Table 1: Base Proposal Form

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT S3C067-11G							
ITEM NO.	EST. QTY.	UNIT					
1.	1	Lump Sum	**BASE BID ITEM INCLUSIVE OF ALL CONTRACT WORK UNLESS LISTED SEPARATELY IN BID ITEMS 2 THROUGH 17 OR PROPOSAL ALTERNATE 1:** Lump sum base bid for furnishing all labor, equipment, materials, appurtenances, accessories, testing, startup, temporary construction, temporary facilities, demolition, restoration, coordination, or incidentals required for all construction work, as shown on the Contract Documents, for the Cedar Creek Water Pollution Control Plant Influent Pumping System Improvements project, complete and ready for operation, excluding the work included under Bid Items 2 through 17 and Proposal Alternate 1 as described in Section 012001. _____	N/A	N/A		
2.	8	WEEKS	**Weekly Maintenance of the Supplemental Bypass Pumping System while Operated by the Owner:** For furnishing all labor, equipment, materials, and incidentals required to maintain the Supplemental Bypass Pumping System while it is operated by the Owner as described in Sections 012001, 013513.24, and 015728. _____				

PROPOSAL

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT S3C067-11G							
ITEM NO.	EST. QTY.	UNIT					
3.	46	MONTHS	**Monthly Maintenance of the Supplemental Bypass Pumping System while in Standby:** For furnishing all labor, equipment, materials, and incidentals required to maintain the Supplemental Bypass Pumping System while on standby as described in Sections 012001, 013513.24, and 015728.				
4.	23	MONTHS	**Monthly Maintenance and Operation of the Plant Drain Bypass Pumping System:** For furnishing all labor, equipment, materials, and incidentals required to maintain and operate the Plant Drain Bypass Pumping System as described in Sections 012001, 013513.24, and 015728.				
5.	4	WEEKS	**Weekly Maintenance and Operation of the Plant Drain Bypass Pumping System:** For furnishing all labor, equipment, materials, and incidentals required to maintain and operate the Plant Drain Bypass Pumping System as described in Sections 012001, 013513.24, and 015728.				

PROPOSAL

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT S3C067-11G							
ITEM NO.	EST. QTY.	UNIT					
6.	80	CUBIC YARDS	**Removal of Solids from Wet Well:** For furnishing all labor, equipment, materials, and incidentals required to remove and dispose of grit and solid material in the wet wells as specified. The measured volume shall be on a cubic yard basis as described in Section 012200.				
7.	1,000	SQUARE FEET	**Partial Depth Concrete Slab Repair:** For furnishing all labor, equipment, materials, and incidentals required for partial depth slab repair of spalled/deteriorated concrete in the wet wells if and where directed by the Owner. The measure area shall be on a square foot basis as described in Section 012001 and Division 3.				
8.	1,200	SQUARE FEET	**Partial Depth Concrete Wall Repair:** For furnishing all labor, equipment, materials, and incidentals required for partial depth wall repair of spalled/deteriorated concrete in the wet well if and where directed by the Owner. The measure area shall be on a square foot basis as described in Section 012001 and Division 3.				

PROPOSAL

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT S3C067-11G							
ITEM NO.	EST. QTY.	UNIT					
9.	500	SQUARE FEET	**Concrete Beam Repair:** For furnishing all labor, equipment, materials, and incidentals required for beam repair of spalled/deteriorated concrete in the wet wells if and where directed by the Owner. The measure area shall be on a square foot basis as described in Section 012001 and Division 3. _____				
10.	100	SQUARE FEET	**Concrete Column Repair:** For furnishing all labor, equipment, materials, and incidentals required for column repair of spalled/deteriorated concrete in the wet wells if and where directed by the Owner. The measure area shall be on a square foot basis as described in Section 012001 and Division 3. _____				
11.	1,000	LINEAR FEET	**Concrete Crack Injection Repair:** For furnishing all labor, equipment, materials, and incidentals required for crack injection repair of cracked concrete in the wet wells if and where directed by the Owner. The measure area shall be on a linear foot basis as described in Section 012001 and Division 3. _____				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT S3C067-11G							
ITEM NO.	EST. QTY.	UNIT					
12.	80	CUBIC YARDS	**Disposal of Hazardous Building Materials:** For disposal of hazardous waste as shown on Contract Drawings and as described in Spec. Sections 028200, 028300, 028310, and 028600.				
13.	1	Allowance	**Allowance for Laboratory Testing and Specialty Inspections:** Allowance for laboratory testing and specialty inspections and described in Section 012001 and 014000. Any unused allowance balance shall be returned to the Owner. *One Hundred Thousand* *Zero*				
14.	1	Allowance	**Allowance for Bridge Crane Repairs:** Allowance for repairs to existing owner-furnished bridge crane that may be authorized for Contractor use during construction. Any unused allowance balance shall be returned to the Owner. *Fifty Thousand* *Zero*	N/A	N/A	$ 50,000	00

FOR INFORMATIONAL PURPOSES ONLY - DO NOT USE TO SUBMIT A BID

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT S3C067-11G

ITEM NO.	EST. QTY.	UNIT					
15.	1	Allowance	**Allowance for Fueling of Temporary Systems:** Allowance for reimbursement of actual documented cost of fuel purchases associated with the operation of temporary systems as required under the Contract. Any unused allowance balance shall be returned to the Owner. *Two Hundred Thousand* *Zero*	N/A	N/A	$ 200,000	00
16.	1	Allowance	**Allowance for Miscellaneous Additional Work:** Allowance for furnishing all labor, materials, equipment and incidentals required for if and miscellaneous additional work. Any unused allowance balance shall be returned to the Owner. *4 Million* *Zero*	N/A	N/A	$ 4,000,000	00
17.	1	Lump Sum	**SIPP Lining of existing 48" force mains:** For furnishing all labor, equipment, materials, and incidentals required to install SIPP lining of the existing 48" diameter force mains as shown on the Contract Drawings and described in Section 330130.70.	N/A	N/A		

Table 2: Proposal Alternates

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON S3C067-11G						
ITEM NO.	APPROX. QUANTITIES					
1.	Lump Sum	**Mobilization and Demobilization of the Supplemental Bypass Pumping System:** For furnishing all labor, equipment, materials, and incidentals required to mobilize, demobilize, test, start up, and turnover the Supplemental Bypass Pumping System for operation by the Owner as shown on the Contract Drawings and described in Sections 012001, 013513.24, and 015728	N/A	N/A		

FOR INFORMATIONAL PURPOSES ONLY - DO NOT USE TO SUBMIT A BID

ALLOWANCES

It is expressly understood and agreed that the total Bid presented in this Proposal is the basis for establishing the amount of the Bid Security and includes the following allowances:

- Item No. 13: Allowance for Laboratory Testing and Specialty Inspections
- Item No. 14: Allowance for Bridge Crane Repairs
- Item No. 15: Allowance for Fuel Price Escalation
- Item No. 16: Allowance for Miscellaneous Additional Work

All in accordance with the requirements of Division 01, General Requirements; Section 011000, Summary; Section 012100, Allowances; and Section 015000, Temporary Facilities and Controls.

Final Contract Payment for allowance items shall be based upon actual payments, and not on the approximate amounts cited herein.

DETERMINATION OF LOW BID

Determination of low Bid will be made by comparing the Total Base Bid which shall include the lump sum Bid prices and allowances.

MAJOR EQUIPMENT ITEMS

The Bidder shall fill the name and address of the one proposed manufacturer for each major equipment item tabulated hereinafter. It is expressly understood that the furnishing of this information will not relieve the Bidder of any requirements of the Contract Documents and failure to fill out properly is grounds for rejection.

Specification Number	Description	Manufacturer
432341	End Suction Solids Handling Pumps	
432341	Eddy Current Drives	

GENERAL CONDITIONS – INDEX

ARTICLE GC1 - APPLICATION OF GENERAL CONDITIONS 1
ARTICLE GC2 - CORRELATION AND INTENT OF DOCUMENTS 1
ARTICLE GC3 - ORAL MODIFICATIONS 1
ARTICLE GC4 - KNOWLEDGE OF CONDITIONS 1
ARTICLE GC5 - DRAWINGS AND SPECIFICATIONS 1
ARTICLE GC6 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS 2
ARTICLE GC7 - COORDINATION WITH OTHER CONTRACTORS 3
ARTICLE GC8 - MEETINGS 3
ARTICLE GC9 - BID BREAKDOWN 4
ARTICLE GC10 - SUPERINTENDENCE AND WORKERS 4
ARTICLE GC11 - LAWS AND ORDINANCES 5
ARTICLE GC12 - PERMITS 5
ARTICLE GC13 - ACCIDENTS 5
ARTICLE GC14 - CONTRACTOR SUBMISSIONS 5
ARTICLE GC15 - SAMPLES 15
ARTICLE GC16 - TEMPLATES AND PATTERNS 16
ARTICLE GC17 - MATERIALS AND EQUIPMENT, APPROVALS, SUBSTITUTIONS AND DEVIATIONS 16
ARTICLE GC18 - CONTRACTOR COSTS FOR ENGINEERING SERVICES 24
ARTICLE GC19 - INSPECTION AND TESTING 25
ARTICLE GC20 - NOT USED 29
ARTICLE GC21 - PROTECTION REQUIREMENTS 29
ARTICLE GC22 - ACCESS ROADS AND PARKING AREAS 31
ARTICLE GC23 - TRAFFIC REGULATIONS 32
ARTICLE GC24 - BARRICADES, WARNING SIGNS AND LIGHTS 32
ARTICLE GC25 - DUST CONTROL AND SPILLAGE 33
ARTICLE GC26 - VERMIN CONTROL 33
ARTICLE GC27 - FIRST AID FACILITIES 33
ARTICLE GC28 - LAYOUT AND LEVELS 33
ARTICLE GC29 - CUTTING AND PATCHING 35
ARTICLE GC30 - OPENINGS AND CHASES 35
ARTICLE GC31 - SLEEVES, INSERTS AND WALL CASTINGS 36

1525 of the New York State Environmental Conservation Law.

ARTICLE GC32 - SCAFFOLDING, RIGGING AND HOISTING 36
ARTICLE GC33 - CLEANING 37
ARTICLE GC34 - PIPING AND EQUIPMENT IDENTIFICATION 37
ARTICLE GC35 - OPERATION AND MAINTENANCE MANUALS 37
ARTICLE GC36 - RECORD DRAWINGS 37
ARTICLE GC37 - PHOTOGRAPHS 38
ARTICLE GC38 - PROJECT CLOSEOUT 39
ARTICLE GC39 - DEWATERING 39
ARTICLE GC40 - PRESERVATION OF WETLANDS AND WATERWAYS 41
ARTICLE GC41 - NOTIFICATION OF SUBCONTRACTOR 41
ARTICLE GC42 - JURISDICTIONAL DISPUTES 41

1525 of the New York State Environmental Conservation Law.

ARTICLE GC1 - APPLICATION OF GENERAL CONDITIONS

The provisions of the General Conditions as hereinafter stipulated shall form a part of each Prime Contract and/or separate trade specification except insofar as any such provision or provisions may be manifestly not applicable to any such trade specification.

It shall be the duty of the Contractors to fully familiarize themselves with all of the provisions of the Contract Documents.

ARTICLE GC2 - CORRELATION AND INTENT OF DOCUMENTS

The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all.

The intent of the Contract Documents is to include everything necessary for the proper execution of the complete finished Work.

ARTICLE GC3 - ORAL MODIFICATIONS

No oral statement of any person shall be allowed in any manner or degree to modify or otherwise affect the terms of the Contract.

ARTICLE GC4 - KNOWLEDGE OF CONDITIONS

(See Instructions to Bidders, Section B, Bidder's Obligations.)

ARTICLE GC5 - DRAWINGS AND SPECIFICATIONS

A. The Drawings and Specifications prepared by the Engineer are intended to agree and anything shown or called for on the Drawings and not mentioned in the Specifications, or vice versa, or any Work or materials necessary to, and usually included in, the complete finish of the Work and/or materials of the character to be furnished by the Contractors, shall be considered to be included herein and shall be performed and furnished by the Contractors without any extra charge, as though the same were both shown and specified.

   The Engineer will furnish in addition to the Drawings listed in the Contract Documents, such other and additional Drawings and such explanations in writing as may, in the Engineer's opinion, be necessary for the performance of the Work by the Contractors, and all such details and explanations shall be binding upon and shall be strictly followed and complied with by the Contractors. All such Drawings shall be consistent with the Contract Documents, true developments thereof, and reasonably inferential therefrom.

B. All Drawings, and such notes, interlineations, figures and details, as may be noted thereon, shall be considered as a part of and complementary to the Specifications. Full size Drawings and large-scale details shall, in general, govern and take precedence over the small scale Drawings which they are intended to amplify. Figure dimensions shall govern in laying out the Work, and no Work shall be executed from dimensions obtained by scaling the Drawings.

1525 of the New York State Environmental Conservation Law.

While the Specifications are subdivided into trades, (but only for the purpose of facilitating the Work) Contractors shall, nevertheless, furnish all labor and materials necessary to complete all the Work in accordance with the Contract despite the fact that it may not appear under the Work specified for the particular trade under which it would be normally classified.

C. The Contractors shall check all supplementary information furnished them immediately upon their receipt. The supplementary information shall not be altered by the Contractors, but should any error or inconsistency appear, or in the event of any doubt or question arising in respect to the true meaning and intent of the Drawings or Specifications, or should anything be omitted from the Drawings or Specifications which is necessary to a clear understanding of the Work, they shall report same in writing within five (5) days to the Engineer who will make any necessary rectification and decisions.

If, in the Contractor's opinion, any Work is shown on the Drawings or called for in the Specifications in such a manner to make it impossible for him to produce or guarantee a first-class piece of Work, he shall refer the same in writing to the Engineer before proceeding.

D. If, at any time, the County shall fail to supply sufficient or clear information to enable the Contractor to proceed with the Work, the Contractor shall immediately notify the Engineer in writing, and in no case, will the lack of such information, or failure to understand the Drawings or Specifications, or ignorance of the contents of either, be considered or received as an excuse for improper or inferior construction, workmanship or materials, or for any delay in performing the Work, or as a justification for any claim for Extra Work or materials.

Should any question or disagreement arise concerning the meaning of Drawings or Specifications, such question or disagreement shall be settled by the Engineer, whose decision in writing shall be final.

E. The Contractor(s) will be furnished by the County, without charge, the following:

CONTRACT	
General Construction	Portable digital media with Contract Documents (pdf)
	Portable digital media with Auto CADD Contract Documents

F. The Contractors shall keep at least one copy of all Drawings and Specifications at the Site in good order and available to the County, the Engineer, or their representatives. These Drawings and Specifications shall be kept up to date at all times and show all changes.

ARTICLE GC6 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

All Drawings and Specifications are and shall remain the property of the County. These are furnished to the Contractors as instruments of service. They are not to be used on any other work.

1525 of the New York State Environmental Conservation Law.

ARTICLE GC7 - COORDINATION WITH OTHER CONTRACTORS

A. During the progress of the Work on this Contract, other contractors may be engaged in performing Work within the Contract area and in areas adjacent to this Contract area.

1. The Contractor's attention is specifically directed to the fact that because of the work on other contracts within and adjacent to the limits of this Contract he may not have exclusive occupancy of the territory within or adjacent to the limits of this Contract.

2. The Contractor will be required to cooperate with other Prime Contractors and the owners of the various utilities and to coordinate and arrange the sequence of his Work in such a manner that all work, proposed or in progress within or adjacent to the limits of the Contract, can be progressed with as little interference as possible.

3. In case of interference between the operations of a Contractor and/or utility owners and/or other Contractors, the Commissioner shall be the sole judge of the rights of each party and of the sequence for Work necessary to expedite the completion of all the work progressed or about to be progressed within or adjacent to the Contract limits.

B. The direction of the Commissioner on the order and sequence of the Work shall not in itself constitute a basis for extra compensation or an Extension of Time.

ARTICLE GC8 - MEETINGS

A. Pre-Award Meeting

During the Pre-Award meeting with the contractor(s), a County Official from the Office of Minority Affairs will discuss the Minority Business Enterprise/Women's Business Enterprise (M/WBE) "Best Effort" requirement discussed in Appendix EE of the Agreement Section of the project specifications.

B. Pre-Construction Meetings

1. After the Contract has been awarded, but prior to the start of actual construction, two separate and distinct Pre-Construction Meetings will be scheduled by the Engineer.

2. One conference will include representatives of the New York State Department of Environmental Conservation and the Nassau County Department of Public Works, Contractors, Subcontractors as requested, and the Engineer. The purpose of this Meeting will be generally administrative and will include but not necessarily be limited to discussion of State requirements, use of Subcontractors, submissions required from the Contractor prior to start of Work, major equipment deliveries and priorities, construction procedures, payment criteria, time for completion, and any specific or unique criteria to be followed.

3. The second Meeting will involve the Nassau County Department of Public Works, Local Municipalities, Police and Fire Department, New York State Department of Transportation, Utility Companies, the Contractors and the Engineer. The prime

purpose of this conference is to acquaint local officials, highway departments, and utilities with the proposed Contract limits, construction procedures, maintenance of traffic, and areas where utilities may be affected.

C. Progress Meetings

1. Regular Meetings will be held bi-monthly at the County Field Office during the performances of the Work of this Contract. Additional Meetings may be called as progress of the Work dictates.

2. Responsible representation from major equipment manufacturers will be the Contractors' responsibility at Progress Meetings on demand from the County. Refer to all Divisions of the Technical Specifications for other requirements.

3. Attendance:

   a. County

   b. Engineer

   c. Contractor

   d. Subcontractors, only with Engineer's approval or request, as pertinent to the agenda.

4. Minimum Agenda

   a. Review minutes of previous meetings.

   b. Review progress of Work since last meeting.

   c. Note and identify problems which impede planned progress.

   d. Develop corrective measures and procedures to regain planned Schedule.

   e. Revise construction Schedule as indicated and plan progress during next Work period.

   f. Maintaining of quality and work standards.

   g. Complete other current business.

ARTICLE GC9 - BID BREAKDOWN

(See Agreement, Article XXXIV, "Submission of Bid Breakdown".)

ARTICLE GC10 - SUPERINTENDENCE AND WORKERS

(See Agreement, Articles XXIX, "Character and Competency" and XXX, "Superintendence".)

ARTICLE GC11 - LAWS AND ORDINANCES

The Contractors accept the Drawings and Specifications and other Contract Documents, submitted by the Engineer, on the basis that such Drawings, Specifications and other Contract Documents do not constitute a release of responsibility on the part of the Contractors to know and supervise the actual construction in all its parts so that such construction complies with all legal regulations. The Contractors shall be held to be both responsible and accountable for any damage which the County may suffer as a result of non-compliance with any or all legal regulations.

The Work shall be performed by the Contractors, in all respects, in strict conformity to all laws, rules, regulations, requirements and ordinances of the federal, state, and local governments and all departments and bureaus thereof, and of the National Fire Protection Association. Should the Drawings or the Specifications conflict with the law, the Contractors shall immediately notify the Engineer in writing of such conflict, and shall thereafter follow the written instructions of the Engineer in respect thereto; or should the Drawings or Specifications require more than the law requires, the Drawings and Specifications shall be followed nevertheless.

The Prime Contractor shall obtain and pay for all permits and fees required by the Work performed under his Contract. Notwithstanding the requirements of the preceding paragraphs, all Contractors shall be additionally governed by OSHA requirements. All electrical Work shall comply with the N.E.C. and the respective Contractor will be required to furnish for his Work, Underwriters Certificates issued by Underwriters Laboratories for compliance.

Compliance with the foregoing requirements shall not relieve the Contractors of any other of their obligations under this Contract. (See Agreement, Articles III, "Contractor's Responsibility" and IV, "Compliance with Laws".)

ARTICLE GC12 - PERMITS

(See Agreement, Article IV, "Compliance with Laws".)

ARTICLE GC13 - ACCIDENTS

A. If death, serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Commissioner and the Engineer.

B. Contractor shall promptly report in writing to the Engineer all accidents whatsoever arising out of, or in connection with, the performance of the Work, which cause death, personal injury or property damage, giving full details and statements of witnesses.

C. If any claim is made by anyone against the Contractor or Subcontractor on account of any accidents, the Contractor shall promptly report the facts in writing to the Engineer, giving full details of the claim.

ARTICLE GC14 - CONTRACTOR SUBMISSIONS

In accordance with the requirements of the Contract Documents, the Contractor shall furnish all required submittals which shall include, but not be limited to, the following tabulation of Contractor submissions.

A. Materials and Equipment

1. Suppliers and Manufacturers

Within fifteen (15) days after Notice to Proceed, the Contractor shall submit to the Commissioner and the Engineer a list of materials and equipment suppliers and manufacturers for approval in accordance with the requirements of the General Conditions, Article GC-17. "Materials and Equipment Approvals, Substitutions, and Deviations".

2. Material and Equipment Orders Schedule

a. Within fifteen (15) days after Notice to Proceed, Contractor shall prepare and submit his tabulation of principal items of equipment and materials to be purchased to the Engineer for review and approval.

The schedule shall be revised as required prior to approval by the Engineer.

b. Ten (10) updated copies of the schedule shall be submitted to the Engineer with the application for partial payment.

c. The schedule shall be updated biweekly and one copy submitted to the Engineer.

d. Schedule shall be submitted until all of the data is incorporated into the CPM Scheduling for the project.

3. Form of Schedule

Schedule shall be in tabular form with appropriate spaces to insert the following information for principal items of equipment and materials:

a. Date on which shop drawings are requested and received from the manufacturer.

b. Dates on which certification is received from the manufacturer and transmitted to the Engineer.

c. Dates on which shop drawings are submitted to the Engineer and returned by the Engineer for revision.

d. Dates on which shop drawings are revised by manufacturer and resubmitted to the Engineer.

e. Date on which shop drawings are returned by Engineer annotated either "Approved" or "Approved as Noted".

f. Date on which accepted shop drawings are transmitted to manufacturer.

g. Date of manufacturer's scheduled delivery.

h. Date on which delivery is actually made.

B. Substitutions

1. Within a fifteen (15) day period from the Notice to Proceed, requests for substitutes may be proposed to the Commissioner. This period for submitting requests will be strictly enforced. Such requests shall conform to the requirements of General Conditions, Article GC-17, "Materials and Equipment, Approvals, Substitutions and Deviations".

2. Requests for substitutions will be received and considered from Prime Contractors only and not from manufacturers, suppliers, subcontractors, or other parties.

C. Shop Drawings

1. Within fifteen (15) days after the Notice to Proceed, the Contractor shall prepare and submit fifteen (15) copies of his schedule of shop drawings submissions of the Engineer for review and approval.

2. In order to maintain the construction schedule for this project the Contractor shall submit all shop drawings within sixty days after the Notice to Proceed as indicated in Division 1, General Requirements to the Technical Specifications and the Contractor's schedule of shop drawing submissions shall conform to these requirements.

3. Shop drawings shall be submitted without fail in time to permit correction, resubmission and final approval, as hereinafter specified, without causing any delay in the construction of any work. The Contractors may begin the preparation of shop drawings as soon as possible after signing of the Contract. Formal submission of shop drawings will begin after execution of the Contract by the County Executive.

D. Coordination Drawings

1. Coordination Drawings shall be completed by all Contractors within ninety (90) days from the Notice to Proceed.

2. Coordination Drawings shall be initiated, completed and submitted for distribution so as not to delay the construction.

E. Layout and Installation Drawings

1. Layout and installation drawings shall be completed by all Contractors within one hundred and twenty (120) days from the Notice to Proceed.

2. Layout and installation, drawings submitted for review by the Engineer shall include all pipes, valves, fittings, sewers, drains, heating and ventilation ducts, all electrical,

heating, ventilating and other conduits, plumbing lines, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, communications power supply, alarm circuits, etc., under this Contract.

F. Operations and Maintenance Manuals

1. For special requirements for Final Operations and Maintenance Manuals, see Division 1, General Requirements of the Technical Specifications.

G. Maintenance and Lubrication Schedules

1. A maintenance and lubrication schedule for each piece of equipment shall be submitted with the shop drawings. Submission shall be fifteen (15) copies.

2. The schedules shall provide the information and be in the form indicated in Division 1, General Requirements of the Technical Specifications.

H. Samples

1. Samples and Shop Drawings which are related to the same unit of work or Specification Section shall be submitted at the same time. If related shop drawings and samples are submitted at different times, they cannot be reviewed until both are furnished to the Engineer.

2. All samples are to be submitted in accordance with the requirements of General Conditions, Article GC-15, "Samples".

I. Shop Drawing Requirements

1. Where the nature of the work of the Contract makes it necessary, or where so required by the Engineer, Contractors shall submit scale and full size shop drawings of their work for the approval of the Engineer. The shop drawings shall be complete in every detail including provisions required of various trades, connections with other work, all cutting, fitting and drilling required and any and all other necessary information in accordance with usual trade practice as particularly required for any special purposes.

2. Shop drawings include, but are not limited to, shop drawings, layout and installation drawings in plan and elevation, certified wiring diagrams, interconnecting wiring diagrams, manufacturer's data, etc. Contractor shall be responsible for securing all of the information, details, dimensions, drawings, etc., necessary to prepare the Shop Drawings required and necessary under this Contract and to fulfill all other requirements of his Contract. Contractor shall secure such information, details, drawings etc. from all possible sources including the Contract Drawings, drawings prepared by subcontractors, suppliers, etc.

3. All shop drawings submitted by the Contractors which involve a change at variance with the Contract Drawings shall be noted by the Contractors by advising the Engineer in writing as to the recommended change and the reason therefor.

4. Contract Drawings are for engineering and general arrangement purposes only and are not to be used as shop drawings.

5. Shop drawings shall accurately and clearly present the following:

   a. All working and installation dimensions.

   b. Arrangement and sectional views.

   c. Units of equipment in the proposed positions for installation details of required attachments and connections and dimensioned locations between units and in relation to the structures.

   d. Necessary details and information for making connections between the various trades including, but not limited to, power supplies and interconnecting wiring between units, accessories appurtenances, etc.

6. Structural and all other layout drawings prepared specifically for the Project shall have a plan scale of not less than 1/4-inch equal to 1 foot and they shall be not larger than the size of the Contract Drawings.

7. Where manufacturer's publications in the form of catalogs, brochures, illustrations, compliance certificates, or other data sheets are submitted in lieu of prepared shop drawings, such submissions shall specifically indicate the item for which approval is requested. Identification of items shall be made in ink, and submissions showing only general information are not acceptable.

8. The Contractor shall provide all required copies for the use of the various trades and at the site, and one (1) copy of approved shop drawings shall be provided by the Contractor to the other Prime Contractors.

9. A submittal record form shall accompany each submittal. A facsimile copy of the record form will be provided by the County. This is the only form to be used by the Contractor for his submittals.

10. <u>Contractor Responsibilities</u>

   a. Before submitting shop drawings to the Engineer all submittals from subcontractors, manufacturers or suppliers shall be sent directly to the Contractor for preliminary review, coordination and checking. Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of material or equipment. Contractor shall thoroughly check all drawings for accuracy and conformance to the intent of the Contract Documents. Drawings found to be inaccurate or otherwise in error shall be

returned to the subcontractors, manufacturers, or suppliers by the Contractor for correction.

b. All submittals, including shop prepared by or under the direction of the various Contractors, shall be thoroughly checked by the Contractor for accuracy and conformance to the intent of the Contract Documents before being submitted to the Engineer and shall bear the Contractor's signature of approval certifying that they have been so checked. Submittals without the Contractor's signature of approval will not be reviewed by the Engineer and will be returned to the Contractor stamped "Rejected". Before submitting them to the Engineer, all submittals shall be bound, properly labeled and consecutively numbered. In a clear space above the title block, or on the back, the Contractor shall hand stamp the following, and enter the required information:

"NASSAU COUNTY

NAME OF PROJECT

Date _____

Contract No. _____

Equipment Identification No. _____

Contract Drawings No. _____

Specification Section _____

This document has been reviewed, coordinated and checked in detail for accuracy of content and for compliance with the Contract Documents and is hereby approved. The information contained herein has been coordinated with all involved Contractors.

Contractor _____

Signed _____"

c. Shop Drawings shall be submitted as a single package including all associated drawings for any operating system and shall include all items of equipment and any mechanical units involved or necessary for the functioning of such system. Where applicable, the submittal shall include elementary wiring diagrams showing circuit functioning and necessary interconnection wiring diagrams for construction.

d. If the submittals contain any departures from the Contract Documents, specific mention thereof shall be made in the Contractor's letter of transmittal. Otherwise, the review of such submittals shall not constitute approval of the departure. The Contractor shall call the Engineer's attention to any changes by the use of large rubber stamp, or by larger letters on shop drawings. If this is not done, even if the work is incorporated in the construction, it will not be accepted by the Engineer even if shop drawings are "Approved".

e. No materials or equipment shall be ordered, fabricated or shipped or any work performed until the Engineer returns to the Contractor the submittals herein required, annotated "Approved".

f. Where errors, deviations, and/or omissions are discovered at a later date in any of the submittals, the Engineer's prior review of the submittals does not relive the Contractor of the responsibility for correcting all errors deviations and/or omissions.

11. Procedure for Review

a. Shop Drawings will be checked for design conformance with the Contract Documents and general arrangement only.

b. Submittals shall be transmitted in sufficient time to allow the Engineer adequate time for review and processing so as not to delay the Project.

c. Contractor shall transmit one (1) reproducible transparency and seven (7) prints of each submittal to the Engineer for review for all drawings greater than 8-1/2 inches by 11-inches in size. The Contractor shall submit fifteen (15) copies of all other submittals. Prints from the reproducible transparencies shall be legible with a sharp, clear definition of all line work and lettering. Reproducible transparencies and resultant prints which in the opinion of the Engineer are not legible will not be reviewed and will be returned to the Contractor annotated "Rejected".

d. Submittals shall be accompanied by a submittal record form hereinbefore specified and shall be accompanied with any notification of departures and any pertinent data to facilitate review. If data for more than one Section of the specifications is submitted, a separate transmittal letter shall accompany the data submitted for each Section. A number shall be assigned to each submittal by the Contractor starting with the Number 1 and thence numbered consecutively. Resubmittals shall be identified by the same number followed by the suffix "A" for the first Resubmittals and the suffix "B" for the second Resubmittals, etc.

e. Submittals will be annotated by the Engineer in one of the following ways:

"Approved" - no exceptions are taken.

"Approved as Noted" - minor corrections are noted and shall be made and a Resubmittals is required.

"Disapproved" - major corrections are noted and shall be made and a Resubmittals is required.

"Rejected" - Based on the information submitted, the submission is not in conformance with the Contract Documents. The deviations from the Contract Documents are too numerous to list and a completely revised submission of the proposed equipment or a submission of other equipment is required.

or

Reproducible transparencies and resultant prints are not legible and will not be reviewed and a Resubmittal is required.

f. If a submittal is satisfactory to the Engineer, the Engineer will annotate the submittal, "Approved" and return three (3) copies to the Contractor. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor, plus two prints.

g. If a Resubmittal is required, the Engineer will annotate the submittal "Approved as Noted" or "Disapproved" or "Rejected" and return three (3) copies to the Contractor for appropriate action. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor, plus two prints. The Contractor shall resubmit in accordance with paragraph D.3, hereof.

h. Contractor shall revise and resubmit submittals as required by the Engineer until submittals are "Approved" by the Engineer.

i. Approval of a Shop Drawing by the Engineer will constitute approval of the subject matter for which the Drawing was submitted and not for any other structure, material, equipment or appurtenances shown.

J. Coordination Drawings Requirements

1. The General Construction Contractor shall initiate coordinating the installations of all the Contract Work by means of Coordination Drawings, as specified herein. The Coordination Drawings may lack complete data in certain instances pending receipt of shop drawings, but sufficient space shall be allotted for the items affected. When final information is received, such data shall be promptly inserted on the Coordination Drawings.

2. The General Construction Contractor shall prepare a set of mylar transparencies, indicating equipment and appurtenances, at not less than 3/8-inches scale. The Drawings shall also show beams, ceiling heights, walls, floor to floor dimensions,

floors, partitions, columns, windows, door and other major architectural and structural features shown on the General Construction Drawings. Site coordination drawings shall be at not less than 1"-20' scale. Two sets of prints from the transparencies shall be furnished to the County's review for conformance with the intent of this Section. Corrections, if required, shall be made to the transparencies.

4. In the preparation of all the Coordination Drawings, composite drawings, large scale details as well as cross and longitudinal sections shall be made as required, or as directed by the Engineer, to fully delineate all conditions. Particular attention shall be given to the locations, size and clearance dimensions of equipment items, shafts and similar features. In preparing the Coordination Drawings, minor changes in duct, pipe or conduit routings that do not affect the intended function may be made as required to avoid space conflicts, when mutually agreed, but items may not be resized or exposed items relocated without the County's approval. No changes shall be made in any wall or chase locations, ceiling heights, door swings or locations, windows or other openings, or other features affecting the function or aesthetic effect of the building. During this period, the Contractors shall make a good faith effort to coordinate work among themselves. If conflicts or interferences cannot be satisfactorily resolved, the County shall be notified and its decision obtained.

5. No preference or advantage shall be given to any Contractor in considering resolution of conflicts, or grant priority to any one Contractor in the allocation of space. If the Contractors are unable to reach agreement on a matter of interference, the matter shall be submitted to the County for its binding decision. Should any problems of coordination require architectural or structural change of design, the change shall be submitted to the County for resolution. At the completion of this phase of the Coordination Drawings preparation, the County shall hold coordination meetings with the Prime Contractors to eliminate any interference among the trades that the Drawings indicate and to avoid any conflicts during installation of the work.

6. At the completion of these meetings, and after the General Construction Contractor's set of mylars has been coordinated and all necessary changes have been made, the County shall hold a final coordination meeting where these Drawings shall then be signed-off by each of the Contractors, indicating their awareness of, and agreement with, the indicated routings and layouts and their inter-relationship with the adjoining or contiguous work of all Contracts. Thereafter no unauthorized deviations will be permitted and if made without the knowledge or agreement of the County or other affected contractors, will be subject to removal and correction at no additional cost to the County.

7. After the final Coordination Drawings have been agreed upon and signed by all Contractors, the General Construction Contractor shall provide and distribute four (4) copies to each of the Contractors and fifteen (15) copies to the County, for reference and record purposes. Contractors desiring additional copies of such drawings, beyond the basic distribution indicated above, shall arrange and pay for cost of same.

8. The record copies of final Coordination Drawings shall be retained by each Contractor as a working reference. All shop drawings, prior to their submittal to the County, shall be compared with the Coordination Drawings and developed accordingly by the Contractor responsible. Any revisions to the Coordination Drawings which may become necessary during the progress of the work shall be noted by all Contractors and shall be neatly and accurately recorded on the recorded copies. Each Contractor shall be responsible for the up-to-date maintenance of his own record copies of the Coordination Drawings and to keep one copy available at the Site. The Coordination Drawings and any subsequent changes thereto, shall be utilized by each Contractor in the development of his as-built drawings.

9. No extra compensation will be paid by the County to any Contractor for relocating any duct, pipe, conduit or other material that has been installed without proper coordination among all the Contractors and the trades involved. If any improperly coordinated work, or work installed that is not in accordance with the approved Coordination Drawings, necessitates additional work by the other Contractors, the costs of such additional work shall be assessed to the Contractor responsible, as determined by the County.

10. All changes in the work on any Contract, whether a change in price is given or not, shall be shown on the Coordination Drawings.

11. All work on the Coordination Drawings shall be performed by competent draftsmen, in clear, legible manner. The County shall be the sole judge of the acceptability of the Coordination Drawings.

12. Coordination Drawings shall not be used for "as-built" drawings.

K. Layout and Installation Drawings Requirements

1. Layout and installation drawings are to be submitted in accordance with the requirements hereinbefore specified under Paragraph I, Shop Drawings Requirements.

2. Layout and installation drawings, are required for both interior and exterior piping, valves, fittings, sewers, drains, heating and ventilation ducts, conduits, plumbing lines, electrical cable trays, etc. The final dimensions, elevations, locations, etc. of the various items may depend upon the dimensions of equipment, valves, etc. to be furnished by the Contractor.

3. Layout and installation drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.

4. Drawings shall show the location and type of all supports, hangers, foundations, etc. and the required clearances to operate valves, equipment, etc.

5. The drawings for pipes, ducts, conduits, etc. shall show all electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes,

structures, manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe, duct, conduit, etc. for which the profile is drawn.

ARTICLE GC15 - SAMPLES

A. General

1. Where required in the specifications for the various trades or otherwise requested by the County or Engineer, samples of any material to be used and of the finish to be applied in the work, shall be submitted by the Contractor for approval in accordance with the General Conditions, Article GC-14, "Contractor Submissions". Samples shall be of such a nature to fully illustrate the character of the finished work or as may be more fully described in the trade specifications.

2. Samples shall be furnished so as not to delay fabrication, allowing the Engineer reasonable time for the consideration of the samples submitted.

3. Contractor shall store and protect large samples and mock-ups until the Project is complete or until a time approved by the Engineer.

4. Accepted samples will establish the standards by which the completed work will be judged.

B. Samples

1. Samples shall be of sufficient size or quantity to clearly illustrate the quality, type range of color, finish or texture and shall be properly identified.

2. Samples shall be checked by the Contractor for conformance to the Contract Documents before being submitted to the Engineer and shall bear the Contractor's stamp of approval certifying that they have been checked.

3. Samples shall be submitted in triplicate and each sample shall be identified with the name and number of the project, reference to Specification Section, Contract Drawings number, nature of the material, trade name of manufacturer and the location of its intended placement. Written approval shall be obtained, and the work furnished shall conform strictly to the samples approved by the Engineer. No approval of a sample shall be taken in itself to change or modify any of the requirements of the Contract.

4. Transportation charges or samples submitted to the Engineer shall be prepaid by the Contractor. Samples shall be delivered to the Engineer's field office. If the Contractor requires a sample for his use, he shall notify the Engineer in writing.

5. If samples are disapproved, the Contractor shall make all corrections required and shall resubmit the required number of new samples until approval is received.

C. Job Mock-Ups

1. Job mock-ups (sample panels) shall be constructed on Site by the Contractor and only one of each type will be required. Mock-ups shall be constructed only after the individual samples and components used in the mock-up have been approved by the Engineer. If a mock-up is not approved, Contractor shall construct additional ones until approval is received.

D. Samples for Tests

1. Contractor shall furnish such samples of material as may be required for examination and test. All samples of material for tests shall be taken according to standard methods and as required by the Contract Drawings.

ARTICLE GC16 - TEMPLATES AND PATTERNS

Templates and patterns shall be prepared and provided as required for the proper execution of the Work under the various Prime Contracts, by the various trades.

ARTICLE GC17 - MATERIALS AND EQUIPMENT, APPROVALS, SUBSTITUTIONS AND DEVIATIONS

A. Approval of Materials and Equipment Suppliers and Manufacturers

1. The Contractor shall submit to the Commissioner and the Engineer for approval a list of materials and equipment suppliers and manufacturers who are to furnish items of materials or equipment. This submission is to be made in accordance with the time conditions stipulated in General Conditions, Article GC-14, "Contractor Submissions".

2. Where the acceptability of any equipment or material specified herein is conditioned upon that item having a record of satisfactory operation for a specified period of time, such acceptability may be considered lacking such record, only if the manufacturer and/or supplier can provide a bond or cash deposit which will guarantee replacement at no cost to the County in the event of failure occurring prior to the expiration of the experience record term specified. The item proposed must meet all other technical requirements stipulated in the Specifications.

3. If the materials and equipment submitted are offered as substitutes to the Contract Documents the Contractor shall advise the County and the Engineer of the substitutions and comply with the requirements hereinafter specified in this Article.

B. Storage and Protection of Equipment and Materials

The Contractor shall make every effort to minimize extended storage periods for materials and equipment at the site by judiciously scheduling deliveries to coincide with construction needs. The Contractor shall store his material and equipment in accordance with the requirements of Division 1, General Requirements of the Technical Specifications. The Contractor shall not store unnecessary materials or equipment at the site and shall take care to prevent

any structure from being loaded with a weight which will endanger its integrity or the safety of persons. The Contractor shall follow the instructions of the Engineer, regarding the posting of regulatory signs for loading on structures and other safety precautions. The Contractor shall obtain from the equipment manufacturers a letter detailing the method of storage and the maintenance of the stored equipment for the Engineers review. All storage and methods of protection for material and equipment at the site shall be subject to the prior approval of the Engineer. Any costs associated with the storage and protection of materials and equipment shall be deemed to be included under the Contract and no additional payment will be made.

1. Materials

   a. Materials may be stored out of doors if supported on wood runners above ground surface and protected with approved, effective durable covers.

   b. Materials shall not be placed within ten (10) feet of fire hydrants.

   c. Avenues for personnel and vehicular movement, gutters, drainage channels and inlets shall be kept unobstructed at all times.

2. Major Equipment

   a. No Major Equipment Item shall be brought to the site until the following conditions are met:

      (1) The County must have received the manufacturer's recommendations for on site storage in writing.

      (2) The structure in which the equipment is to be installed is roofed (roofing must be watertight) and has such protection of doorways, windows and other openings that will provide reasonable protection from the weather.

   b. The manufacturer must certify to the County, in writing, that the equipment has been properly stored.

3. Special Equipment

   a. The storage of special equipment shall be in accordance with the requirements specified in Division 1 of the Technical Specifications.

4. Equipment other than Major Equipment

   a. The Contractor shall not ship any equipment to the site until approval is received from the County. Under no circumstances shall equipment be delivered to the Site more than one month prior to installation without written authorization from the County.

b. Storage of any mechanical or electrical equipment out of doors at any time is absolutely prohibited regardless of the protection furnished. Storage of mechanical and electrical equipment within structures at the Site will not be permitted until all structural work has been completed and the structure is made weathertight.

c. All mechanical and electrical equipment shall be coated, wrapped and otherwise protected from snow, rain, drippings of any sort, dust, dirt, condensed water vapor, etc. during shipment, storage, and subsequent to installation and until placed in service.

d. Should storage of mechanical and electrical equipment become necessary before it can be stored at the Site, the Contractor shall provide storage in a weatherproof warehouse.

e. All costs for equipment protection including warehousing or other work to meet the scheduled completion date shall be deemed to be included under the Contract and no additional payment will be made.

f. All equipment having moving parts such as gears, electric motors, etc. and/or instruments shall be stored in a temperature and humidity controlled building approved by the County, until such time as the equipment is be installed.

g. All equipment shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer.

h. Manufacturer's storage instructions shall be carefully studied by the Contractor and reviewed with the County by him. These instructions shall be carefully followed and a written record of this kept by the Contractor.

i. Moving parts shall be rotated a minimum once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

j. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

k. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its conditions has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If

such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

l. Where equipment must be installed before the erection of adequate protective structures, the Contractor, without additional compensation shall provide approved, effective and durable covers and provide such other protection as required for fully protecting such equipment from damage from the elements or other causes.

C. Installation of Equipment

1. General

a. Contractor shall have on hand sufficient personnel, proper equipment, and machinery of ample capacity of facilitate the work.

b. Contractor shall be responsible for locating, aligning and leveling all equipment and shall employ a licensed surveyor to set all lines and levels of equipment to the accuracy required.

c. Complete manufacturer's installation instructions, including permissible tolerances, shall be furnished in duplicate with each unit of equipment or set of identical units before installation.

d. All equipment shall be installed in accordance with the approved shop drawings: inclusive of manufacturer's specifications, drawings and tolerances; under the direct supervision of the required manufacturer's engineer. In no instance shall the directions of the manufacturer's engineer contravene the Engineers direction.

e. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the drawings unless directed otherwise by the engineer during installation.

2. Installation

a. Special care shall be used in locating, aligning and leveling all equipment and parts thereof to ensure that each item is in the proper position relative to other equipment, and that all parts are aligned within allowable tolerances. The Contractor shall be responsible for this accuracy, and shall notify the Engineer of any conditions in prior work which would prevent this alignment before proceeding with the work. The Contractor shall employ a licensed surveyor to set all lines and levels of equipment to the accuracy required.

b. Concrete foundations for equipment shall be approved design and shall be adequate in size, suitable for the equipment erected thereon.

D. Nameplates

1. Each unit of equipment shall have the manufacturer's name or trademark on a corrosion-resistant nameplate securely affixed in a conspicuous place. The manufacturer's name or trademark may be cast integrally, stamped, or otherwise permanently marked upon the item of equipment.

2. Such other information as the manufacturer may consider necessary to complete identification, or as specified, shall be shown on the nameplate.

E. Painting

1. Except as otherwise specified or required, equipment shall be primed and finish painted at the factory, in accordance with the recommendations of the approved manufacturer.

2. Necessary field painting, as assigned to the individual Prime Contractors, shall be in accordance with the requirements of the painting specifications in the General Construction Contract. Any damage to shop coatings shall be corrected to the satisfaction of the Engineer.

F. Damage During Tests and Instruction Periods

Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and he shall neither have nor make any claim for damage which may occur to equipment prior to the time when the County formally takes over the operation thereof.

G. Services of Manufacturer's Engineers

The contract price shall include the cost of furnishing competent engineers or superintendents from each company manufacturing equipment for the Project to:

1. Assist the Contractor to install, adjust and test the equipment in conformity with the Contract Documents.

2. Supervise start-up operations and adequately instruct designated employees of the County in the proper operation and maintenance procedures of equipment installed.

3. The manufacturer's engineers shall devote, as a minimum, the full time specified in the detailed equipment specifications. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representatives shall sign in an out in a book kept by the Engineer on every occasion they are on the site and shall indicate time of arrival and departure.

4. Be available to check equipment operation and maintenance procedures, when required by the County, throughout the guarantee period of the equipment.

H. Equipment Manufacturers Certification

As a condition precedent to acceptance of equipment installed and operating, the Contractor will provide the County with written certification, obtained from each company manufacturing equipment for the Project, that the equipment is installed and does operate in accordance with the specifications and manufacturer's recommendations.

I. Substitutions

1. Unless otherwise specified, all materials and equipment incorporated in the work under these Contracts shall be new.

2. Whenever specific references are made in the Specifications, to manufacturer's or brand names, the intent is to establish a standard of type, quality and function of the required material or equipment. Where several of such specific references are given for any item of material or equipment, at least one will include a specific catalog number or other identifying designation. The products of the other listed manufacturers must in the opinion of the Commissioner, be equivalent to the product so identified. The fact that one or more of the other manufacturers listed does not provide material essentially meeting the standards of the referenced manufacturer or other Specifications requirements shall not relieve the Contractor of responsibility for providing materials complying with such requirements. The fact that manufacturer's names are specified for any item shall not be constructed as implying that such item need not comply with any additional performance, construction or other requirements specified for the item. In all cases, the Specifications requirements shall take precedence over the manufacturer's standard.

3. Requests for substitutions of equipment or materials shall be made in accordance with the time conditions stipulated in General Conditions, Article GC-14, "Contractor Submissions". This period for submitting requests will be strictly enforced. Such requests shall conform to the following requirements:

   a. Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Commissioner to determine if the proposed substitution is equal.

   b. Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.

   c. A list of installations where the proposed substitution is equal to the specified piece of equipment or materials.

   d. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the County.

4. Requests for substitutions after the period stipulated in General Conditions, Article GC-14, "Contractor Submissions", will not be accepted for evaluation except in case of strikes, discontinuance of manufacturer or other reason deemed valid by the Commissioner whereby the specified products or those approved are unobtainable. In such case the Contractor shall provide substantial proof that the acceptable products are unavailable.

5. Where the approval of a substitution requires revision or redesign of any part of work, including that of other Contracts, all such revision and redesign, and all new drawings and details required therefore, shall be provided by the Contractor at his own cost and expense, and shall be subject to the approval of the Commissioner.

6. In the event that the Engineer is required to provide additional engineering services, then the Engineer's charges for such additional services shall be charged to the Contractor by the County in accordance with the requirements of the General Conditions, Article GC-18, "Contractor Costs for Engineering Services".

7. Any modifications in the work required under other Contracts to accommodate the changed design will be incorporated in the appropriate Contracts and any resulting increases in Contract prices will be deducted by the County from payments otherwise due the Contractor who initiated the changed design.

8. In all cases the commissioner shall be the judge as to whether a proposed substitution is to be approved. The Contractor shall abide by his decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item specified or indicated. No substitute items shall be used in the work without written approval of the Commissioner.

9. In making request for substitution, Contractor represents that:

    a. Contractor has investigated proposed substitution, and determined that is equal to or superior in all respects to the product, manufacturer or method specified.

    b. Contractor will provide the same or better warranties or bonds for proposed substitution as for product, manufacturer or method specified.

    c. Contractor waives all claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.

    d. Contractor shall have and made no claim for an extension of time or for damages by reason of the time taken by the County and Engineer in considering a substitution proposed by the Contractor or by reason of the failure of the County and Engineer to approve a substitution proposed by the Contractor. Any delays arising out of consideration for an approval of a substitution shall be the sole responsibility of the Contractor requesting that substitution and he shall arrange his operations to make up the time lost.

10. Proposed substitutions will not be accepted if:

    a. Acceptance will require substantial revision of Contract Documents.

    b. They will change design concepts or Technical Specifications.

    c. They will delay completion of the work, or the work of other Contractors.

    d. They are indicated or implied on a Shop Drawing and are not accompanied by a formal request for substitution from Contractor.

11. Only those products originally specified and/or added by approved requests for substitutions submitted in accordance with the preceding paragraphs may be used in the work. Whenever requests for substitutions are approved, it shall be understood that such approval is conditional upon strict conformance with all requirements of the Contract and further subject to the following:

    a. Any material or article submitted for approval in accordance with the above procedure must be equal, in the sole opinion of the Commissioner, to the material or article specified. It must be readily available in sufficient quantity to prevent delay of any work, inspection of tests; it must be available in a reasonably equivalent range of colors, textures, dimensions, gauges, types and finishes as the material or article specified; it must be equal to the specified item in strength, durability, efficiency, serviceability, compatibility with existing systems, ease and cost of maintenance; it must be compatible with the design and not necessitate design modifications by the Engineer; its use must not impose additional work, or require changes in, the work of any other Contractor without the written agreement of such Contractor. Availability of spare parts shall be assured for the useful life of the Project.

    b. Request for all substitutions shall be accompanied by all information needed for the Commissioner to make an evaluation, including manufacturer's brand to trade names, model numbers, description of specification of item, performance data, test reports, samples, history of service, and other data as applicable.

    c. The Commissioner reserves the right to disapprove, for aesthetic reasons, any material or equipment on the basis of design or color considerations alone, without prejudice to the quality of the material or equipment, if the manufacturer cannot meet the required colors or design.

    d. All requests for substitutions of materials or other changes from the Contract requirements, shall be accompanied by an itemized list of all other items affected by such substitution or change. The Commissioner shall have the right, if such is not done, to rescind any approvals for substitutes or changes and to order such work removed and replaced with work conforming to requirements of the Contract, all at the Contractor's expense, or to assess all additional costs resulting from the substitution to the Contractor.

12. Approval of a substitution will not relieve Contractor from the requirement for submission of Shop Drawings or any of the provisions of the Contract Documents.

J. Deviations

1. Within fifteen (15) days after the Notice to Proceed, requests for deviations from the Contract Documents and the reasons therefore, may be proposed to the Commissioner. This period for submitting requests will be strictly enforced. The Contractor waives all claims for additional costs or extension of time related to proposed deviations that subsequently may become apparent.

2. Deviations shall mean the departure by the Contractor from the performance of his work in accordance with the Contract Documents.

3. In all cases the Commissioner shall be the judge as to whether a proposed deviation is to be approved. The Contractor shall abide by his decision when proposed deviations are rejected and shall in such instances perform the work in accordance with the meaning and intent of the Contract Documents.

4. Any delays arising out of consideration for an approval of a deviation shall be the sole responsibility of the Contractor, and he shall arrange his operations to make up the time lost.

ARTICLE GC18 - CONTRACTOR COSTS FOR ENGINEERING SERVICES

A. In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or as a result of Contractor's errors, omissions or failure to conform to the requirements of the Contract Documents, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the County.

B. Structural design shown on the Drawings is based upon the configuration of and maximum loading for major items of equipment as indicated on the Drawings and specified. If the equipment furnished differs from said features, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's charges in connection therewith.

C. The Contractor shall respond to required submittals with complete information and accuracy to achieve required approvals within three (3) submissions. All costs to the Engineer involved with subsequent submissions of Shop Drawings, Samples or other items requiring approval, will be back charged to the Contractor, at the rate by deducting such costs from payments due for Work completed. In the event an approved item is requested by the Contractor to be changed or substituted for, all involved costs in the reviewing and approval process will likewise be back charged to the Contractor unless judged by the Engineer that

the need for such deviation from previously approved data is beyond the control of the Contractor.

ARTICLE GC19 - INSPECTION AND TESTING

Inspection shall be as specified in the Agreement, Article V, "Inspection", and as hereinafter stipulated.

A. Testing Laboratory Services

1. General

a. The County will perform the following tests; concrete slump, concrete cylinder, concrete materials, concrete air content, soils density tests, and paving materials. The Contractor shall plan and conduct his operations to permit taking of field samples and test specimens, as required, and to allow adequate time for laboratory tests by the County. The collection, field preparation and storage of field samples and test specimens shall be as directed by the County and Engineer, and shall be the responsibility of the Contractor.

b. The Contractor shall provide and pay for all other laboratory testing and checking required by the Technical Specifications, including the cost of transporting all Samples and test specimens. The Contractor shall submit the names of three experienced testing laboratories, one of which will be chosen by the County to conduct the testing specified.

c. Tests performed by the County shall not relieve the Contractor from the responsibility of supplying certificates from manufacturers or suppliers to demonstrate conformance with the Specifications.

d. The County reserves the right to test any and all materials being manufactured expressly for this Project, offered to be furnished or delivered at the Site, or installed in place.

2. Test Reports

a. During the progress of the Work, four copies of all test reports shall be submitted directly to the Engineer from the testing laboratory, as they are completed, with a copy sent to the Contractor.

b. Each test report shall be signed and certified by a responsible officer of the testing laboratory.

3. Significance of Tests

Test results shall be binding on both the Contractor and the County, and shall be considered irrefutable evidence of compliance or non-compliance with the Specification requirements, unless supplementary testing shall prove, to the

satisfaction of the County, that the initial Samples were not representative of actual conditions.

4. Supplementary and Other Testing

The Contractor may conduct additional tests as he may require. Should the Contractor at any time request the County to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the County. Testing of this nature shall be conducted at the Contractor's expense.

B. Watertightness of Structures

1. General

a. It is the intent of these Specifications that all concrete Work, sealing Work around built-in items and penetrations be performed as required to ensure that:

(1) Groundwater, surface water, and water or liquids in liquid retainment structures will not intrude into any equipment rooms, pipe galleries, habitable areas or other generally dry areas.

(2) leakage in process tankage or other liquid retainment structures does not exfiltrate through to the exterior.

b. The required watertightness shall be achieved by quality construction, proper sealing of all joints and penetrations and repair of existing joints and penetrations.

c. Each unit shall be tested separately and the leakage tests shall be made prior to backfilling and before equipment is installed. Only potable water shall be used for the tests unless specified otherwise.

d. The General Construction Contractor shall provide at his own expense all labor, material, temporary bulkheads, pumps, water, measuring devices, etc. necessary to perform the required tests unless specified otherwise.

2. Built-in Items and Penetrations

a. All pipe sleeves, built-in items and penetrations shall be sealed as detailed and as required to ensure a continuous watertight seal.

b. Penetration through built-up roofing areas shall be made prior to application of the built-up roofing utilizing suitable sleeves and flashings as required. If roofing surfaces are penetrated after roofing has been applied, the waterproofing integrity shall be restored by the roofer and paid for by the Contractor responsible for the penetration.

3. Enclosing Structures

a. All underground structures enclosing operational and other dry areas to be constructed under this Contract shall be repaired by the General Construction Contractor where there are visible internal signs of leakage. Particular attention to this matter is required when dewatering activities are terminated and the groundwater table returns to natural levels.

b. If required, such Work shall be performed on exterior surfaces of the structures and shall include the necessary excavation, sheeting, dewatering, repair, backfill, etc., associated with the repair.

4. Leak Repair

The General Construction Contractor shall perform remedial work required to eliminate or reduce leaks to allowable amounts per the Specifications. If the General Construction Contractor fails to comply, the County shall have the authority to have these leaks repaired by others. The cost of repairs, by others, shall be deducted from monies due or to become due to the General Construction Contractor.

C. Field Testing of Equipment

1. General

All equipment shall be set, aligned, assembled and tested in conformance with the approved Shop Drawings, manufacturer's drawings and instructions, and as indicated in the Specifications.

2. Field Tests

a. Upon completion of the installation, and at a time approved by the Engineer, equipment will be tested by operating it as a unit with all related piping, ducting, electrical controls and mechanical operations.

b. All costs in connection with such tests including all materials, equipment, instruments, labor, etc. shall be borne by the Contractor.

D. Shop Witness Testing and Certification

1. Each item of equipment or material for which pressure, head, capacity, rating, efficiency, performance, function or special requirements are specified or implied shall be tested at the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and applicable test codes and standards.

2. a. When the Technical Specifications require witness shop tests at the point of manufacture, or other approved facility, the only tests which will be accepted are those made in the presence of the Engineer or his representative. The

Contractor shall give the Engineer written notice thirty (30) consecutive calendar days in advance of the time when the equipment will be ready for the witness shop tests or for required inspections. This notification shall include a diagram of testing set-up and a list of instruments the manufacturer proposes to use for the tests. All instruments shall be of ranges suitable for the quantities to be measured, with approved laboratory calibration. Seven (7) copies of witness shop test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to by a responsible official of the manufacturing company, shall be forwarded to the Engineer for approval.

All equipment and material to be witness shop tested shall be identified with serial numbers and/or approved permanent type identification marks.

b. The Engineer shall be available Tuesday, Wednesday and Thursday to witness shop testing during normal business hours which defined herein as an eight-hour period between 8:00 a.m. and 6:00 p.m. with a one hour break for lunch. In the event dangerous or hazardous conditions exist at the test facility or if adequate lighting has not been provided, the test will be terminated until the conditions are corrected. Witness shall be provided with protection from the element and sanitary facilities and drinking water shall be available for their use.

Testing shall be conducted in an expeditious manner and it is expected that each day's testing shall start as scheduled. Excessive or repetitious delays will be considered cause for the witnesses to terminate and reschedule the witnessing of the tests.

All costs, including travel and subsistence expenses, incurred by the Engineer or his representative because of termination of the tests, will be back charged to the Contractor by deducting such costs from payment due for work completed.

3. When the Technical Specifications do not require witness shop tests of such equipment at the point of manufacture, or other approved facility, or when witness shop tests specified in the Technical Specifications are waived by the Engineer, seven (7) copies of the manufacturer's actual test data and the interpreted results thereof, accompanied by a certificate of authenticity sworn to be a responsible official of the manufacturing company, shall be forwarded to the Engineer for approval.

4. In the event any equipment or material fails to meet the test requirements, the manufacturer shall make all necessary changes, adjustments and replacements and the tests shall be repeated, at no additional cost to the County, until the equipment or material test requirements are acceptable to the County.

5. No equipment or material shall be shipped to the Project until the Engineer notifies the Contractor, in writing, that the shop test reports are acceptable.

E. Inspection of Manufacturer's Facilities

In accordance with the terms of Article V of the Agreement, the Engineer may inspect the manufacture or fabrication of any material or equipment that will be utilized in the Work. The Contractor shall advise the Engineer on the status of the progress of the manufacture or fabrication of such material or equipment. Sufficient advance notice shall be given of various stages in the manufacturing or fabrication process so that the Engineer may schedule inspections of the facility engaged in the performance of the work.

ARTICLE GC20 - NOT USED

ARTICLE GC21 - PROTECTION REQUIREMENTS

The Contractor shall be responsible for protection against vandalism, theft or malicious mischief of all of his Work, materials and equipment at all times from the start to Final Acceptance of the Work.

A. Protection of Property

1. Contractor shall be responsible for the preservation and protection of property on or adjacent to the Work Site against damage or injury as a result of his operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.

2. In the event of any claims for damage or alleged damage to property as a result of Work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of Work in the vicinity of property adjacent to the Work Site, the Contractor at his own expense shall take such surveys as may be necessary to establish the existing condition of the property. Before Final Payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims to have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

3. Contractor shall not, except after written consent from proper parties, enter or occupy with men, tools, materials or equipment, privately-owned land except on easements provided herein. In the event that the Contractor has trespassed upon private property in the prosecution of the Work of this Contract, the County may withhold payment for the value of the claim, but in any case no less than a sum of five hundred dollars ($500) for each incident, until the Contractor has secured a release from the property owner upon whose property the trespass was committed.

4. Contractor expressly undertakes to place upon the Work, or any part thereof, only such loads as are consistent with the safety of that portion of the Work.

B. Open Excavations

1. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access during construction shall be removed when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the County. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the County may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench shall not remain open overnight.

2. The Contractor shall take precautions to prevent injury to the public and County personnel due to open trenches. All trenches, excavated material, equipment or other obstacles which could be dangerous to the public and County personnel shall be well-lighted at night.

C. Fire Protection

1. Contractor shall take all necessary precautions to prevent fires at or adjacent to the Work, buildings, etc. and shall provide adequate facilities for extinguishing fires which do occur. No burning of trash or debris will be permitted.

2. When fire or explosion hazards are created in the vicinity of the Work as a result of the locations of fuel tanks, or similar hazardous utilities or devices, the Contractor shall immediately alert the Nassau County Fire Marshall and the Engineer of such hazards. The Contractor shall exercise all safety precautions and shall comply with all instructions issued by the Fire Marshall and the Engineer to prevent the occurrence of fire or explosion.

D. Chemicals

All chemicals used during Project construction or furnished for Project operation, whether herbicide, pesticide, disinfectant, polymer, or reactant of other classification, must show approval of the EPA and other recognized certifying Agencies. Use of all such chemicals and disposal of residues shall be in strict conformance with regulatory requirements.

E. Explosives

Use of explosives is prohibited unless approved by the County.

F. Protection of Persons

The Contractor shall take all necessary precautions for the safety of employees on the Work and shall comply with all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the

premises where the Work is being performed. He shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards for the protection of workers and the public and shall post danger signs warning against the hazards created by such features of construction as protruding nails, hoists, well holes, elevator hatchways, scaffolding, window openings, stairways, trenches, and other excavations, and falling materials and he shall designate a responsible member of his organization on the Work, whose duty shall be the prevention of accidents. The name and position of any person so designated shall be reported to the Engineer by the Contractor. The person so designated shall be available by phone during non-working hours.

G. Contractor's Right to Act

1. In case of an emergency which threatens loss or injury of property and/or safety of life, the Contractor will be allowed to act, without previous instructions from the County, in a diligent manner. He shall notify the County immediately thereafter.

2. The amount of reimbursement claimed by the Contractor on account of any emergency action shall be determined in the manner provided in the Agreement, Article XXII, "Extra Work."

ARTICLE GC22 - ACCESS ROADS AND PARKING AREAS

A. Access Roads

1. The General Construction Contractor shall construct and maintain such temporary access roads as required to perform his Work and that of all other Contractors on the Project. Access roads must be installed and continuously maintained in a condition that will allow passage of all vehicles under their own power. The General Construction Contractor will be responsible for all damages resulting from his failure to perform as herein required.

2. Access roads, where possible, shall be located over the areas of the future road system and relocated and replaced as necessary to accommodate the progress of the Work.

3. Access roads shall be located within the property lines of the plant unless the Contractor, with the approval of the County, independently secures easement for his use and convenience.

4. The Contractor shall keep the above roads clean and serviceable at all times. Use of mechanical sweeper at least once per week is required.

5. Dust resulting from construction operations shall be controlled by Contractor to prevent a nuisance on the Site or in adjacent areas. Use of water will not be permitted when it results in hazardous or objectionable conditions such as ice, mud, ponds and pollution.

B. Maintenance of Traffic

1. Unless permission to close a plant road is received in writing from the County, all excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, he shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the County.

2. Detours around construction will be subject to the approval of the County. Periods when traffic is being detoured will be subject to approval of the County.

3. Requests for road closings or detours shall be submitted to the County for approval a minimum of seven (7) days prior to the proposed closing or detour. Requests shall be accompanied by a schedule indicating the duration of closing or detour.

C. Parking Areas

See Division 1, General Requirements of the Technical Specifications, for provisions for suitable parking areas for each Contractor's use.

D. Restoration

At the completion of the Work, the surfaces of land used for access roads and parking areas shall be restored by the General Construction Contractor as per the requirements of the Contract Documents. In the absence of specific requirements, the General Construction Contractor shall restore the surfaces to their original condition.

ARTICLE GC23 - TRAFFIC REGULATIONS

A. Contractor shall obey all traffic laws and comply with all the requirements, rules and regulations of the New York Department of Transportation and local authorities having jurisdiction to maintain adequate warning signs, lights, barriers, etc. for the protection of traffic on public roadways.

B. The Contractor vehicles and mobile equipment shall adhere to the speed limits posted in the Project area. The General Construction Contractor shall post the necessary speed limit signs.

C. The Contractor shall provide flagmen at junctions of public traffic and Contractor vehicles and equipment.

ARTICLE GC24 - BARRICADES, WARNING SIGNS AND LIGHTS

A. Each Contractor shall provide, erect and maintain as necessary for his Work, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to ensure safety to the public. All barricades and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise. Sufficient barricades shall be erected to keep vehicles from being driven on or into Work under construction. Contractor shall furnish watchmen in sufficient numbers to protect the Work. Contractor's responsibility for

the maintenance of barricades, signs, lights, and for providing watchmen shall continue until the Project is accepted by the County.

B. Each Contractor shall provide and maintain such other warning signs and barricades in other areas and around their respective Work as may be required for the safety of all those employed in the Work, plant operating personnel, or those visiting the Site or plant.

ARTICLE GC25 - DUST CONTROL AND SPILLAGE

A. Each Contractor shall take all necessary measures to control dust from his operations and to prevent spillage of excavated materials on roads.

B. Each Contractor shall remove all spillage of excavated materials, debris or dust from roads by methods as approved by the Engineer.

C. The General Construction Contractor shall sprinkle calcium chloride at locations and in such quantities and at such frequencies as may be required to control dust as directed by the Engineer.

ARTICLE GC26 - VERMIN CONTROL

All piping, ducts, conduit, etc. passing through walls, floors, ceiling and/or other solid construction, shall be sealed to prevent the passage of vermin.

Seals shall be made by means of rock wool or other approved inert materials, packed sleeves or other approved construction.

ARTICLE GC27 - FIRST AID FACILITIES

The Contractor shall provide at the Site such equipment and facilities as are necessary to supply first aid to any of his personnel who may be injured in connection with the Work.

ARTICLE GC28 - LAYOUT AND LEVELS

A. Buildings and Structures

The location of the buildings and structures is shown on the plot plan.

1. The Contractor for General Construction Work shall lay out the buildings and structures correctly and shall be responsible for any damage caused the County due to incorrect laying out of the Work.

2. The Contractor for General Construction Work shall verify all grades, lines levels and dimensions as shown on the Drawings and he shall report any errors or inconsistencies in them to the Engineer before commencing Work.

3. The Contractor for General Construction Work shall establish bench marks in not less than two widely separated places. As the Work progresses he shall establish bench marks at each floor, giving the exact levels of the floors.

4. The Contractor for General Construction Work shall employ a licensed surveyor to lay out the building or structure, establish bench marks and give levels of floors to which all measurements shall be referred.

5. The Contractor for General Construction Work shall employ a licensed surveyor to scribe bench marks on all columns, where they exist, and on all exterior walls, exactly 4 feet above the finished floor.

6. Before starting construction Work the Contractor for General Construction Work shall submit to the Engineer for approval three (3) copies of a complete "Construction Stake Layout" of the building or structure at all corners and angles.

7. Upon completion of foundation walls, the Contractor for General Construction Work shall prepare and deliver to the Engineer three (3) copies of a certified survey showing that all dimensions, elevations, and angles and the location of the building or structure is in accordance with the Plans.

8. Each Prime Contractor shall have the responsibility to carefully preserve the bench marks, reference points and stakes, and in the case of destruction thereof by the Contractor or resulting from his negligence the Contractor shall be charged with the expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.

9. Existing or new control points, property markers and monuments that will be or are destroyed during the normal course of construction shall be reestablished by the General Construction Contractor and all reference ties recorded therefore shall be furnished to the Engineer. All computations necessary to establish the exact position of the Work shall be made and preserved by the General Construction Contractor.

10. The Engineer may check all or any portion of the Work and the General Construction Contractor shall afford all necessary assistance to the Engineer in carrying out such checks. Any necessary corrections to the Work shall be immediately made by the General Construction Contractor. Such checking by the Engineer shall not relieve the General Construction Contractor of any responsibilities for the accuracy or completeness of his Work.

B. <u>All Other Work</u>

Each Contractor is responsible for layout of his Work including but not limited to, substructures foundations, manholes, utility lines, equipment pads based upon the reference lines and grades established herein.

1. Contractor shall keep neat legible notes of all measurements and calculations made by him while surveying and laying out the Work.

2. Two copies of all notes and other records shall be furnished to the County monthly. Furnish complete notes upon final completion.

ARTICLE GC29 - CUTTING AND PATCHING

A. Contractor Requirements

1. Contractors shall perform all cutting and patching necessary for the Work of the Contract in accordance with the requirements of the Drawings and Specifications. Work performed by another contractor shall not be cut or altered without the approval of the Engineer.

2. Before doing any cutting, the Contractor shall obtain the approval of the Engineer as to the location, size and method of making such openings.

3. All cutting and rough patching as defined by the Engineer will be performed by each respective Prime Contractor. All finish patching shall be performed by the General Construction Contractor.

4. All cutting shall be performed in such a manner as to limit the extent ofpatching.

5. All patching shall be done in a manner to match the surrounding existing surfaces as closely as possible.

6. All painted surfaces which are patched shall have the patch painted to match the existing wall surfaces as closely as possible. The Engineer shall be the sole judge of the color/texture match of finish.

7. All holes cut through concrete walls or slabs shall be core drilled unless otherwise specified or shown. Prior to core drilling, Contractor shall drill sufficient number of small exploratory holes to establish that the area to be core drilled is free of existing embedded conduits. No structural members shall be cut without approval of the Engineer and all such cutting shall be done in a manner directed by him. No holes, except for small screws, may be drilled in beams or other structural members without obtaining prior approval. All Work shall be done in a neat manner by mechanics skilled in their trades and as approved.

8. Contractors shall install sleeves for their Work for all pipes and conduits passing through any wall or floor slab.

B. Errors and Omissions

Details and procedures are as stipulated in Paragraph A of this Article. Contractor responsible for error or omission will be responsible for all costs associated with cutting and patching.

ARTICLE GC30 - OPENINGS AND CHASES

A. The General Construction Contractor shall provide all openings and chases in his Work to fit his own Work and that of any other Contractors. All such openings or chases shown on the Contract Drawings, or reasonably implied thereby, or as confirmed or modified by Shop

Drawings approved by the Engineer, shall be provided by the General Construction Contractor.

B. Where equipment frames or supports are to be installed as integral parts of an opening, the opening frames or supports shall be furnished and installed by the Contractors installing the equipment.

C. When required by the Progress Schedule or requested by the General Construction Contractor, the Contractor installing the equipment frames and supports and Contractors who require openings or chases in slabs and walls for passage of ducts, mounting of equipment, etc., shall furnish all necessary information and instruction of the required openings, chases, frames, etc. When such items are secured in position by the installing Contractor and just prior to construction of the surrounding slab or wall, the installing Contractor shall ascertain the proper number, locations and settings thereof; and the General Construction Contractor shall schedule his operations so as to provide a reasonable opportunity and time interval for such inspection.

D. Any cost resulting from correction and defective, ill-timed, or mislocated Work, or for subsequent Work which becomes necessary because of omitted openings, chases, frames, etc., shall be borne by the Contractor responsible therefor. To this end, no Contractor shall arbitrarily cut, drill, alter, damage, or otherwise endanger the Work of another Contractor. The nature and extent of any corrective or additional Work shall be subject to the approval of the Engineer following consultation with the Contractors involved.

ARTICLE GC31 - SLEEVES, INSERTS AND WALL CASTINGS

Each Contractor shall furnish and install in place, conduits, outlets, piping sleeves, boxes, inserts, other materials and equipment necessary to be built into Work to be performed by the Contractor for General Construction as soon as the requirements of the Progress Schedule require them.

All Contractors shall cooperate fully in connection with the performance of the above Work, as cutting into new Work is neither contemplated nor will it be tolerated.

In the event timely delivery of sleeves or other materials cannot be made, if approved by the Engineer, and to avoid delay, the affected Contractor shall arrange to have boxes or forms set at locations where piping or other material is to pass through or in slabs, walls or other Work. Upon subsequent installation of sleeves or other material, the General Construction Contractor shall fill around them with materials as required by Contract or by the Engineer. Necessary expenditure incurred for boxing out or filling shall be borne without extra costs to the County by Contractor or Contractors responsible therefor.

ARTICLE GC32 - SCAFFOLDING, RIGGING AND HOISTING

Each Contractor shall furnish all adequately designed scaffolding, rigging, hoisting and services necessary for erection and delivery or removal of any equipment and apparatus under his Contract. The Contractor shall remove same from Work involved when no longer required.

Each Contractor involved in this type of activity shall take all precautions to prevent accidents or damage to persons or property about the Work involved and shall erect and maintain proper warning

signs and guard rails, barricades, etc. In the event of the Contractor's negligence, he shall indemnify the County against all claims, suits, damages and judgements, including counsel fees and disbursements incurred in the defense of any action to which he may be subjected by reason of such negligence.

ARTICLE GC33 - CLEANING

A. Rubbish Removal and Cleaning

The General Construction Contractor shall remove from the Project, and dispose of, all debris and rubbish resulting from the Work of all Contractors, at least once a week and more often if same interferes with the Work under any contract, plant operations or presents a fire hazard. All debris and rubbish shall be removed from the County property and legally disposed of. Each Contractor shall be responsible for consolidating all debris and rubbish resulting from his Work to one location in his work area. During course of demolition or new construction, the General Construction Contractor shall maintain and keep free of debris or building material required egress in accord with Fire Safety Regulations and the Nassau County Fire Marshall.

B. County's Right to Clean

Should the Contractor fail, refuse or neglect to remove rubbish and waste materials and temporary Work or clean the building and premises as required herein, then the County may or shall, without obligation to do so, remove and dispose of the said rubbish, waste materials and temporary work, clean the building and premises and deduct the cost thereof from any money due, or to become due, the Contractor under this Contract.

ARTICLE GC34 - PIPING AND EQUIPMENTIDENTIFICATION

Each Prime Contractor shall furnish and install all components of the system for identification of piping and equipment as specified. The system shall include the placing of identification signs, direction-of-flow arrows, identification tags, etc. on plant piping, equipment and structures.

ARTICLE GC35 - OPERATION AND MAINTENANCE MANUALS

Federal regulations and County requirements stipulate time limitations for submittal and approval of operations and maintenance manuals. See Division 1, General Requirements of the Technical Specifications, for specific requirements.

ARTICLE GC36 - RECORD DRAWINGS

The County shall furnish to each Prime Contractor a set of mylar reproducible of the Contract Drawings for his Contract.

Each Prime Contractor shall maintain in the construction office at the job a set of prints of the Contract Drawings. A daily record in red pencil, shall be kept on these prints of the Work installed and all modifications or changes therein. This set of prints shall be available at all times to the Engineer for inspection.

During the progress of the construction, each Contractor shall transfer once each month all information from field prints to the tracings and submit to the Engineer with his monthly payment request, two (2) prints of the tracings showing the Work completed and highlighting the changes made. When roughing is completed, it must be shown. The use of approved shop drawings for record drawings is not acceptable.

All Work installed shall be shown on Drawings to a scale of at least 1/4 inch equals 1 foot. Where the Contract Drawings are to a smaller scale, or do not show the area of Work involved, the Contractor shall prepare Drawings, as required, to that larger scale showing the outline of the structure. These additional Drawings shall be on mylar reproducible and shall be referenced on the smaller scale Drawings to show the area covered. The Contractor shall submit a print of the outline on the additional Drawings for approval before entering any of the installed Work thereon. The sheet size of the additional Drawings shall be the exact same size as that of the Contract Drawings.

All details on Drawings must also be corrected for changes and/or modifications.

Upon completion of all Work each Contractor shall complete the mylar reproducible and sign them indicating that the Work was installed as shown. One set of paper prints shall be submitted to the Engineer for review and acceptance. Upon receipt of the Engineer's acceptance, the Contractor shall submit the mylar reproducible and two sets of paper prints stamped "Record Drawings of Work as Built", stamped and certified.

The submittal of Record Drawing acceptable to the Engineer as specified herein, shall be a condition precedent to payments to the Contractor that may otherwise be then due.

ARTICLE GC37 - PHOTOGRAPHS

A. The Contractor for General Construction shall engage the services of an experienced photographer, approved by the Commissioner, to take job photographs. The photographer will be required to take preliminary photographs of the Site prior to the commencement of Work as directed by the Engineer. Subsequent photographs as determined by the Engineer shall be taken during the construction phase. The price bid shall be based on the following:

1. The photographer visiting the Site twenty-five (25) times as directed by the engineer. As the work progresses, additional visits may be required.

2. Taking a total of five hundred (500) color photographs for the purpose of this section, a photograph shall be defined as one exposure. The Commissioner shall reserve the right to reject any photograph that is not clear or definitive. Any photograph so rejected shall be subtracted from the total exposure before computations for payment or credit under this section.

3. Supplying three (3) 8-inch by 10-inch prints and one (1) digital file of each photograph.

4. Included shall be photographs of electrical installations underneath or in floor slabs prior to backfilling or placing concrete. Photographs shall be labeled to identify:

a. Conduit size

b. Conduit Identification: Number, label, etc. conforming to record drawing identification.

c. Service(s).

d. Locations: Referenced to structures, roadways, etc.

B. In the event that less than five hundred photographs are required, the Contractor shall credit the County fifteen ($15.00) dollars for each photograph under five hundred photographs. Should more than five hundred photographs be required, the Contractor will be paid twenty ($20.00) dollars for each photograph over five hundred photographs.

C. Three 8-inch by 10-inch matte finish prints and digital file of each photograph shall be submitted to the Engineer with the Contractor's monthly estimate. The prints shall be mounted on a cloth with a flap for binding and shall have indelibly printed on their reverse side the following:

Project Name

Photo Number

View and description, indicating location of camera, general description of what photograph represents and whether this is a preliminary or construction photograph.

The Contractor shall also furnish a sufficient number of hard-back binders for each of the three sets of prints and the negatives.

D. No separate payment will be made for job photographs; payment shall be included in the lump sum bid for the General Construction Contract.

E. Digital photo files can be submitted in lieu of negatives.

ARTICLE GC38 - PROJECT CLOSEOUT

Division 1, General Requirements, and the other provisions of the Technical Specifications stipulate requirements for Project closeout. Items such as final cleaning, lubrication survey, spare parts and special tools, equipment start-up services and other items specified are included. Final Payment will be contingent on each Contractor complying with these requirements.

ARTICLE GC39 - DEWATERING

A. Any proposed dewatering operation must be carried out by only licensed well drillers in accordance with Section 15-1525 of the New York State Environmental Conservation Law.

The Contractor is responsible for notifying the New York State Department of Environment Conservation prior to the proposed starting date of the dewatering operation and obtaining the necessary permits, giving the following details in full: the name of the licensed well

driller, the details of the dewatering system to be installed, including the size, the number and the spacing of the well points, the pump capacity, the pumping rate and the expected volume of water to be withdrawn.

Also to be included, will be the amount of water table drawdown, the final disposition of the water, and the expected duration of the operation.

B. Before any dewatering operation is to begin, approval of all the aforementioned items is required. If any unforeseen emergency construction arises, the Contractor must notify the New York State Department of Environmental Conservation as soon as possible that dewatering under such circumstances has been started.

Notification shall be made to the following:

New York State Department of Environmental Conservation (NYSDEC)
SUNY at Stony Brook, 50 Circle Road
Stony Brook, NY 11790
516-444-0405

The entire dewatering operation and the apparatus connected therewith must, at all reasonable hours, be open to inspection and test by duly accredited representatives of the New York State Department of Environmental Conservation.

C. Where private wells, used for water supply, have become dry or cease to produce potable water due to the dewatering operation, the Contractor will be responsible for providing the necessary water at no cost to the County.

D. When dewatering systems utilizing central pumping stations are used, these stations will be acoustically shielded from neighboring residences. Styrofoam or other sound absorbing material will be used on the inside of the enclosure surrounding the pump. In addition, an exhaust stack extension will be provided when required by the Engineer. The use of old pumps generating excessive emissions and/or noise will not be permitted by the Engineer. The noise level twenty-five (25) feet from the pump shall not exceed sixty (60)decibels.

E. The contractor will not be allowed to discharge water containing sediments directly to storm sewers or streams without treating it with filtration or sediment trapping devices.

The Contractor shall not discharge groundwater directly into creeks, ponds, lakes or waterways without first obtaining the proper permit from the New York State Department of Environmental Conservation. Every effort shall be made to discharge groundwater into existing recharge basins. The use of dewatering systems utilizing central pumping stations header or discharge lines which remain in place at one location for more than six (6) weeks will not be permitted unless approved in writing by the Engineer. All well point header and discharge lines must not remain in place beyond the period for which they are required to perform Work in their immediate vicinity, nor shall they be placed far in advance of their use. All dewatering systems shall be subject to the approval of the Engineer who shall be the sole judge as to the conformance with the above requirements, and any additional requirements which may be specified in Division 2 of the Technical Specifications.

ARTICLE GC40 - PRESERVATION OF WETLANDS AND WATERWAYS

No Contractor is permitted to dump spoil onto those areas designated as wetlands or waterways. Further, the Contractor shall not stockpile or store spoil, materials, tools or equipment on wetlands. Surplus excavated material, either unsatisfactory for or over and above that require for backfilling, shall be disposed of by the Contractor at his own expense, off the Site of Work in a lawful manner. The Contractor must contact Alfred T. Keller, NYS Department of Environmental Conservation at (516) 751-7900 for approval of any proposed disposal site.

ARTICLE GC41 - NOTIFICATION OF SUBCONTRACTOR

Each Prime Contractor and Subcontractor shall include by reference the EEO clause and applicable Bid Conditions in all advertisements or other solicitations for bids, and shall include the EEO clause and applicable Bid Conditions in all contracts.

Each Prime Contractor and Subcontractor must provide written notice to each Subcontractor of the specific reporting and record keeping requirements under the EEO clause and applicable Bid Conditions. Upon award of a Subcontract, each Contractor shall immediately notify the Compliance Agency of the Contract number, the Subcontractor's name, dollar amount of Contract estimated start and completion dates and the crafts which will perform Work under the Subcontract.

ARTICLE GC42 - JURISDICTIONAL DISPUTES

It shall be the responsibility of the Contractor to pay all costs that may be required to perform any of the Work shown on the Drawings or specified herein in order to avoid any Work stoppages due to jurisdictional disputes. The basis for subletting Work in question, if any, shall conform with precedent agreements and decisions on record with the Building and Construction Trades Department, AFL-CIO, date June, 1973, including any amendments thereto.

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COUNTY OF NASSAU

STATE OF NEW YORK

DEPARTMENT OF PUBLIC WORKS

SUPPLEMENTARY CONDITIONS

GC 20

Change this title of GC 20 from "Not Used" to "Value Engineering Change Orders."

Include the following after the new title:

A. The term "proposal" as used in this Article is construed to mean a Value Engineering Construction Proposal submitted by the Contractor for changing the Plans, Specifications, or other requirements of the Contract. This Section conforms to the provisions of N.J.S.A. 40A:11-16.6 and is only applicable to Contracts greater than or equal to $5,000,000. Value Engineering Construction Proposals shall conform to the provisions of this Article.

1. Purpose and Scope. The intent of Value Engineering is to share with the Contractors any cost savings generated on the Contract as a result of a proposal or proposals offered by the Contractor and approved by the Owner. The purpose is to encourage the use of Contractor's ingenuity and experience in arriving at alternative, lower cost or time-saving construction methods other than those reflected in the Contract Documents, by the sharing of savings resulting therefrom. The proposals contemplated are those that could produce a savings to the Owner without, in the judgment of the Owner's Engineer and approved by the Owners, impairing essential functions and characteristics of the Project or a portion of the Work involved. They include but are not limited to safety, service life, stage construction, economy of operation, ease of maintenance, and desired appearance.

2. Submittal of Initial Proposal. An initial submission is required to use the Value Engineering process. The initial proposal shall outline the general technical concepts associated with the proposal and the estimated savings that will result.

The initial proposal will be reviewed by the Owner and, if found to be conceptually acceptable, approval to submit a final proposal will be granted by the Owner. A finding of conceptual acceptability of the initial proposal in no way obligates the Owner to approve the final proposal. The Contractor shall have no claim against the Owner as a result of the rejection of any such final proposal.

3. Submittal of Final Proposal. Final proposals will be considered only after Owner approval of the initial proposal according to Subheading 2 above. As a minimum, the following materials

and information shall be submitted with each final proposal plus any additional information requested by the Owner:

a) A statement that the final proposal is submitted as a Value Engineering proposal.

b) A description of the difference between the existing Contract requirements and the proposed change, and the comparative advantages and disadvantages of each, including considerations of safety, service life, economy of operations, stage construction, ease of maintenance, and desired appearance.

c) Complete plans, specifications, and calculations showing the proposed revisions relative to the original Contract features and requirements. All plans and engineering calculations shall bear the signature of a Professional Engineer licensed to practice in the State.

d) A complete cost analysis indicating the final estimated costs and quantities to be replaced by the proposal, the new costs and quantities generated by the final proposal, and the cost effects of the proposed changes on operational, maintenance, and other considerations.

e) A specific date by which a Change Order adopting the final proposal must be executed so as to obtain the maximum cost reduction during the remainder of the Contract. This date must be selected to allow the Owner ample time, usually a minimum of 45 days, for review and processing a Change Order. Should the Owner fund the insufficient time is available for review and processing, it may reject the final proposal solely on such basis.

f) A statement as to the effect the final proposal has on the Contract Time.

g) A description of any previous use or testing of the final proposal on another Owner project or elsewhere and the conditions and results therewith. If the final proposal was previously submitted on another Owner project, indicate the date, the project, and the action taken by the Owner.

4. Conditions for Consideration. Proposals will be considered only after Award of Contract and only when all of the following conditions are met:

a) The Contractor is cautioned not to base any bid prices on the anticipated approval of a proposal and to recognize that such proposal may be rejected. In the event of rejection, the Contractor is required to complete the Contract according to the original Plans and Specifications and the prices initially bid and accepted by the Governing Body.

b) All proposals, approved or not approved by the Owner for use in the Contract, apply only to the ongoing Contract or Contracts referenced in the proposal. The proposals shall become the property of the Owner and shall contain no restrictions imposed by the Contractor on their use or disclosure. The Owner will have the right to use, duplicate, and disclosure in whole or in part any data

necessary for the utilization of the proposal. The Owner retains the right to use any accepted proposal or part thereof on any other or subsequent project without any obligation to the Contractor. This provision is not intended to deny rights provided by law with respect to patented materials or processes.

c) If the Owner already has under consideration certain revisions to the Contracts that are subsequently incorporated in a proposal, the Owner will reject the Contractor's proposal and may proceed with such revisions without any value engineering obligation to the Contractor.

d) The Contractor shall make no claim against the Owner or Owner's agents for any costs or delays due to the Owner's rejection of a proposal, including but not limited to development costs, anticipated profits, or increased materials or labor costs resulting from delays in the review of such proposal.

e) The Engineer will determine whether a proposal qualifies for consideration and evaluation. The Owner may reject any proposal which is not consistent with the basic design criteria for the Project.

f) The Engineer may reject all or any portion of Work performed pursuant to an approved proposal if the Engineer determines that unsatisfactory results are being obtained. The Engineer may direct the removal of such rejected Work and require the Contractor to proceed according to the original Contract requirements without reimbursement of any Work performed under the proposal, or for its removal. Where modifications to the proposal are approved to adjust to field or other conditions, reimbursement is limited to the total amount payable for the Work at the Contract prices as if it were constructed according to the original Contract requirement. Such rejection or limitation of reimbursement does not constitute the basis of any claim against the Owner for delay or for any other costs.

g) Proposals will be considered only if equivalent options are not already provided in the Contract Documents.

h) The proposed shall be made based on items of work schedule to be done by the Contractor. Anticipated cost savings based on revisions of utility relocations or other similar items to be done by others will not be considered. Proposals that may increase the cost of Work done by others may be considered.

i) If additional information is needed to evaluate proposals, this information must be provided in a timely manner. Such additional information could include, where design changes are proposed, result of field investigations and surveys, design computations, and field change sheets.

5. Approval of Final Proposal

a) The proposal shall not be approved unless the Engineer reports to the Owner's governing body that the proposal appears consistent with the required performance, quality, reliability, and safety of the project and odes not impair any of the essential functions, or characteristics of the project, or any portion of the work involved.

b) The Owner shall have the sole direction to approve or disapprove a value engineering construction proposal.

6. Payment. If the proposal is accepted, the changes will be authorized by Change Order. Payment will be made as follows:

a) The changes will be incorporated into the Contract by adjustments in the quantities of Pay Items, agreed upon Extra Work Items or by Force Account, as appropriate, according to the Specifications.

b) Once the project is completed, the contractor unit's engineer shall verify the cost savings to reflect the actual cost of work. Such verified cost saving shall be the basis of the savings shared equally with the contractor. The costs of such verification shall be borne equally by both parties.

c) The Owner's costs for review and processing of the proposal will be deducted from the savings. The cost of the Engineer to verify the savings shall be apportioned equally between the parties.

d) A Contractor's costs for development, design, and implementation of the proposal are not eligible for reimbursement.

e) The Contractor may submit proposals for the approved Subcontractor, provided that reimbursement is made by the Owner to the Contractor and that the terms of the remuneration to the Subcontractor are satisfactorily negotiated and accepted before the proposal is submitted to the Owner. Subcontractors may not submit a proposal except through the Contractor.

GC_32

Immediately following the last paragraph, insert the following:

The Contractor may only use the Owner's monorails and hoists located at the facility for the loading of equipment and materials or use any other Owner owned equipment at the facility, with the express written approval of the Owner and Engineer and upon execution of the Release and Waiver form attached to this section. If authorized to use any monorails, hoists or other Owner owned equipment, the Contractor shall be fully responsible for confirming its load capacity and/or operability. Such confirmation shall be performed by an experienced hoist and monorail service and inspection firm, who shall provide written certification for the operability and capacity of the hoist. The cost for such inspection and certification shall be borne by the Contractor. Should the inspection firm determine that repairs are required to the hoist to make it operable, the Contractor shall have such repairs made prior to

utilizing the hoist. The Contractor shall bare all costs for such repairs. The Contractor shall assume full responsibility as it relates to the use of the monorails, hoists or other Owner owned equipment and any subsequent damage to materials, equipment and/or injury to personnel thereto.

See County of Nassau Release and Waiver attachment.

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Addendum #63 - June 2026

Project Specific Addendum to the Project Labor Agreement Dated May 2011
Between Nassau County and the Nassau Suffolk Building and Construction Trades Council and their Affiliated Local Construction Trade Unions

This Addendum relates to the Cedar Creek WPCP Influent Pumping System Improvements project under the conditions and requirements of the PLA referenced above.

1. **Project Description: Cedar Creek WPCP Influent Pumping System Improvements (Project No. S3C067-11G)**

   The Cedar Creek WPCP Influent Pumping System Improvements project entails the following scope at the Cedar Creek WPCP:

   - Replace of all seven existing extended shaft centrifugal pumps and magnetic drives with six new centrifugal extended shaft influent pumps, motors and eddy current drives as well as replace suction and discharge piping and valves;
   - Rehabilitate force mains with non-structural internal liners and replace elbows, tees, and fittings;
   - Replace all system isolation and check valves, prioritizing suction gate valves, discharge knife gate isolation valves and cone check valves;
   - Install new medium and low-voltage power distribution equipment and motor control systems;
   - Preserve and modernize electrical system with new switches, starters, and dual feed arrangements;
   - Upgrade all instrumentation and controls to a state-of-the-art PLC-based platform, fully integrated with the plant's SCADA network for remote operation, monitoring, and troubleshooting;
   - Installation of instrumentation such as flow meters, level sensors, pressure transmitters, and vibration monitoring systems;
   - Full system integration, testing, and commissioning of controls and automation;
   - Install concrete baffle walls in wet wells;
   - Reroute plant drain piping through the dry well and provide new isolation knife gate valves;
   - Employ a multi-phase construction sequence to maintain plant operations (MOPO) throughout, including incremental pump and force main replacement and use of inflatable line stops for isolation;
   - Replace Main Equipment Building HVAC systems within mechanical rooms and on roof to restore ventilation systems and modify ventilation systems;
   - Replace the existing sump pump system with new sump pumps, piping and controls;
   - Structural modifications, concrete rehabilitation, and installation of new equipment and piping supports, framing, and foundations;
   - Installation of new access platforms, grating, and handrails;
   - Associated application of coatings and painting;

   Generally, the work under this project is typical for an upgrade to a wastewater treatment plant in that it requires both special labor skills for the project work force, as well as engineering sophistication in construction management for the successful contractors.

Based on the 36-month anticipated construction schedule from issuance of Notice to Proceed (NTP), the current overall Construction Cost Estimate for this project is estimated to be $78,370,200 of which labor is $8,615,300 or approximately 11%. It is estimated that approximately 64,000 man-hours will be expended on the project. The details of the work to be covered under this PLA will be detailed in the Contract Documents (i.e. Plans and Specifications), which will incorporate the Master PLA with the projects specific Addendum.

2. Feasibility Study

Nassau County has engaged Camp Dresser McKee and Smith (CDM Smith) to perform a PLA Feasibility Analysis Study (June 2026) to determine if the development and implementation of a PLA for this project will provide benefit to the County in terms of time, cost and quality. As detailed in the Study, a PLA would generate a potential cost savings of $4,789,500 (6.1% of the estimated Total Construction Cost).

In addition, the Study has determined that the utilization of the Master PLA will provide for labor harmony on the Projects sites, eliminate strikes, labor disruptions and job actions, standardize working conditions, expedite the resolutions of grievances and jurisdiction disputes, increase the competitive bidding process, and generally level the labor playing field for trade labor participating on these projects.

3. PLA Administrator

To our knowledge, Nassau County has not designated at PLA Administrator for the Project. Typically, the Construction Manager is designated to administer the PLA, but in certain circumstances, the firm that generated the feasibility study can perform this role.

4. Wicks Law

The project is subject to Wicks Law requirements but is anticipated to be a single prime contract under the Master PLA.

5. Project engineer and Construction Manager

The project Engineer is CDM Smith. The project Construction Manager is Gannett Fleming (GFT Inc).

6. Project Labor Agreement Adjustments

Add after Article XIII:

"Article XIV, WORKERS' COMPENSATION ADR

The parties may negotiate regarding the application of a Workers Compensation Alternate Dispute Resolution (ADR) program on a Project wide basis with the option of individual Union affiliates to opt out at their discretion. Notwithstanding the status of any of these negotiations, the remainder of this Agreement will remain in full force and effect."

7. Project PLA Letter of Assent

See attached below.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed and effective as of

The Second day of July 2026.

Michael Kwaschyn

Nassau County Department of Public Works

By: Michael Kwaschyn, Commissioner DPW

Nassau Suffolk Building and Construction Trades Council

By: Matthew Aracich, President

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TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS

General Requirements Subgroup

DIVISION 01 - GENERAL REQUIREMENTS

011000 Summary
012001 Price and Payment
012100 Allowances
012600 Contract Modification Procedures
012900 Payment Procedures
013100 Project Management and Coordination
013200 Construction Progress Documentation
013233 Photographic Documentation
013300 Submittal Procedures
013513.24 Special Procedures for Maintenance of Plant Operation and Sequence of Construction
013526 Governmental Safety Requirements
014000 Quality Requirements
014200 References
015000 Temporary Facilities and Controls
015728 Temporary Bypass Pumping Systems
016000 Product Requirements
017300 Execution
017419 Construction Waste Management and Disposal
017700 Closeout Procedures
017823 Operation and Maintenance Data
017839 Project Record Documents
017900 Demonstration and Training
018819 Tightness and Performance Requirements
019113 General Commissioning Requirements

Facility Construction Subgroup

DIVISION 02 - EXISTING CONDITIONS

024119 Selective Demolition
028200 Asbestos Removal
028300 Removal and Disposal of Lead-Containing Paint
028310 LCP/LBP Disturbances Using OSHA Lead Safe Work Practices
028600 Identification and Disposal of Hazardous Waste
028700 Removal and Disposal of Universal Waste

DIVISION 03 - CONCRETE

030100 Maintenance of Concrete

030551 Concrete Bonding Agents
030555 Concrete Admixtures and Additives
031113 Structural Cast-In-place Concrete Forming
031500 Concrete Accessories
032100 Reinforcing Steel
032200 Welded Wire Fabric Reinforcing
033100 Structural Concrete
033500 Concrete Finishing
033900 Concrete Curing
036000 Grout
038100 Concrete Cutting
038200 Concrete Boring

DIVISION 05 - METALS

051200 Structural Steel Framing
051400 Structural Aluminum
055000 Metal Fabrications and Anchorage
055117 Pre-Engineered Aluminum Stairs
055215 Aluminum Handrails and Railings
055300 Metal Grating

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

061000 Rough Carpentry
066100 Fiberglass Reinforced Plastics (FRP) Fabrications Pultruded Tube Guardrail and Handrail

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

072100 Thermal Insulation
075216 Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing
076200 Sheet Metal Flashing and Trim
077100 Roof Specialties
078413 Penetration Firestopping
079200 Joint Sealants

DIVISION 09 - FINISHES

099123 Interior Painting
099679 Atmospheric Protection and Plant Service Areas Coatings

Facility Services Subgroup

DIVISION 22 - PLUMBING

220523.14 Check Valves for Plumbing Piping
220523.15 Gate Valves for Plumbing Piping
220529 Hangers and Supports for Plumbing Piping and Equipment
220553 Identification for Plumbing Piping and Equipment

221316 Sanitary Waste and Vent Piping
221429 Sump Pumps

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

230517 Sleeves and Sleeve Seals for HVAC Piping
230519 Meters and Gages for HVAC Piping
230523.12 Ball Valves for HVAC Piping
230523.13 Butterfly Valves for HVAC Piping
230529 Hangers and Supports for HVAC Piping and Equipment
230548.13 Vibration Controls for HVAC
230553 Identification for HVAC Piping and Equipment
230593 Testing, Adjusting, and Balancing for HVAC
230713 Duct Insulation
230719 HVAC Piping Insulation
230923 Direct Digital Control (DDC) System for HVAC
230923.11 Control Valves
230923.12 Control Dampers
230923.23 Pressure Instruments
230923.27 Temperature Instruments
232113 Hydronic Piping
232116 Hydronic Piping Specialties
232123 Hydronic Pumps
232213 Steam and Condensate Heating Piping
232216 Steam and Condensate Heating Piping Specialties
232223 Steam Condensate Pumps
233113 Metal Ducts
233116 Nonmetal Ducts
233300 Air Duct Accessories
233416 Centrifugal HVAC Fans
233423 HVAC Power Ventilators
233713.23 Registers and Grilles
233723 HVAC Gravity Ventilators
235700 Heat Exchangers for HVAC
237343.16 Outdoor, Semi-Custom Air-Handling Units
238216.11 Hydronic Air Coils

DIVISION 26 - ELECTRICAL

260010 Supplemental Requirements for Electrical
260011 Facility Performance Requirements for Electrical
260505 Selective Demolition for Electrical
260513 Medium-Voltage Cables
260519 Low-Voltage Electrical Power Conductors and Cables
260523 Control-Voltage Electrical Power Cables
260526 Grounding and Bonding for Electrical Systems

260529	Hangers and Supports for Electrical Systems
260533.13	Conduits for Electrical Systems
260533.16	Boxes and Covers for Electrical Systems
260533.23	Surface Raceways for Electrical Systems
260544	Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260548	Vibration and Seismic Controls for Electrical Systems
260553	Identification for Electrical Systems
260573	Power System Studies
260800	Commissioning of Electrical Systems
261839	Medium-Voltage Motor Controllers
262200	Low-Voltage Transformers
262413	Switchboards
262416	Panelboards
262505	480V Control Panels
262726	Wiring Devices
262813	Fuses
262816	Enclosed Switches and Circuit Breakers
263600	Transfer Switches

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

284621.11	Addressable Fire-Alarm Systems

Site and Infrastructure Subgroup

DIVISION 31 - EARTHWORK

310515	Soils and Aggregates for Earthwork
311000	Site Clearing
312319	Dewatering
312333	Trenching and Backfilling
312500	Erosion and Sedimentation Controls

DIVISION 32 - EXTERIOR IMPROVEMENTS

321123	Aggregate Base Courses
321216	Asphalt Paving
321623	Asphalt Sidewalks
329200	Turfs and Grasses

DIVISION 33 - UTILITIES

330130.70	Spray-In-Place Polymeric Pipe Lining

Process Equipment Subgroup

DIVISION 40 - PROCESS INTERCONNECTIONS

400506	Couplings, Adapters, and Specials for Process Piping
400507	Hangers and Supports for Process Piping

400517	Copper Process Pipe and Tubing
400519	Ductile Iron Process Pipe
400523	Stainless Steel Process Pipe and Tubing
400524	Steel Process Pipe
400531	Thermoplastic Process Pipe
400532	Double Wall Chemical Pipe System
400551	Common Requirements for Process Valves
400553	Identification for Process Piping
400557	Actuators for Process Valves and Gates
400559.23	Stainless Steel Slide Gates
400561	Gate Valves (Owner-supplied)
400561.43	Knife Gate Valves (Owner-supplied)
400562	Plug Valves
400563	Ball Valves
400565.13	Cone Valves
400567.36	Pressure-Regulating Valves
400567.39	Pressure-Relief Valves
400576	Hot-Tapping Valves and Line Stops
400578.21	Air Release Valves for Wastewater Service
400578.29	Combination Air Valves for Wastewater Service
400582	Solenoid Valves for Process Service
400593.13	Medium-Voltage Motors for Process Equipment
404213	Process Piping Insulation
406100	Process Control and Enterprise Management Systems General Provisions
406121.20	Process Control System Testing
406126	Process Control System Training
406196	Process Control Descriptions
406263	Operator Interface Terminals
406343	Programmable Logic Controllers
406613	Switches and Routers
406717	Industrial Enclosures
406733	Panel Wiring
406763	Control Panel Mounted UPS
406863	Configuration of HMI Software
406866	Configuration of Controller Software
407000	Instrumentation for Process Systems
407113	Magnetic Flow Meters
407143	Variable Area Flow Meters
407166	Transit Time Flow Meters
407179	Flow Switches
407223	Radar Level Meters
407276	Level Switches
407313	Pressure and Differential Pressure Gauges
407326	Gauge-Pressure Transmitters

407336 Pressure and Differential Pressure Switches
407363 Diaphragm Seals
407413 Resistance Temperature Devices
407719 Vibration Velocity Measurement Devices
407723 Vibration Monitoring Systems
407816 Indicating Lights
407819 Switches and Push Buttons
407833 Annunciators
407853 Relays
407856 Isolators, Intrinsically Safe Barriers, and Surge Suppressors
407859 Power Supplies
408100 Industrial Control System Cybersecurity

DIVISION 43 - WATER AND WASTEWATER EQUIPMENT
432341 End Suction Solids Handling Pumps

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APPENDICES

Appendix A: Valve Pre-Purchase Contract/Proposal
Appendix B: Verdantas Flow Labs Physical Hydraulic Model Study
Appendix C: Cast Iron Piping Condition Assessment Report
Appendix D: Hazardous Building Materials Assessment Data
Appendix E: 1985 Geotechnical Data Report
Appendix F: Monorail and Hoist Release and Waiver

END OF TABLE OF CONTENTS

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Multiple Work Packages.
6. Work under Owner’s separate contracts.
7. Future work not part of this Project.
8. Owner’s product purchase contracts.
9. Owner-furnished/Contactor-installed (OFCI) product.
10. Owner-furnished/Owner-installed (OFOI) products.
11. Contractor-furnished/Owner-installed (CFOI) products.
12. Contractor’s use of site and premises.
13. Coordination with occupants.
14. Work restrictions.
15. Specification and Drawing conventions.
16. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 “Execution” for coordination of Owner-installed products.
3. Section 013513.24 “Special Procedures for MOPO and Construction Sequence” for details associated with the scope of work, suggested construction sequence, and limitations for maintenance of plant operations during construction.

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Cedar Creek Water Pollution Control Plant (WPCP) Influent Pumping System Improvements, Contract No. S3C067-11G.

1. Project Location: 3340 Merrick Rd, Wantagh, NY 11793.

B. Owner: Nassau County Department of Public Works, Westbury, NY.

1. Owner's Representative: Karen A. Fay, P.E., 3340 Merrick Road, Building R, 3rd Floor, Wantagh, NY 11793; email: kfay@nassaucountyny.gov ; tel: 516.571.7534.

C. Engineer: CDM Smith, 324 S Service Rd Suite 204, Melville, NY 11747.

1. Engineer's Representative: Megan Messmann, PE; email: messmannmr@cdmsmith.com; tel: 516.697.8113.

D. Construction Manager (CM): GFT Infrastructure, Inc.

1. Construction Manager Representative: Lazarus Francino, PE.
2. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Contractor, according to a separate contract between Owner and Construction Manager.

E. Project Coordinator for Multiple Contracts: Jacobs has been engaged by Owner to serve as Project coordinator.

1. Graham Sharkey, PE, CCM, has been engaged by Owner to serve as Project coordinator.

F. Contract Operator: The Cedar Creek WPCP is operated by Veolia North America on behalf of the Owner.

1. Veolia North America Representative: David Crisdell, 3340 Merrick Road, Wantagh, NY 11793; email: david.crisdell@veolia.com; tel: 516.390.6426

G. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following. See Spec. Section 013513.24 “Special Procedures for MOPO and Construction Sequence” and Contract Drawings for more detail associated with the work.

1. Complete Replacement of Influent Pumping System

a. Replace all seven existing extended shaft centrifugal pumps and magnetic drives with six new centrifugal extended shaft influent pumps (each rated for 37.5 MGD and 75-ft head), providing N+1+1 redundancy and a total duty capacity of 150 MGD.
b. Reconfigure suction and discharge piping and valves for optimal hydraulics, construction sequencing, and redundancy.

2. Force Main Upgrades

a. Tie new pumping system into two existing 48-inch diameter force mains.
b. Rehabilitate force mains with non-structural internal liners and replace elbows, tees, and fittings most susceptible to corrosion.

3. Valve Replacement

a. Replace all system isolation and check valves, prioritizing suction gate valves, knife gate isolation valves and cone check valves for reliability and maintenance.

4. Pump Drives Replacement

a. Install eddy current drives for robust, reliable flow control over the life of the pumps.

5. Electrical System Modifications

a. Install new medium and low-voltage power distribution equipment and motor control systems.
b. Preserve and modernize electrical system redundancy; power new pumps via new switches, starters, and dual feed arrangements.
c. Elevate all vital electrical and control equipment above regulatory flood elevations for storm resilience.
d. Update plantwide power system study.

6. Instrumentation & Automation

a. Upgrade all instrumentation and controls to a state-of-the-art PLC-based platform, fully integrated with the plant’s SCADA network for remote operation, monitoring, and troubleshooting.
b. Installation of instrumentation such as flow meters, level sensors, pressure transmitters, and vibration monitoring systems.
c. Full system integration, testing, and commissioning of controls and automation.

7. Wet Well Improvements

a. Install concrete baffle walls to improve hydraulic performance.

8. Plant Drain Relocation

a. Reroute plant drain piping through the dry well and provide new isolation knife gate valves to allow discharge to both the east and west wet wells.

9. Constructability & Maintenance of Plant Operations (MoPO)

    a. Employ a multi-phase construction sequence to maintain plant operations throughout, including incremental pump and force main replacement, use of inflatable line stops for isolation, and reliance on both existing and new infrastructure.
    b. Schedule capacity-limiting steps during dry weather and overnight periods to minimize risk.
    c. Refer to Spec. Section 013513.24 “Special Procedures for Maintenance of Plant Operation and Sequence of Construction” for suggested sequence of construction, general criteria, existing plant operations, restrictions, and constraints during construction.

10. HVAC Improvements

    a. Replace Main Equipment Building HVAC systems within mechanical rooms and on roof to restore ventilation systems and modify ventilation systems that will be impacted by the new force main routing.

11. Plumbing Improvements

    a. Replace the existing sump pump system with new sump pumps, piping and controls.

12. General Structural and Architectural Improvements

    a. Structural modifications, concrete rehabilitation, and installation of new equipment and piping supports, framing, and foundations.
    b. Installation of new access platforms, grating, and handrail throughout Main Equipment Building B for safe operations and maintenance of major system components.

13. All other work necessary to complete the work under this contract including demolition, temporary facilities, bypass pumping system, masonry, roofing, painting, plumbing, HVAC, electrical, instrumentation and controls, commissioning services, and maintenance of plant operations.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 WORK PERFORMED BY OWNER

A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.7 WORK UNDER OWNER'S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

1.8 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Pre-Purchase Contract: The Owner will pre-purchase a total of twenty-three (23) electrically actuated valves of various sizes for installation under this contract. Delivery of pre-purchased valves will occur with Work under this Contract. Acceptance, storage, maintenance, installation, testing, and commissioning of pre-purchased valves and actuators is included under this contract.

1. Specifications related equipment included in the pre-purchase contract are included within this contract for information and specifically called out as being part of the pre-purchase contract.
2. Pertinent pre-purchase contract details are included in Appendix A of these Specifications.
3. Pre-purchased valves to be installed as part of this contract are specifically denoted in Valve Schedule included on Contract Drawing MG-003 and MG-004.

B. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.

    a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

C. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

D. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. Gate Valves
2. Knife Gate Valves
3. Temporary Knife Gate Valves

    a. Temporary OFCI Knife Gate Valves shall remain the property of the Owner after temporary use and will be delivered to the Owner per specified salvage requirements.

1.9 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times.

    a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.10 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy Project site and existing buildings during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.11 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 3:30 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Construction Manager and Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Construction Manager's and Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Construction Manager and Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Construction Manager's and Owner's written permission before proceeding with disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

F. Employee Identification: Owner will provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.12 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.13 MISCELLANEOUS PROVISIONS (NOT USED)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

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SECTION 012001 - PRICE AND PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Lump sum prices.

B. Unit prices.

1.3 LUMP SUM PRICES

A. Base Bid Item Inclusive Of All Contract Work Not Listed Separately In Bid Items 2 Through 17 (Bid Item 1)

1. Payment:

a. Payment of the lump sum price bid for Item 1 shall constitute full compensation for performing and completing the Work required by the Contract Documents, excluding only those items specifically measured and paid for under Bid Items 2 through 13.
b. No separate payment will be made for work, materials, equipment, appurtenances, accessories, testing, startup, temporary construction, temporary facilities, demolition, restoration, coordination, or other requirements necessary for a complete and functional installation unless a separate Bid Item is expressly provided in the Bid Schedule. Any Work not specifically identified as a separate pay item shall be considered incidental to and included in the Base Bid Item
c. Payment shall fully compensate the Contractor for all incidental work which is not specified or shown but which is evidently required to complete the work of this item.

2. Measurement:

a. The measurement shall be the percentage of work performed and in place as of the date of payment and shall be determined for each item of the schedule of values. The measurement shall be documented by calculation of costs incurred, quantities in place, and invoices of materials and equipment supplied, as well as a certification of the Contractor as to the accuracy of the measurement.

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1.4 SIPP LINING OF EXISTING 48” DIAMETER FORCE MAINS (Bid Item 17)

1. Payment:

a. Payment of the lump sum price bid for Alternate Bid Item 1 shall constitute full compensation for furnishing all labor, materials, tools, equipment, transportation, and incidentals required to install a complete SIPP liner system withing the existing 48” diameter force mains in accordance with the Contract Documents. Payment shall fully compensate the Contractor for all incidental work which is not specified or shown but which is evidently required to complete the work of this item.

2. Measurement:

a. The measurement shall be the percentage of work performed and in place as of the date of payment and shall be determined for each item of the schedule of values. The measurement shall be documented by calculation of costs incurred, quantities in place, and invoices of materials and equipment supplied, as well as a certification of the Contractor as to the accuracy of the measurement.

B. Mobilization and Demobilization of the Supplemental Bypass Pumping System (Proposal Alternate 1)

1. Payment:

a. Payment for the Mobilization and Demobilization of the Supplementary Bypass Pumping System shall constitute full compensation for furnishing, designing, permitting, installing, testing, commissioning, maintaining, repairing, replacing, removing, and restoring all temporary facilities required to provide a fully functional supplementary bypass pumping system in accordance with the Contract Documents. Payment shall include, but not be limited to:

1) Delegated design and preparation of calculations and drawings.
2) Furnishing all pumps, piping, fittings, valves, controls, instrumentation, power supplies, generators, appurtenances, supports, temporary structures, and ancillary equipment.
3) Mobilization, installation, startup testing, performance testing, and turnover to the Owner for operation.
4) All labor, materials, equipment, supervision, maintenance, preventive maintenance, exercising of standby equipment, monitoring, repairs, replacement parts, and emergency response services.
5) Temporary access provisions, excavation, restoration, traffic and pedestrian protection, and site restoration.
6) Removal of the bypass system and restoration of affected facilities upon completion of the Work.
7) All incidentals necessary to provide a complete and operational bypass pumping system.

b. Payment for fuel is identified elsewhere in the Bid Form as a separate allowance item and shall be made in accordance with the requirements of that allowance and shall not be included in this bid item.

2. Measurement:

a. The measurement shall be the percentage of work performed and in place as of the date of payment and shall be determined for each item of the schedule of values. The measurement shall be documented by calculation of costs incurred, quantities in place, and invoices of materials and equipment supplied, as well as a certification of the Contractor as to the accuracy of the measurement.

1.5 UNIT PRICES

A. Quantity and measurement estimates stated in the Bid Form are estimates for bidding purposes only. Actual payments to be based on actual quantities installed (or removed), in-place, as measured and/or verified by the Engineer.

B. Unless otherwise provided in the General Conditions, the bid unit prices to be in effect throughout the contract duration, regardless of variances between the estimated quantities and the actual installed quantities.

C. No claim for anticipated profits, loss of profit, damages or any extra payment due to any difference between the amounts of work actually completed, or materials or equipment furnished, and the estimated quantities will be accepted.

D. Unless otherwise approved by the Owner, any unit quantities exceeded may not be invoiced until the estimated quantity is increased by contract change order.

E. Assist Engineer by providing necessary equipment, workers, and survey personnel as required to measure quantities.

F. Round measured quantities to the nearest whole integer, unless value of the unit price exceeds $100, in which case measured quantities shall be rounded to the nearest half unit, or as defined further below.

G. Weekly Maintenance of the Supplemental Bypass Pumping System while Operated by the Owner (Bid Item 2)

1. Payment:

a. Payment for the actual measured quantity of Weekly Maintenance of the Supplemental Bypass Pumping System While Operated by the Owner shall be made at the Contract Unit Price per Week.
b. The unit price shall constitute full compensation for all labor, supervision, materials, tools, equipment, transportation, maintenance personnel, manufacturer support, replacement parts, lubricants, consumables, preventive maintenance, routine inspections, testing, exercising of standby pumps, emergency response, repair services, administrative costs, and incidentals required to maintain the supplemental bypass pumping system in a fully operational condition throughout the operating period.
c. The unit price shall also include maintaining required service personnel availability, providing 24-hour emergency response, furnishing replacement

equipment as necessary to prevent interruption of service, and performing all maintenance required by the equipment manufacturer.

d. No separate payment will be made for repairs, replacement of failed equipment, standby equipment, maintenance-related mobilization, demobilization, temporary facilities, monitoring required for maintenance activities, or other incidental work required to keep the supplemental bypass pumping system operational by the Owner.

e. Fuel reimbursement is provided as a separate allowance item and shall be paid in accordance with the requirements of that allowance and shall not be included in this bid item.

f. Payment shall be made only for actual measured weeks that the supplemental bypass pump system is operated by the Owner. Estimated quantities not utilized shall not be paid and shall be credited to the Owner.

2. Measurement:

a. Measurement for Weekly Maintenance of the Supplemental Bypass Pumping System While Operated by the Owner shall be based on the actual number of weeks that the supplemental bypass pumping system has been in operation after it has been installed, tested, accepted, placed under Owner control for operation, and maintained in a fully functional condition.

b. A week shall be measured as a consecutive seven-calendar-day period during which the Contractor remains responsible for maintenance, inspection, preventive maintenance, exercising of standby equipment, emergency repairs, replacement of defective equipment, provision of manufacturer's recommended maintenance services, and maintaining the system in compliance with the Contract Documents.

c. Partial weeks at the beginning or end of the operating period shall be measured on a prorated basis.

d. Weeks during which the supplemental bypass pumping system has not been operated, been removed from service permanently, has not been accepted by the Owner, or is unavailable due to deficiencies shall not be measured for payment.

H. Monthly Maintenance of the Supplemental Bypass Pumping System While in Standby (Bid Item 3)

1. Payment:

a. Payment for the actual measured quantity of Monthly Maintenance of the Supplemental Bypass Pumping System While in Standby shall be made at the Contract Unit Price per Month.

b. The unit price shall constitute full compensation for all labor, supervision, materials, tools, equipment, transportation, maintenance personnel, manufacturer support, replacement parts, lubricants, consumables, preventive maintenance, routine inspections, testing, exercising of standby pumps, emergency response, repair services, replacement equipment, administrative costs, and incidentals required to maintain the supplemental bypass pumping system in an immediately available condition throughout the standby period.

c. The unit price shall also include maintaining required service personnel availability, providing 24-hour emergency response, furnishing replacement equipment as necessary to maintain an immediately available service, and performing all maintenance required by the equipment manufacturer.

d. No separate payment will be made for repairs, replacement of failed equipment, standby equipment, maintenance-related mobilization, demobilization, temporary facilities, monitoring required for maintenance activities, or other incidental work required to keep the supplemental bypass pumping system available for Owner use.
e. Payment shall be made only for actual measured months that the supplemental bypass pumping system is in standby. Estimated quantities not utilized shall not be paid and shall be credited to the Owner.

2. Measurement:

a. Measurement for Monthly Maintenance of the Supplemental Bypass Pumping System While in Standby shall be based on the actual number of Months that the supplemental bypass pumping system has been installed, tested, accepted, placed under Owner control for operation, and maintained in a fully functional, ready-for-service condition.
b. A Month shall be measured as a calendar month during which the Contractor remains responsible for maintenance, inspection, preventive maintenance, exercising of standby equipment, emergency repairs, replacement of defective equipment, provision of manufacturer's recommended maintenance services, and maintaining the system in compliance with the Contract Documents.
c. Partial months at the beginning or end of the maintenance period shall be measured on a prorated basis.
d. Months during which the supplemental bypass pumping system has been in operation by the Owner, removed from service permanently, has not been accepted by the Owner, or is unavailable due to deficiencies shall not be measured for payment.

I. Monthly Maintenance and Operation Of The Plant Drain Bypass Pumping System (Bid Item 4)

1. Payment:

a. Payment for the actual measured quantity of Monthly Maintenance and Operation of the Plant Drain Bypass Pumping System shall be made at the Contract Unit Price per Month.
b. The Contract Unit Price shall constitute full compensation for furnishing all labor, supervision, materials, tools, equipment, maintenance personnel, operators, transportation, replacement parts, lubricants, consumables, temporary power, generators, fuel storage facilities, monitoring, inspections, testing, preventive maintenance, corrective maintenance, repairs, replacement of failed equipment, emergency response, manufacturer support, administrative costs, and all incidentals required for complete operation and maintenance of the plant drain bypass pumping system.
c. Payment shall include continuous operation of the plant drain bypass pumping system, routine monitoring, provision of qualified operating personnel, maintenance of required pumping capacity, furnishing and maintaining backup equipment, exercising standby pumps, and performing all manufacturer-recommended maintenance necessary to ensure reliable operation throughout the service period.
d. The Contract Unit Price shall further include all costs associated with emergency repairs, replacement pumps, replacement generators, bypass piping repairs, control

system repairs, mobilization of maintenance personnel, and any other work necessary to maintain uninterrupted plant drain flow conveyance.

e. No separate payment shall be made for maintenance activities, operating personnel, supervision, inspections, repair work, replacement equipment, preventive maintenance, emergency response services, standby equipment, temporary facilities, testing, or other incidental work required to operate and maintain the plant drain bypass pumping system.

f. Payment shall be made only for actual measured months of operation or partial months based on the percent number of days operating per month for more than 14 days per month. Unused estimated quantities shall not be paid and shall be credited to the Owner. This bid item is intended to compensate the Contractor for complete operation and maintenance of the plant drain bypass pumping system for the duration that the system is required to remain in service.

g. Fuel reimbursement is provided as a separate allowance item and shall be paid in accordance with the requirements of that allowance and shall not be included in this bid item.

2. Measurement:

a. Measurement for Monthly Maintenance and Operation of the Plant Drain Bypass Pumping System shall be based on the actual number of Months that the plant drain bypass pumping system has been installed, tested, accepted, placed into operation, and maintained and operated in a fully functional, ready-for-service condition.

b. A Month shall be measured as a calendar month during which the Contractor remains responsible for maintenance, operation, inspection, preventive maintenance, exercising of standby equipment, emergency repairs, replacement of defective equipment, provision of manufacturer's recommended maintenance services, and maintaining the system in compliance with the Contract Documents.

c. Partial months at the beginning or end of the maintenance period shall be measured based on the percent number of days operating per month for more than 14 days per month.

d. Months during which the plant drain bypass pumping system operates for 14 days or, has been removed from service permanently, has not been accepted by the Owner, or is unavailable due to deficiencies shall not be measured for payment.

J. Weekly Maintenance and Operation of the Plant Drain Bypass Pumping System (Bid Item 5)

1. Payment:

a. Payment for the actual measured quantity of Weekly Maintenance and Operation of the Plant Drain Bypass Pumping System shall be made at the Contract Unit Price per Week.

b. The Contract Unit Price shall constitute full compensation for furnishing all labor, supervision, materials, tools, equipment, maintenance personnel, operators, transportation, replacement parts, lubricants, consumables, temporary power, generators, fuel storage facilities, monitoring, inspections, testing, preventive maintenance, corrective maintenance, repairs, replacement of failed equipment, emergency response, manufacturer support, administrative costs, and all incidentals required for complete operation and maintenance of the plant drain bypass pumping system.

c. Payment shall include continuous operation of the plant drain bypass pumping system, routine monitoring, provision of qualified operating personnel, maintenance of required pumping capacity, furnishing and maintaining backup equipment, exercising standby pumps, and performing all manufacturer-recommended maintenance necessary to ensure reliable operation throughout the service period.

d. The Contract Unit Price shall further include all costs associated with emergency repairs, replacement pumps, replacement generators, bypass piping repairs, control system repairs, mobilization of maintenance personnel, and any other work necessary to maintain uninterrupted plant drain flow conveyance.

e. No separate payment shall be made for maintenance activities, operating personnel, supervision, inspections, repair work, replacement equipment, preventive maintenance, emergency response services, standby equipment, temporary facilities, testing, or other incidental work required to operate and maintain the plant drain bypass pumping system.

f. Payment shall be made only for actual measured weeks of operation up to the 14 days of a month based on the number of weeks operating. Unused estimated quantities shall not be paid and shall be credited to the Owner. This bid item is intended to compensate the Contractor for complete operation and maintenance of the plant drain bypass pumping system for the duration that the system is required to remain in service.

g. Fuel reimbursement is provided as a separate allowance item and shall be paid in accordance with the requirements of that allowance and shall not be included in this bid item.

2. Measurement:

a. Measurement for Weekly Maintenance of the Plant Drain Bypass Pumping System While in Standby shall be based on the actual number of Weeks up to the first two weeks of a month that the plant drain bypass pumping system has been installed, tested, accepted, placed into operation, and maintained in a fully functional, ready-for-service condition.

b. A week shall be measured as a consecutive seven-calendar-day period up tot he first two weeks of a month during which the Contractor remains responsible for maintenance, operation, inspection, preventive maintenance, exercising of standby equipment, emergency repairs, replacement of defective equipment, provision of manufacturer's recommended maintenance services, and maintaining the system in compliance with the Contract Documents

c. Partial weeks at the beginning or end of the operating period shall be measured based on the percent number of days operating per week for 14 days or less.

d. Weeks during which the plant drain bypass pumping system has been operated n excess of 14 days, removed from service permanently, has not been accepted by the Owner, or is unavailable due to deficiencies shall not be measured for payment.

K. Removal of Solids From Wet Well (Bid Item 6)

1. Payment:

a. Bid Item 6 shall include furnishing all labor, supervision, equipment, materials, transportation, disposal, permits, testing, health and safety measures, dewatering, cleaning, and incidentals required to remove, handle, transport, and legally dispose

of grit, debris, sediment, sludge, and other accumulated solid materials from the influent pump station wet wells as specified and shown on the Contract Drawings.

b. The Work shall include, but not be limited to, wet well access, confined space entry procedures, collection and removal of deposited materials, loading, hauling, disposal at an approved facility, cleaning of affected surfaces, and restoration of the Work area upon completion. All removed material shall be disposed of in accordance with applicable federal, state, and local regulations.

c. Removal of solids may be required every time a wet well is shut down and emptied as part of the construction sequence.

d. Provisions for temporary bypassing or flow control as required should be included in the Lump Sum Base Bid item (Bid Item 1) described herein.

e. Payment for Bid Item 6 shall be made at the unit price bid per cubic yard for which price and payment shall be full compensation for furnishing all labor, equipment, materials, and incidentals required to remove and dispose of grit and solid materials in the wet wells as needed for construction sequencing.

2. Measurement:

a. Measurement for payment shall be based on the actual quantity of solids removed and disposed of, measured in cubic yards. Quantities shall be determined by field measurements, truck volume records, disposal receipts, or other documentation acceptable to the Owner. No measurement shall be made for water removed with the solids, and compensation for incidental dewatering, handling, transportation, and disposal operations shall be included in the unit price.

L. Partial Depth Concrete Slab Repair (Bid Item 7)

1. Payment: Payment for Bid Item 7 shall be made at the unit price bid per square foot for which price and payment shall be full compensation for furnishing all labor, materials, tools, equipment, transportation, and incidentals required for completing all work involved in partial depth slab repair of spalled/deteriorated concrete in the wet wells, complete in accordance with the Contract Documents and as directed by the Owner and the Engineer.
2. Measurement: Area of partial depth slab repair shall be based upon actual measured lengths in the field.

M. Partial Depth Concrete Wall Repair (Bid Item 8)

1. Payment: Payment for Bid Item 8 shall be made at the unit price bid per square foot for which price and payment shall be full compensation for furnishing all labor, materials, tools, equipment, transportation, and incidentals required for completing all work involved in partial depth wall repair of spalled/deteriorated concrete in the wet well, complete in accordance with the Contract Documents and as directed by the Owner and the Engineer.
2. Measurement: Area of partial depth wall repair shall be based upon actual measured lengths in the field.

N. Concrete Beam Repair (Bid Item 9)

1. Payment: Payment for Bid Item 9 shall be made at the unit price bid per square foot for which price and payment shall be full compensation for furnishing all labor, materials,

tools, equipment, transportation, and incidentals required for completing all work involved in beam repair of spalled/deteriorated concrete in the wet wells, complete in accordance with the Contract Documents and as directed by the Owner and the Engineer.

2. Measurement: Area of beam repair shall be based upon actual measured lengths in the field.

O. Concrete Column Repair (Bid Item 10)

1. Payment: Payment for Bid Item 10 shall be made at the unit price bid per square foot for which price and payment shall be full compensation for furnishing all labor, materials, tools, equipment, transportation, and incidentals required for completing all work involved in column repair of spalled/deteriorated concrete in the wet wells, complete in accordance with the Contract Documents and as directed by the Owner and the Engineer.
2. Measurement: Area of column repair shall be based upon actual measured lengths in the field.

P. Concrete Crack Injection Repair (Bid Item 11)

1. Payment: Payment for Bid Item 11 shall be made at the unit price bid per linear foot for which price and payment shall be full compensation for furnishing all labor, materials, tools, equipment, transportation, and incidentals required for completing all work involved in crack injection repair of cracked concrete in the wet wells, complete in accordance with the Contract Documents and as directed by the Owner and the Engineer.
2. Measurement: Length of crack repair shall be based upon actual measured lengths in the field.

Q. Disposal Of Hazardous Building Materials (Bid Item 12)

1. Payment:

a. Payment for Bid Item 12 shall consist of furnishing all labor, equipment, materials, transportation, permits, fees, manifests, testing coordination, and incidentals necessary for the off-site transportation and final disposal of hazardous building material (HBM) waste generated under the Contract, including but not limited to asbestos-containing materials, lead-contaminated waste, universal waste, and other regulated waste streams identified in the Contract Documents.

b. All hazardous building material abatement, removal, disturbance controls, containment, worker protection, packaging, labeling, stockpiling, temporary storage, waste characterization, and related requirements specified in Sections 028200, 028300, 028310, 028700, and other applicable Contract Documents shall be included in the Base Bid (Bid Item 1) and shall not be paid for under this Bid Item. This Bid Item is strictly limited to the transportation and disposal of HBM waste that has been generated and packaged as part of the Base Bid Work.

c. The Contractor shall dispose of all HBM waste at properly licensed and permitted facilities in accordance with all applicable Federal, State, and local regulations and shall furnish all required manifests, bills of lading, disposal receipts, certificates of disposal, and related documentation.

d. Payment for Disposal of Hazardous Building Materials shall be made at the Contract Unit Price per cubic yard. The Unit Price shall constitute full compensation for all labor, equipment, transportation, hauling, disposal facility fees, tipping fees, permits, manifests, certificates of disposal, regulatory

compliance, and all other incidentals required for the lawful off-site disposal of HBM waste.

2. Measurement:

a. Measurement for payment shall be based on the actual volume of hazardous building material waste transported off-site and accepted for disposal, measured in cubic yards (CY).
b. The measured quantity shall be the volume of HBM waste documented by disposal manifests, disposal facility tickets, transporter records, container measurements, or other records acceptable to the Engineer. No separate measurement shall be made for abatement activities, containment systems, worker protection, packaging materials, waste characterization, stockpiling, loading, handling, temporary storage, transportation to transfer stations, testing, permits, or administrative requirements associated with generating the waste, as these costs shall be included in the Base Bid.

1.6 TOTAL BID

A. A single total bid will be issued to the designated Contractor.

1.7 PAYMENT, PARTS I AND II

A. Payment of the total price bid in the Form for General Bid shall fully compensate the Contractor for furnishing all labor, materials, equipment and incidentals required to complete the work as outlined above and under Section 011000. Payment shall also include compensation for all other work required to complete the Project as described in the Contract Documents and not specifically mentioned under Lump Sum.

1.8 EXTRA WORK

A. Extra work, if any, will be performed in accordance with Article XXII of the Agreement.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012001

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SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Contingency allowances.
2. Testing and inspecting allowances.

C. Related Requirements:

1. Section 012600 “Contract Modification Procedures” for procedures for submitting and handling Change Orders.
2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Engineer of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Engineer from the designated supplier.

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1.5 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Engineer for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.8 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of testing and inspection services not specifically required by the Contract Documents are Contractor responsibilities and not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

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1.9 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance for Laboratory Testing And Specialty Inspections (Bid Item 13): Testing and Inspection Allowance to be used only as authorized by the Owner for laboratory testing,

analytical services, environmental sampling, specialty inspections, and related professional services.

1. The Allowance may be utilized for services including, but not limited to:

    a. Hazardous building material waste characterization and disposal-related testing.
    b. TCLP and other waste classification analyses required for transportation and disposal of regulated materials.
    c. Environmental sampling, monitoring, and analytical laboratory services associated with hazardous building materials, asbestos-containing materials, lead-containing materials, universal waste, or other regulated waste streams.
    d. Specialty inspection and testing services required to verify compliance with Contract requirements.
    e. Structural, concrete, welding, coatings, electrical, mechanical, or other specialty inspections.
    f. Third-party inspections, evaluations, reports, and testing necessary to document construction quality, regulatory compliance, or acceptance of the Work.
    g. Retesting or additional investigation directed by the Owner where existing conditions differ from those anticipated in the Contract Documents

2. Payments from the Allowance shall be based upon the actual cost of approved laboratory testing, analytical services, specialty inspections, and related professional services. Any portion of the Allowance not utilized at the completion of the Work shall be credited to the Owner. Any work performed by the Contractor in support of testing and inspection activities, including scheduling, coordination, access, protection of work, and corrective work resulting from failed tests, shall be considered incidental to the Contract and shall not be paid from this Allowance unless specifically authorized by the Owner.
3. Any portion of the Allowance that is not utilized during the Contract shall remain the property of the Owner and shall be credited to the Owner through the final Contract adjustment.

B. Allowance for Bridge Crane Repairs **(**Bid Item 14): Contingency Allowance for Bridge Crane Repairs:

1. This Contingency Allowance shall be used only as directed and authorized by the Owner for bridge crane repairs, replacement parts, specialty services, and related work necessary to restore or maintain operation of the existing bridge crane systems. Payment shall be based on actual authorized costs for repairs, modifications, replacement parts, and related services associated with the existing bridge crane systems.
2. The Allowance may be utilized for work identified as necessary as a result of verifying its load capacity and operability in accordance with the supplemental conditions of the Contract and may include:

    a. Repair or replacement of worn, damaged, deteriorated, or non-functional bridge crane components.
    b. Repairs to crane bridge assemblies, trolleys, hoists, drives, motors, brakes, controls, electrical components, festoon systems, conductors, and associated equipment.
    c. Replacement of cables, hooks, sheaves, bearings, limit switches, contactors, control stations, and other crane appurtenances.

d. Electrical troubleshooting, testing, calibration, and corrective work required to return the crane to proper operation.
e. Structural repairs or modifications to crane support components, rails, connections, or related elements.
f. Manufacturer, supplier, or specialty contractor services required for repairs, adjustments, startup, operational testing, and certification.
g. Procurement of replacement parts, materials, equipment rentals, and incidental items necessary to complete authorized crane repairs.

3. Inspection, certification, load testing, and verification required by the Supplementary Conditions before the Contractor uses the crane are incidental to the Contract and not payable from the Allowance. The Bridge Crane Repair Allowance is reserved for Owner-directed repairs, replacement parts, specialty contractor services, or corrective work identified during those inspections that the Owner elects to fund through the allowance.
4. Any portion of the Allowance that is not utilized during the Contract shall remain the property of the Owner and shall be credited to the Owner through the final Contract adjustment.

C. Allowance for Fueling Of Temporary Systems (Bid Item 15): This Contingency Allowance is established to provide reimbursement to the Contractor for actual documented cost of eligible fuel purchases, as approved by the Owner.

1. Payment shall constitute reimbursement of the Contractor's actual invoiced fuel costs only. No overhead, profit, administrative costs, markup, handling charges, contingency, escalation factor, or other additions shall be applied to the reimbursable fuel cost.
2. The Contractor shall submit copies of all invoices, delivery tickets, receipts, and supporting documentation with each payment request. Reimbursement shall be limited to the actual quantities and costs shown on the supporting documentation and approved by the Owner.
3. The Allowance amount stated in the Bid Form is an estimated quantity established for bidding purposes only and does not guarantee the amount of fuel that will be required during the Work. Payment shall be based solely on actual documented fuel costs incurred. Any unused portion of the Allowance shall remain with the Owner and shall not be paid to the Contractor.
4. The Contractor shall include all costs associated with procurement, handling, storage, fueling operations, fuel management, recordkeeping, and administration of the fuel program within the bid prices for other Contract items. No separate payment shall be made for such activities.
5. Reimbursement shall be based on the actual quantity of fuel furnished and consumed for operation of temporary systems required under the Contract, including but not limited to temporary bypass pumping systems, standby pumping equipment, temporary generators, and other approved temporary equipment.
6. Measurement shall be based on actual documented fuel purchases supported by paid invoices, delivery tickets, receipts, and other records acceptable to the Owner. Documentation shall identify the date of purchase, fuel type, quantity, unit cost, total cost, and the temporary system for which the fuel was utilized.
7. Only fuel reasonably required for the operation of approved temporary systems and consumed during performance of the Work shall be eligible for reimbursement. Fuel purchases in excess of actual project requirements, fuel used for Contractor vehicles or construction equipment not identified as temporary systems, and undocumented fuel expenses shall not be measured for payment.

D. Allowance for Miscellaneous Additional Work (Bid Item 16): This Contingency Allowance is established to provide funding for additional work that may be required during construction and is not otherwise included in the Contract Documents or compensated under other Bid Items, Allowances, Unit Price Items, or provisions of the Contract. This Allowance is intended to address both Owner-directed additional work and work required to investigate, accommodate, mitigate, modify, repair, or otherwise address unforeseen conditions encountered during performance of the Work.

1. The Allowance may be utilized, upon written authorization by the Owner or Engineer, for furnishing all labor, materials, equipment, subcontractors, transportation, permits, temporary facilities, professional services, and incidentals necessary to perform additional work beyond that specifically identified in the Contract Documents.
2. Eligible work may include, but is not limited to:

    a. Modifications to the Work directed by the Owner or Engineer.
    b. Supplemental repairs or construction activities.
    c. Installation of additional materials or equipment.
    d. Changes required to accommodate field conditions.
    e. Investigation and remediation of concealed or unknown conditions.
    f. Unanticipated deterioration of existing facilities.
    g. Conflicts with existing utilities, structures, or site features.
    h. Undisclosed subsurface, structural, mechanical, electrical, operational, or site conditions.
    i. Other work determined by the Owner to be necessary and in the best interest of the Project.

3. No expenditures shall be made against this Allowance without prior written authorization from the Owner or Engineer.
4. The Allowance shall not be used for:

    a. Work otherwise required by the Contract Documents.
    b. Work reasonably inferable from the Contract Documents.
    c. Work necessary to complete the Work as specified.
    d. Work resulting from the Contractor's means and methods.
    e. Corrective work required due to defective workmanship or nonconforming work.
    f. Work resulting from the Contractor's failure to properly investigate, coordinate, schedule, or perform the Work.

5. Payments from this Allowance shall be based on the actual cost of Owner-authorized work and shall be processed in accordance with the Contract requirements.
6. The Contractor shall provide such documentation as the Owner may require to substantiate payment requests, including but not limited to labor records, equipment records, material invoices, subcontractor invoices, delivery tickets, quotations, and other supporting cost documentation.
7. Any portion of the Allowance not utilized during construction shall remain the property of the Owner and shall be credited to the Owner through the final Contract adjustment

END OF SECTION 012100

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

A. Engineer will issue through Construction Manager Field Orders authorizing minor changes in the Work, not involving adjustment to the Contract Price or the Contract Time, on EJCDC Form C-942 or other form acceptable to Owner.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Construction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Price or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Requests For Proposal (RFP) issued by Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 5 days after receipt of RFP, submit a quotation estimating adjustments to the Contract Price and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    e. Quotation Form: Use forms acceptable to Engineer.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Price and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Proposal Request Form: Use form acceptable to Engineer.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Change Order Request, Construction Manager will issue a Change Order for signatures of Owner and Contractor on EJCDC Form C-941 or other form acceptable to Owner.

1.6 WORK CHANGE DIRECTIVE

A. Work Change Directive: Construction Manager may issue a Work Change Directive on EJCDC Document C-940 or other form acceptable to Owner. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Price or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Engineer through Construction Manager at earliest possible date, but no later than ten days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Owner’s name.
c. Owner’s Project number.

d. Name of Engineer.
e. Engineer's Project number.
f. Contractor's name and address.
g. Date of submittal.

2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

a. Related Specification Section or division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

1) Labor.
2) Materials.
3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
5. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
6. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
7. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
8. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct coat of actual work-in-place as separate line items.
9. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
11. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

C. Include a breakdown of the following specific items in the Schedule of Values.

1. Total and monthly cost for General Conditions inclusive of project management and coordination, progress documentation, submittals, delegated design services, maintenance of general temporary facilities, and construction waste management.
2. Total and monthly cost associated with storage and maintenance of Owner pre-purchased valves and actuators.
3. Total and monthly cost associated with maintenance and storage of pumps, motors, and drives.
4. Total and monthly cost associated with rental of bypass pumping systems.
5. Cost associated with commissioning of the complete influent pumping system.
6. Cost associated with all delegated design items including but not limited to:

    a. Groundwater control for suction elbow demolition
    b. Temporary Bypass Pumping Systems
    c. Aluminum Handrails and Railings
    d. Hangers and Supports for Plumbing Piping and Equipment
    e. Hangers and Supports for HVAC Piping and Equipment
    f. Vibration Controls for HVAC
    g. Direct Digital Control (DDC) System for HVAC
    h. Control Valves
    i. Control Dampers
    j. Hydronic Piping
    k. Steam and Condensate Heating Piping
    l. Metal Ducts
    m. HVAC Power Ventilators
    n. Outdoor, Semi-Custom Air-Handling Units
    o. Hangers and Supports for Electrical Systems
    p. Addressable Fire-Alarm Systems
    q. Spray-in-Place Polymeric Pipe Lining
    r. Couplings, Adapters, and Specials for Process Piping
    s. Hangers and Supports for Process Piping
    t. Common Requirements for Process Valves
    u. Stainless Steel Slide Gates
    v. Hot-Tapping Valves and Line Stops
    w. End Suction Solids Handling Pumps – base anchorage.
    x. Forming, shoring and bracing
    y. Metal fabrications and anchorage
    z. Pre-engineered aluminum stairs
    aa. Roof specialties
    bb. Power System Studies
    cc. Temporary bulkheads
    dd. Mechanical Pipe Plugs
    ee. Inflatable Pipe Plugs
    ff. Any and all other temporary facilities.

7. Cost associated with dewatering of the East and West Wet Wells beyond a depth of 9-ft.

D. Should an item in the scope of work be deleted from the contract during construction it shall be credited to the Owner for the amount recorded in the Schedule of Values.

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1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and Construction Manager and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Engineer monthly. The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Engineer.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Maintain an updated set of drawings to be used as record drawings in accordance with Section 017839 “Project Record Documents.” As a prerequisite for monthly progress payments, exhibit the updated record drawings for review by Owner and Engineer for completeness and accuracy.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule.
4. Combined Contractor's construction schedule incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Sustainable design action plans, including preliminary project materials cost data.
7. Schedule of unit prices.
8. Submittal schedule.
9. List of Contractor's staff assignments.
10. List of Contractor's principal consultants.
11. Copies of building permits.
12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
13. Initial progress report.
14. Report of preconstruction conference.

I. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work proceeding this application, as described in Section 017700 “Closeout Procedures.”

2. Include initial submittal of closeout record drawings in accordance with Section 017839 “Project Record Documents.”
3. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.

4. Final submittal of closeout record drawings in accordance with Section 017839 “Project Record Documents.”
5. Updated final statement, accounting for final changes to the Contract Sum.
6. AIA Document G706.
7. AIA Document G706A.
8. AIA Document G707.
9. Evidence that claims have been settled.
10. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
11. Final liquidated damages settlement statement.
12. Proof that taxes, fees, and similar obligations are paid.
13. Waivers and releases.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Construction Manager, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in each built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination of Multiple Contracts: Each contractor shall cooperate with Project coordinator, who shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and direction of Project coordinator to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of

visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Engineer will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make suitable modifications and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.

3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Engineer to review and resolve conflicts on the coordination drawings.

D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format:

    a. DWG, Version AutoCAD 2023, operating in Microsoft Windows operating system.

2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and PDF format.
3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.

    a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Engineer.

4. Engineer will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

    a. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    b. Digital Data Software Program: Drawings are available in AutoCAD 2023.
    c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.

2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Engineer and Construction Manager.
5. Engineer's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Engineer.

1. Attachments shall be electronic files in PDF format.

D. Engineer's and Construction Manager's Action: Engineer and Construction Manager will review each RFI, determine action required, and respond. Allow fourteen days for Engineer's response for each RFI. RFIs received by Engineer or Construction Manager after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Engineer's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer or Construction Manager of additional information.
3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer and Construction Manager in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Engineer and Construction Manager.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Engineer's and Construction Manager's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

F. On receipt of Engineer's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer and Construction Manager within three days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Engineer's Digital Data Files: Digital data files of Engineer's BIM model and CAD drawings will be provided by Engineer for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Autodesk Revit 2023 and AutoCAD 2023, operating in Microsoft Windows operating system.
4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

    a. Subcontractors and other parties granted access by Contractor to Engineer's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Engineer.

B. Web-Based Project Management Software Package: Provide, administer, and useweb-based Project management software package for purposes of hosting and managing Project

communication and documentation until Final Completion. General Contractor shall be responsible for the full cost for the project team including costs for Owner, Engineer, Contractor, subcontractors and suppliers.

1. Web-based Project management software includes, at a minimum, the following features:

    a. Compilation of Project data, including Contractor, subcontractors, Engineer, Engineer's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.
    f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    g. Processing and tracking of payment applications.
    h. Processing and tracking of contract modifications.
    i. Creating and distributing meeting minutes.
    j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    k. Management of construction progress photographs.
    l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner, Construction Manager, Engineer, and Engineer's consultants. Provide eight hours of software training at Engineer's office for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Engineer. Provide data in locked format to prevent further changes.
4. Provide one of the following web-based Project software packages under their current published licensing agreements:

    a. Autodesk; Construction Cloud.
    b. Corecon Technologies, Inc.
    c. Meridian Systems; Prolog.
    d. Newforma, Inc.
    e. Procore Technologies, Inc.
    f. Viewpoint, Inc.; Viewpoint for Project Collaboration.

C. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times a minimum of five days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Engineer, within three days of the meeting.

B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Construction Manager, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Responsibilities and personnel assignments.
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long lead items.
e. Designation of key personnel and their duties.
f. Lines of communications.
g. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Sustainable design requirements.
o. Preparation of Record Documents.
p. Use of the premises and existing building.
q. Work restrictions.
r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.

y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.
dd. List of major subcontractors and suppliers.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer, Construction Manager of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Construction Manager will schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than 21 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Construction Manager, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

    a. Preparation of Record Documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Procedures for completing and archiving web-based Project software site data files.
    d. Submittal of written warranties.
    e. Requirements for completing sustainable design documentation.
    f. Requirements for preparing operations and maintenance data.
    g. Requirements for delivery of material samples, attic stock, and spare parts.
    h. Requirements for demonstration and training.
    i. Preparation of Contractor's punch list.
    j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    k. Submittal procedures.
    l. Coordination of separate contracts.
    m. Owner's partial occupancy requirements.
    n. Installation of Owner's furniture, fixtures, and equipment.
    o. Responsibility for removing temporary facilities and controls.
    p. Final cleaning.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Construction Manager will conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Construction Manager, and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) Status of sustainable design documentation.
        6) Deliveries.
        7) Off-site fabrication.
        8) Access.
        9) Site use.
        10) Temporary facilities and controls.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of correction of deficient items.
        14) Field observations.
        15) Status of RFIs.
        16) Status of Proposal Requests.
        17) Pending changes.
        18) Status of Change Orders.
        19) Pending claims and disputes.
        20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Section 014000 “Quality Requirements” for schedule of tests and inspections.
2. Section 012900 “Payment Procedures” for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.
3. Two paper copies, of sufficient size to display entire period or schedule, as required.

B. Startup construction schedule.

1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, latest allowable start date, latest allowable finish date, status (where critical) and total float and free float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.

2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Unusual Event Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Engineer's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing work stages area separations interim milestones and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.
12. Submit at this conference a preliminary network defining the planned operation during the first 60 calendar days after the Notice to Proceed.

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1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Program Description

1. A Critical Path Method (CPM) construction schedule shall be used to control the Work and to provide a basis for determining job progress. The construction schedule shall be prepared and maintained by the Contractor. All work shall be done in accordance with the established CPM schedule. The Contractor and all subcontractors shall cooperate fully in developing the construction schedule and in executing the work in accordance with the CPM schedule.
2. The construction schedule shall consist of a computerized CPM network (diagram of activities) presented in a time-scaled graphic (print-out) with reports, as specified herein.

B. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Use Primavera P6 software for current Windows operating system.

C. Qualifications:

1. The Contractor shall have the capability of preparing and utilizing the specified CPM schedule, or engage the services of a specialized scheduling professional to do so. Within seven days of the award of contract, provide a résumé or qualifications statement for the individual within the Contractor's organization, or the outside consultant, who is being proposed as the responsible party for development and maintenance of the CPM schedule. The résumé or qualifications statement shall demonstrate that the proposed responsible party has successfully developed and maintained CPM schedules for at least three construction projects of the same size or greater than this project. The proposed responsible party for the CPM schedule is subject to approval by the Construction Manager and Owner. If the proposed responsible party for the CPM schedule is not approved by the Construction Manager and/or Owner, Contractor shall resubmit a more-appropriate candidate for approval.

D. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

E. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
2. Activities to facilitate the Work: Indicate start and completion dates for the following as applicable:

    a. Securing of approvals and permits required for performance of the Work.
    b. Temporary facilities.
    c. Construction of mock-ups, prototypes and samples.
    d. Owner interfaces and furnishing of items.
    e. Interfaces with Separate Contracts.
    f. Regulatory agency approvals.
    g. Punch list.

3. Procurement Activities: Include procurement process activities for long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Commissioning Time: Include no fewer than 15 days for commissioning.
7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

F. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use-of-premises restrictions.

f. Provisions for future construction.
g. Seasonal variations.
h. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

a. Subcontract awards.
b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.
n. Commissioning.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

G. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

H. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

I. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

J. Acceptability

1. Submit the CPM schedule submittals, as specified, and resubmit as needed, until they are in compliance with Contract requirements.
2. The Construction Manager's review of the Contractor's construction schedule submittals will only be for conformance with the Contract requirements – including but not limited to contract time and work sequences specified in the contract documents. The Construction Manager's review of the schedule shall not include the Contractor's means and methods of construction or safety. The Construction Manager's concurrence, acceptance, or approval of the Contractor's schedule submittals will not relieve the Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of the Contractor's schedule will only indicate a general conformance with the Contract Requirements.
3. Construction Manager's review of the Contractor's construction schedule submittals shall not relieve the Contractor from responsibility for any deviations from the Contract Documents unless the Contractor has in writing called Construction Manager's attention to such deviations at the time of submission and Construction Manager has given written concurrence to the specific deviations, nor shall any concurrence by the Construction Manager relieve Contractor from responsibility for errors and omissions in the submittals. Concurrence of the CPM Activity Network by the Construction Manager is advisory only and shall not relieve the Contractor of responsibility for accomplishing the Work within the Contract completion date(s).
4. Concurrence, acceptance, or approval of the Contractor's CPM schedule by the Construction Manager in no way makes the Construction Manager an insurer of the CPM schedule's success, nor liable for time or cost overruns resulting therefrom.
5. Failure to include any element of work required for the performance of this Contract will not excuse the Contractor from completing all Work required within the Contract completion date(s), notwithstanding the review of the network by the Construction Manager.
6. CPM schedules that contain activities with negative float, or which extend beyond the contract completion date, will not be acceptable.
7. Except where earlier completions are specified, CPM schedules which show completion of all work prior to the contract completion date may be indicated; however, in no event shall they constitute a basis for claim for delay by the Contractor.

K. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity. Activities shall not be considered to be complete until they are in fact 100 percent complete.
4. Submit a narrative report based on the CPM schedule evaluation, in a format agreed upon by the Contractor and the Construction Manager. The report shall include a description of the progress during the previous period in terms of completed activities, an explanation of

each activity which is showing a delay, a description of problem areas, current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates and an explanation of corrective action taken or proposed.

L. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

M. The contract completion time will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of any contract completion date, the Contractor shall furnish such justification and supporting evidence as the Construction Manager may deem necessary to determine whether the Contractor is entitled to an extension of time under the provisions of this Contract. The Construction Manager will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If the Construction Manager finds that the Contractor is entitled to any extension of any contract completion date, the Construction Manager's determination as to the total number of days extension shall be based upon the currently approved CPM schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule. Actual delays in activities which, according to the CPM schedule, do not affect any contract completion date shown by the critical path in the network will not be the basis for a change therein.

N. Distribution: Distribute copies of approved schedule to, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.10 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.

a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

a. Preparation and processing of submittals.
b. Mobilization and demobilization.
c. Purchase of materials.
d. Delivery.
e. Fabrication.
f. Utility interruptions.
g. Installation.
h. Work by Owner that may affect or be affected by Contractor's activities.
i. Testing and inspection.
j. Commissioning.

k. Punch list and Final Completion.
l. Activities occurring following Final Completion.
m. Maintenance of existing facilities.
n. Contract milestones.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Engineer's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.

   a. Each activity cost shall reflect an appropriate value subject to approval by Engineer.
   b. Total cost assigned to activities shall equal the total Contract Sum and align with the Schedule of Values.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.11 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Work Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Aerial and preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final Completion construction photographs.
5. Preconstruction video recordings.
6. Periodic construction video recordings.
7. Construction webcam.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
4. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
5. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos on CD-ROM or thumb-drive or by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based Project management software site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer and Construction Manager.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

C. Printed Photographs (Aerial and Land-based): Submit two sets of prints of each photographic view within seven days of taking photographs.

1. Format: 8-by-10-inchsmooth-surface matte prints on single-weight, paper; enclosed back to back in clear plastic sleeves punched for three-ring binder. Include copy of key plan indicating each photograph's location and direction. Provide one binder for each set of prints.
2. Identification: On back of each print, label with the following information:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer and Construction Manager.
d. Name of Contractor.
e. Date photograph was taken if not date stamped by camera.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
g. Unique sequential identifier keyed to accompanying key plan.

D. Video Recordings: Submit video recordings within seven days of recording.

1. Submit video recordings by uploading to web-based Project management software site. Include copy of key plan indicating each video's location and direction.
2. Identification: With each submittal, provide the following information in file metadata tag:

a. Name of Project.
b. Name and address of photographer.
c. Name of Engineer and Construction Manager.
d. Name of Contractor.
e. Date video recording was recorded.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

3. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy duty, three-ring vinyl covered binders. Provide label on front and spine. Include a cover sheet with label information. Include name of Project and date of video recording on each page.

E. Time-Lapse Video: Submit time-lapse sequence video recordings within 7 days of recording.

1. Submit time-lapse sequence video recordings monthly by uploading to web-based Project management software site.
2. Identification: For each recording, provide the following information in file metadata tag:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer and Construction Manager.
d. Name of Contractor.
e. Date(s) and time(s) video recording was recorded.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

B. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with a record of providing satisfactory services similar to those required for Project.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.

C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

D. Metadata: Record accurate date and time and GPS location data from camera.

E. File Names: Name media files with date Project area and sequential numbering suffix.

F. Usage Rights

1. Obtain and transfer copyright usage rights from photographer and videographer to Owner for unlimited reproduction of photographic and videographic documentation.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Construction Manager.

1. Flag construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.

E. Periodic Construction Photographs: Take 20 photographs weekly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Time-Lapse Sequence Construction Photographs: Take 20 photographs as indicated, to show status of construction and progress since last photographs were taken.

1. Frequency: Take photographs monthly, on the same date each month.
2. Vantage Points: Following suggestions by Construction Manager and Contractor, photographer shall select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time, to create a time-lapse sequence as follows:

    a. Commencement of the Work, through completion of subgrade construction.
    b. Above-grade structural framing.
    c. Exterior building enclosure.
    d. Interior Work, through date of Substantial Completion.

G. Final Completion Construction Photographs: Take at least 100 photographs after date of Substantial Completion for submission as Project Record Documents. Construction Manager will inform photographer of desired vantage points.

H. Additional Photographs: Engineer or Construction Manager may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.

3. Circumstances that could require additional photographs include, but are not limited to, the following:

    a. Special events planned at Project site.
    b. Immediate follow-up when on-site events result in construction damage or losses.
    c. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    d. Substantial Completion of a major phase or component of the Work.
    e. Extra record photographs at time of final acceptance.
    f. Owner's request for special publicity photographs.

1.7 CONSTRUCTION VIDEO RECORDINGS

A. Video Recording Photographer: Engage a qualified videographer with not less than three years' experience to record construction video recordings.

B. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.

C. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from video recording opposite the corresponding narration segment.

D. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Construction Manager.

1. Flag construction limits before recording construction video recordings.
2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
4. Show protection efforts by Contractor.

E. Periodic Construction Video Recordings: Record video recording monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be 30 minutes(s).

1.8 CONSTRUCTION WEBCAM

A. Webcam: Provide two fixed-location camera(s) with weatherproof housing, mounted to provide unobstructed view of construction site from location approved by Engineer, with the following characteristics:

1. Static view.
2. Capable of producing minimum 12 megapixel images.
3. Provide mounting, power supply, active high-speed data connection to service provider's network, and static public IP address for each camera.

B. Live Streaming Images: Provide web-accessible image of current site image, updated at five-minute intervals when construction is underway.

C. Web-Based Interface: Provide online interface to allow viewing of each high-definition digital still image captured and stored during construction, from the Internet.

1. Access Control: Provide password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
2. Software: Provide responsive software interface for use on computer, tablet, and mobile screen with accompanying iPhone/iPad app and Android apps.
3. Storage: Maintain images on the website for reference during entire construction period, and for not less than 30 days after Final Completion. Provide sufficient memory on remote server to store all Project images.
4. Online Interface: Provide website interface with Project and client information and logos, calendar-based navigation interface for selecting images, and pan and zoom capability within high-definition images.
5. Forward and Reverse: Provide capability to browse through images, moving forward and backward in time by individual image and by day.
6. Slideshow: Provide capability to automatically display current images from sites when there are three or more cameras used.
7. Time-Lapse: Provide capability for online display of project time-lapse.
8. Dashboard: Provide capability to view thumbnails of all cameras on one screen.
9. Weather: Provide corresponding weather data for each image captured.
10. Provide public viewer open access to most recent Project camera image.

D. Maintain cameras and web-based access in good working order, according to web-based construction photographic documentation service provider's written instructions until Final Completion. Provide for service of cameras and related networking devices and software.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's and Construction Manager's responsive action. Submittals may be rejected

for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Mass Submittals: Six or more submittals or items in one day or 15 or more submittals or items in one week.

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Engineer's and Construction Manager's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

5. Action and information submittals required of the Contractor as part of this contract include but are not limited to the items identified in the attached submittal list. Note that this list is not comprehensive and may not reflect all anticipated Contractor submittals. This list also does not reflect where subdivision or supplement of submittals may be necessary.

1.5 SUBMITTAL FORMATS

A. Numbering System: Utilize the following example submittal identification numbering system to identify submittals and as file names for PDF submissions:

1. First Identifier - Alphabet Character: D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
2. Second Identifier - Next 6 or 8 Digits: Applicable Specification Section Number. Do not mix submittals from different specification sections into a single submittal.
3. Third Identifier - Next Three Digits: Sequential number of each separate item or drawing submitted under each Specification Section, in chronological order submitted, starting at 001.
4. Fourth Identifier - Last Alphabet Character: A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.
5. EXAMPLE: D-033000.13-008-B.

    a. D = Shop Drawing.
    b. 03 30 00.13 = Section; use only 6 digits for sections that do not include 8 digits.
    c. 008 = the eighth different submittal under this Section.
    d. B = the second submission (first resubmission) of that particular shop drawing.

B. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

C. Options: Identify options requiring selection by Engineer.

D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer and

Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

E. Paper Submittals:

1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer and Construction Manager.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Engineer, through Construction Manager, will return one copies.
4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Engineer and Construction Manager will not return copies.
5. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer or Construction Manager observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
6. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using Contractor’s transmittal form.

F. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

G. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.

    a. Engineer, through Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
3. Paper: Prepare submittals in paper form and deliver to Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Construction Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals. Further, no extension of the Contract Time will be authorized should more than a single resubmittal (excessive review cycles) be required due to Contractor’s failure to address comments or provide adequate information.

1. Initial Review: Allow 30 days for initial review of each submittal (and 45 days for multi-discipline reviews). Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Engineer and to Engineer's consultants, allow 30 days for review of each submittal. Submittal will be returned to Construction Manager, through Engineer, before being returned to Contractor.

    a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer and Construction Manager.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Engineer's and Construction Manager's action stamp.
4. Repetitive Reviews: Shop drawings, O&M manuals, and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's and Construction Manager's action stamp.

G. Excessive Review Cycles: No extension of the Contract Time will be authorized should more than a single resubmittal (excessive review cycles) be required due to Contractor's failure to address comments or provide adequate information. The Contractor will be responsible to reimburse the Owner for additional Engineering review time, in excess of two review cycles, based on an Engineer's review rate of $200 per hour.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
    e. Maintenance and lubrication schedules.
    f. Storage requirements.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Engineer's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.

c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches .

a. Two opaque (bond) copies of each submittal. Engineer, through Construction Manager, will return one copy(ies).
b. Three opaque copies of each submittal. Engineer and Construction Manager will retain two copies; remainder will be returned.

3. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer, through Construction Manager, will return submittal with options selected.

8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Engineer and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

2. Contractor’s Certification: Each shop drawing, working drawing, product data, and sample shall have affixed to it the following Certification Statement:

    a. "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements. "

3. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
4. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
5. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
6. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
7. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.

e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.

1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

D. Professional design services or certifications by a design professional required of the Contractor as part of this contract include but are not limited to the following. Note that this list is not comprehensive and may not reflect all delegated design services required as part of the Contract Documents.

1. Groundwater control design and procedures
2. Temporary Bypass Pumping Systems
3. Aluminum Handrails and Railings
4. Hangers and Supports for Plumbing Piping and Equipment
5. Hangers and Support for HVAC Piping and Equipment
6. Vibration Controls for HVAC
7. Direct Digital Control (DDC) System for HVAC
8. Control Valves
9. Control Dampers
10. Hydronic Piping
11. Steam and Condensate Heating Piping
12. Metal Ducts
13. HVAC Power Ventilators
14. Outdoor, Semi-Custom Air-Handling Units
15. Hangers and Supports for Electrical Systems
16. Addressable Fire-Alarm Systems
17. Spray-in-Place Polymeric Pipe Lining

18. Couplings, Adapters, and Specials for Process Piping
19. Hangers and Supports for Process Piping
20. Common Requirements for Process Valves
21. Stainless Steel Slide Gates
22. Hot-Tapping Valves and Line Stops
23. End Suction Solids Handling Pumps – base anchorage.
24. Forming, shoring and bracing
25. Metal fabrications and anchorage
26. Pre-engineered aluminum stairs
27. Roof specialties
28. Power System Studies
29. Temporary bulkheads
30. Mechanical Pipe Plugs
31. Inflatable Pipe Plugs
32. Other temporary facilities.

1.9 PROPOSED PRODUCT LIST

A. Within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.10 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer and Construction Manager.

B. Contractor Responsible for:

1. Determination and verification of materials including manufacturer’s catalog numbers.
2. Determination and verification of field measurements and field construction criteria.
3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
4. Determination of accuracy and completeness of dimensions and quantities.
5. Confirmation and coordination of dimensions and field conditions at Site.
6. Construction means, techniques, sequences, and procedures.
7. Safety precautions.
8. Coordination and performance of Work of all trades.
9. Other requirements enumerated in Contract Documents.

C. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Engineer and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ENGINEER'S AND CONSTRUCTION MANAGER'S REVIEW

A. Do not make mass submittals to Engineer. If mass submittals are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review mass submittals based on priority determined by Engineer after consultation with Owner and Construction Manager.

B. Action Submittals: Engineer and Construction Manager will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Engineer and Construction Manager will indicate, via markup on each submittal, the appropriate action.

C. Informational Submittals: Engineer and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer and Construction Manager will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer and Construction Manager.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Engineer and Construction Manager will return without review submittals received from sources other than Contractor.

G. Submittals not required by the Contract Documents will be returned by Engineer without action.

H. Shop drawings will be returned to the Contractor with the codes listed in Section 007223 “General Conditions”

1.12 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.

B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:

1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.

3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

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Table 1: Submittal List

Spec Section	Spec Name	Description
005213	Agreement	1. Breakdown of Bid Price
007223	General Conditions	1. Tabulation of Contractor Submissions
		2. List of materials and equipment suppliers and manufacturers
		3. Material and equipment orders schedule
		4. Schedule of shop drawings
		5. Coordination drawings
		6. Layout and installation drawings
012100	Allowances	1. Proposals for purchase of products or systems included in allowances
		2. Invoices and delivery slips for material quantities
		3. Time sheets for labor/installation
		4. Documentation of market fluctuations for fuel price escalation
012900	Payment Procedures	1. Schedule of Values
013100	Project Management and Coordination	1. Subcontract List
		2. List of key personnel assignments and names
		3. RFI log
013200	Construction Progress Documentation	1. Startup Construction Schedule
		2. Startup Network Diagram
		3. Contractor's Construction Schedule
		4. CPM Reports: Activity Report, Logic Report, Total Float Report, Earnings Report.
		5. Construction Schedule Updating Reports
		6. Daily Construction Reports
		7. Material Location Reports
		8. Site Condition Reports
		9. Unusual Event Reports
		10. Qualification Data
013233	Photographic Documentation	1. Key Plan
		2. Digital Photographs
		3. Printed Photographs

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		4. Video Recordings
		5. Time-Lapse Video Recordings
013513.24	Special Procedures for Maintenance of Plant Operation and Sequence of Construction	1. Procedures for Maintenance of Plant Operation
		2. Procedures for Maintenance of Plant Operation Updates
		3. Plans of temporary systems.
		4. Flow Isolation Plans
		5. Temporary Support Systems
		6. Photographs of Wet Well Conditions
013526	Governmental Safety Requirements	1. Qualifications of the CIH and the SSHO
		2. Contractor's Project Specific Safety and Health Plan
		3. Training and safety certifications
		4. Weekly safety and health inspection reports
014000	Quality Requirements	1. Contractor's Quality Control Plan
		2. Qualification Data
		3. Contractor's Statement of Responsibility
		4. Testing Agency Qualifications
		5. Schedule of Tests and Inspections
		6. Permits, Licenses, and Certificates
015000	Temporary Facilities and Controls	1. Required Load Letter
		2. Site Utilization Plan
		3. Implementation and Termination Schedule
		4. Project Identification and Temporary Signs
		5. Fire-Safety Program
		6. Moisture- and Mold-Protection Plan
		7. Dust- and HVAC-Control Plan
		8. Noise and Vibration Control Plan
		9. Bypass Pumping Plan
		10. Influent Channel Isolation and Dewatering Drawings
		11. Temporary Bulkhead Drawings
		12. Stop Log Procedure
		13. Inflatable Pipe Plug Procedure

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015728	Temporary Bypass Pumping Systems	1. Description of Proposed Temporary Bypass System
		2. Calculations of static lift, pipe size selection, friction losses, flow velocity, total dynamic head, and pump selection
		3. Pump performance curves and head capacity curves
		4. Detailed plans and sections of proposed pumping system layout
		5. Information of vendor staff capabilities and replacement parts inventory
		6. Description of system operation and controls
		7. Description and schedule for proposed start-up and testing procedures
		8. Plan of Operations for inclement weather
		9. Plan for 24-hour alarm monitoring
		10. Information on pump controller
		11. Proposed method of noise control for each pump/generator
		12. Installation and maintenance schedule
		13. Contact information for bypass pump service company
		14. Information of vendor staff capabilities and replacement parts inventory
		15. Description and schedule for dismantling the system
		16. Evidence that contractor is insured in event of flooding
		17. Evidence that bypass pipe material can withstand normal operations
		18. Denote conditions that cause pump to lose suction and describe rectifying procedures
		19. Show automatic emergency switchover from primary to backup pumping
		20. Show suction and discharge piping is protected from construction activities
		21. Signed and sealed final Shop Drawings
017300	Execution	1. Land surveyor qualification data
		2. Cutting and Patching Plan
		3. Landfill Receipts
		4. Final property survey
017419	Construction Waste Management and Disposal	1. Waste Management Plan (non-hazardous)
017700	Closeout Procedures	1. List of Incomplete Items
		2. Pest control field report
		3. Certificates of release

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		4. Certificate of insurance for continuing coverage.
		5. Maintenance Materials
		6. Testing, adjusting and balancing records
017900	Demonstration and Training	1. Instruction Program
		2. Attendance Record
		3. Evaluations
019113	General Commissioning Requirements	1. Commissioning Plan Information
		2. Commissioning Schedule
		3. Two-week look-ahead schedules
		4. Commissioning Coordinator Letter of Authority
		5. Commissioning Coordinator Qualification Data
		6. List test instrumentation, equipment, and monitoring devices
		7. Test Reports
		8. Construction Checklists
024119	Selective Demolition	1. Engineering Survey
		2. Proposed Protection Measures
		3. Schedule of Selective Demolition Activities
		4. Pre-demolition Photographs or Video
		5. Statement of Refrigerant Recovery
		6. Warranties
030100	Maintenance of Concrete	1. Shop drawings
		2. Samples of Materials
		3. Material certifications and technical data sheets
		4. Information and qualifications of firm awarded work
030551	Concrete Bonding Agents	1. Product Data
		2. Safety Data Sheets
030555	Concrete Admixtures and Additives	1. Product Data
		2. Concrete Mix Designs
		3. Identify chloride content of admixtures
		4. Certification of Compatibility
		5. Laboratory Test Data

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031113	Structural Cast-in-Place Concrete Forming	1. Formwork Shop Drawings
		2. Shoring and Reshoring
		3. Product Data
		4. Design Data
031500	Concrete Accessories	1. Manufacturer's Specifications
		2. Manufacturer's recommended instructions for installing accessories and splicing waterstops
		3. Shop drawing details of joints, accessories, insets, and embedded items
		4. Test results
		5. Furnish Manufacturer's certification
032100	Reinforcing Steel	1.Shop drawings
		2. Certificates
032200	Welded Wire Fabric Reinforcing	1. Shop drawings
		2. Certificates
033100	Structural Concrete	1. Product Data
		2. Concrete Mix Design Data
		3. Certification of Compatibility
		4. Laboratory Test Data
		5. Mill test certificates and reports
		6. Aggregate test results
		7. Concrete supplier
		8. Methods of placing concrete
		9. Working drawings
033500	Concrete Finishing	1. Manufacturer's specifications
		2. Manufacturer's recommended instructions on mixing handling
		3. Material Safety Data Sheets
		4. Manufacturer's certification or test results
		5. Test Panels
033900	Concrete Curing	1. Manufacturer's specifications
		2. Manufacturer's recommended instructions on curing compound application
		3. Material Safety Data Sheets

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		4. Test results
		5. Furnish manufacturer's certification
		6. Proposed curing methods and procedures
036000	Grout	1. Complete materials list of items to be furnished
		2. Data to demonstrate compliance
		3. Manufacturer's instructions
		4. Material Safety Data Sheets
		5. Certified test results
038100	Concrete Cutting	1. Product Data for Concrete Cutting Equipment
		2. Cutting Procedures
		3. Health and safety plan
		4. Temporary bracing plans
038200	Concrete Boring	1. Product Data for Concrete Cutting Equipment
		2. Drilling/Boring Procedures
		3. Health and Safety Plan
		4. Method for catching elevated slab cores
051200	Structural Steel Framing	1. Product Data
		2. Shop Drawings
		3. Erection Procedure
		4. Welding Procedure
		5. Field Welding Procedure
		6. Welders Certificates
		7. Mill Test Reports
		8. Alignment Certificate
051400	Structural Aluminum	1. Certified Mill Test Reports
		2. Affidavit of Compliance with grade specified
		3. Shop Drawings
055000	Metal Fabrications and Anchorage	1. Shop Drawings - signed and sealed by PE
		2. Manufacturer's product data
		3. Anchorage
055117	Pre-Engineered Aluminum Stairs	1. Samples

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		2. Shop Drawings and Calculations
055215	Aluminum Handrails and Railings	1. Shop Drawings
		2. Product Data
		3. Samples
		4. Test Procedure
		5. Design Data
		6. Certificates
		7. Source Quality Control Submittals
		8. Qualifications Statements
055300	Metal Grating	1. Manufacturer's Specifications
		2. Complete fully dimensioned and detailed layout drawings
		3. Details of fastening system
		4. Calculations for gratings and supports
		5. Welding
		6. Samples
061000	Rough Carpentry	1. Product Data
		2. Material Certificates
066100	Fiberglass Reinforced Plastics (FRP) Fabrications Pultruded Tube Guardrail and Handrail	1. Manufacturer's Shop Drawings
		2. Manufacturer's Published Literature
		3. Samples
072100	Thermal Insulation	1. Product Data
		2. Installer's Certification
		3. Product Test Reports
		4. Research Reports
075216	Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing	1. Product Data
		2. Shop Drawings
		3. Samples for Verification
		4. Wind Uplift Resistance
		5. Qualification Data
		6. Manufacturer Certificates
		7. Product Test Reports

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		8. Evaluation Reports
		9. Field Test Reports
		10. Field Quality-Control Reports
		11. Sample Warranties
076200	Sheet Metal Flashing and Trim	1. Installer Qualifications
		2. Samples
		3. Shop Drawings
		4. Sustainable Design
077100	Roof Specialties	1. Shop Drawings
		2. Samples
		3. Manufacturer's Literature
		4. Design Test Reports
		5. Engineering Calculations
		6. Installer Qualifications
		7. Sustainable Design - Environmental Materials Reporting Form
		8. Percentage of recycled content
078413	Penetration Firestopping	1. Product Data
		2. Product Schedule
		3. Qualification Data
		4. Product Test Reports
079200	Joint Sealants	1. Product Data
		2. Sustainable Design
		3. Samples for Initial Selection
		4. Samples for Verification
		5. Joint-Sealant Schedule
		6. Qualification Data
		7. Product Test Reports
		8. Preconstruction Laboratory Test Schedule
		9. Preconstruction Laboratory Test Reports
		10. Preconstruction Field-Adhesion-Test Reports
		11. Sample Warranties

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099123	Interior Painting	1. Product Data
		2. Samples for Verification
		3. Product List
099679	Atmospheric Protection and Plant Service Areas Coatings	1. Product Data
		2. Samples for Initial Selection
		3. Samples for Verification
		4. Product List
220523.14	Check Valves for Plumbing Piping	Product Data
220523.15	Gate Valves for Plumbing Piping	Product Data
220529	Hangers and Supports for Plumbing Piping and Equipment	1. Product Data
		2. Shop Drawings
		3. Detail fabrication and assembly of trapeze hangers
		4. Design calculations
220529	Hangers and Supports for Plumbing Piping and Equipment	1. Welding Certificates
220553	Identification for Plumbing Piping and Equipment	1. Product Data
		2. Equipment Label Schedule
221316	Sanitary Waste and Vent Piping	1. Product Data
		2. Shop Drawings
		3. Field quality-control reports
221429	Sump Pumps	1. Product Data
		2. Shop Drawings
230517	Sleeves and Sleeve Seals for HVAC Piping	1. Product Data
		2. Field quality-control reports
230519	Meters and Gages for HVAC Piping	1. Product Data
		2. Shop Drawings
230523.12	Ball Valves for HVAC Piping	1. Product Data
230523.13	Butterfly Valves for HVAC Piping	1. Product Data
230529	Hangers and Supports for HVAC Piping and Equipment	1. Product Data
		2. Shop Drawings
		3. Qualifications Statement

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		3. Welding Certificates
230548.13	Vibration Controls for HVAC	1. Product Data
		2. Shop Drawings
		3. Design Calculations
		4. Qualifications Statement
		5. Coordination Drawings
		6. Qualification Data
		7. Welding Certificates
230553	Identification for HVAC Piping and Equipment	1. Product Data
		2. Equipment Label Schedule
230593	Testing, Adjusting, and Balancing for HVAC	1. Qualification Data
		2. Contract Documents Examination Report
		3. Strategies and Procedures Plan
		4. System Readiness Checklists
		5. Examination Report
		6. Certified TAB Reports
		7. Sample Report Forms
		8. Instrument Calibration Reports
230713	Duct Insulation	1. Product Data
		2. Shop Drawings
		3. Qualification Data
		4. Material Test Reports
		5. Field Quality-Control Reports
230719	HVAC Piping Insulation	1. Product Data
		2. Shop Drawings
		1. Qualification Data
		2. Material Test Reports
		3. Field Quality-Control Reports
230923	Direct Digital Control (DDC) System for HVAC	1. Multiple Submissions
		2. Product Data
		3. Software Submittal

		4. Shop Drawings
		5. System Description
		6. Documentation showing design compliance
		7. Schedule and Design Calculations for control dampers and actuators
		8. Schedule and Design Calculations for control valves and actuators
		9. Schedule and Design Calculations for selecting flow instruments
		10. Qualification Data
		11. Welding Certificates
		12. Product Certificates
		13. Source Quality-Control Reports
		14. Field Quality-Control Reports
		15. Sample Warranty
230923.11	Control Valves	1. Product Data
		2. Shop Drawings
		3. Schedule and Design Calculations for control valves and actuators
230923.12	Control Dampers	1. Product Data
		2. Shop Drawings
		3. Schedule and Design Calculations for control dampers and actuators
230923.23	Pressure Instruments	1. Product Data
		2. Shop Drawings
		3. Source Quality-Control Reports
		4. Field Quality-Control Reports
230923.27	Temperature Instruments	1. Product Data
		2. Shop Drawings
		3. Coordination Drawings
		4. Product Certificates
		5. Product Test Reports
		6. Field quality-control reports
232113	Hydronic Piping	1. Product Data
		2. Design calculations and fabrication and assembly
		3. Location of pipe anchors, alignment guides, expansion joints and loops

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		4. Location of penetrations
		5. Location of penetration and firestopping
		6. Seismic and thermal analysis
		7. Coordination Drawings
		8. Qualification Data
		9. Welding Certificates
		10. Field quality-control reports
		11. Welding inspection certificates
		12. Preconstruction test reports
232116	Hydronic Piping Specialties	Product Data
232123	Hydronic Pumps	1. Product Data
		2. Shop Drawings
		3. Field quality-control reports
232213	Steam and Condensate Heating Piping	1. Product Data
		2. Design calculations and fabrication and assembly
		3. Location of pipe anchors, alignment guides, expansion joints and loops
		4. Location of penetrations
		5. Location of penetration and firestopping
		6. Qualification Data
		7. Welding Certificates
		8. Field quality-control reports
		9. Welding inspector certificates
232216	Steam and Condensate Heating Piping Specialities	1. Product Data
232223	Steam Condensate Pumps	1. Product Data
		2. Shop Drawings
233113	Metal Ducts	1. Product Data
		2. Shop Drawings
		3. Sheet metal thickness
		4. Joint and steam construction and sealing
		5. Reinforcement details and spacing

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		6. Materials, fabrication, assembly, and spacing of hangers and supports
		7. Design calculations
		8. Coordination Drawings
		9. Welding Certificates
		10. Field quality-control reports
233300	Air Duct Accessories	1. Product Data
		2. Shop Drawings
233416	Centrifugal HVAC Fans	1. Product Data
		2. Shop Drawings
		3. Field quality-control reports
233423	HVAC Power Ventilators	1. Product Data
		2. Shop Drawings
		3. Analysis data for unit hangers and supports
		4. Design calculations
		5. Qualifications Statement
		6. Coordination Drawings
		7. Seismic Qualification Data
		8. Field quality-control reports
233713.23	Registers and Grilles	1. Product Data
		2. Source quality-control reports
233723	HVAC Gravity Ventilators	1. Product Data
		2. Shop Drawings
235700	Heat Exchangers for HVAC	1. Product Data
		2. Shop Drawings
		3. Coordination Drawings
		4. Source quality-control reports
		5. Field quality-control reports
		6. Sample Warranty
237323.16	Outdoor, Semi-Custom Air-Handling Units	1. Product Data
		2. Shop Drawings
		3. Coordination Drawings

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		4. Sample Warranty
		5. Product Certificates
		6. Source quality-control reports
		7. Startup service reports
		8. Field quality-control reports
238216.11	Hydronic Air Coils	Product Data
260010	Supplemental Requirements for Electrical	1. Electrical Installation Drawings
		2. Training Plans
		3. Electrical Installation Schedule
		4. Delegated Design Drawings
		5. Seismic Qualification Data
		6. Wind-Load Performance Data
		7. Qualification Statements
260505	Selective Demolition for Electrical	1. Shop Drawings
260513	Medium-Voltage Cables	1. Product Data
		2. Work plan for each medium voltage system interruption
		3. Switching and testing plans
		4. Coordination Drawings
		5. Qualification Data
		6. Design Data
		7. Source quality-control reports
		8. Field quality-control reports
		9. Manufacturer's cable warranty
260519	Low-Voltage Electrical Power Conductors and Cables	1. Product Data
		2. Product Schedule
		3. Field quality-control reports
260523	Control-Voltage Electrical Power Cables	1. Product Data
		2. Field quality-control reports
260526	Grounding and Bonding for Electrical Systems	1. Product Data
		2. Field quality-control reports
260529	Hangers and Supports for Electrical Systems	1. Product Data

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		2. Shop Drawings
		3. Design calculations and details of hangers
		4. Design calculations for seismic restraints
		5. Qualifications Statement
260533.13	Conduits for Electrical Systems	1. Product Data
		2. Conduit Layouts
260533.16	Boxes and Covers for Electrical Systems	1. Product Data
260533.23	Surface Raceways for Electrical Systems	1. Product Data
260544	Sleeves and Sleeve Seals for Electrical Race-ways and Cabling	1. Product Data
260553	Identification for Electrical Systems	1. Product Data
		2. Identification Schedule
260573	Power System Studies	1. Supplier Qualifications
		2. Preliminary Power System Study Report
		3. Final Power System Study Report
		4. Qualification Data
		5. Product Certificates
		6. Field quality-control reports
260800	Commissioning of Electrical Systems	1. Qualification Data
		2. Field Quality-Control Reports
		3. Certification for relays on MV equipment
		4. Certification for adjustable circuit breakers
		5. Certification for flash labels
		6. MV Master Project Plan
		7. Additional MV Project Plans
		8. Switchgear and Generator Test Plan
		9. Power Monitoring / SCADA Verification Plan
261839	Medium-Voltage Motor Controllers	1. Product Data
		2. Shop Drawings
		3. Specification Compliance
		1. Indoor Installations

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		2. Qualification Data
		3. Seismic Qualification Data
		4. Source quality-control reports
		5. Field quality-control reports
		6. Sample Warranty
262200	Low-Voltage Transformers	1. Product Data
		2. Shop Drawings
		1. Qualification Data
		2. Field Quality-Control Reports
262413	Switchboards	1. Product Data
		2. Shop Drawings
		3. Installation Instructions
		4. Specification Compliance
		1. Qualification Data
		2. Seismic Qualification Data
		3. Source quality-control reports
		4. Field quality-control reports
		5. Sample Warranty
262416	Panelboards	1. Product Data
		2. Shop Drawings
		1. Qualification Data
		2. Field quality-control reports
262505	480v Control Panels	1. Product Data
		2. Shop Drawings
		3. Seismic Qualification Data
		4. Startup Reports
262726	Wiring Devices	Product Data
		Field quality-control reports
262813	Fuses	1. Product Data
262816	Enclosed Switches and Circuit Breakers	1. Product Data
		2. Shop Drawings

		3. Qualification Data
		4. Seismic Qualification Data
		5. Field quality-control reports
263600	Transfer Switches	1. Product Data
		2. Shop Drawings
		3. Qualification Data
		4. Seismic Qualification Data
		5. Field quality-control reports
284621.11	Addressable Fire Alarm Systems	1. Product Data
		2. Shop Drawings
		3. General Submittal Requirements
		4. Drawings with locations of each notification appliance
		5. Design calculations
		6. Audible appliances
		7. Qualification Data
		8. Field quality-control reports
		9. Sample Warranty
330130.7	Spray-In-Place Polymeric Pipe Lining	1. Product Data
		2. Manufacturer's shipping, storage, and handling recommendations
		3. Quality Control Plan
		4. Shop Drawings
		5. Qualification Data for Installer, Manufacturer, and Testing agency
		6. Material Certificates
		7. Material Test Reports
		8. Product Test Reports
		9. QA/QC Plan
		10. Source quality-control reports
		11. Field quality-control reports
		12. Sample Warranty
400506	Couplings, Adapters, and Specials for Process Piping	1. Manufacturer's Certificate
		2. Welder Certificates

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		3. Manufacturer Instructions
		4. Source quality-control submittals
		5. Field quality-control submittals
		6. Qualifications statements
		7. Coordination Drawings
		8. Product Data
		9. Shop Drawings
		10. Firestopping Schedule
400507	Hangers and Supports for Process Piping	1. Product Data
		2. Shop Drawings
		3. Coordination Drawings
		4. Delegated Design Submittal for all new and modified piping systems' hangers and supports
		5. Manufacturer's Instructions
		6. Coordination Drawings
		7. Qualifications Statement
400517	Copper Process Pipe and Tubing	1. Product Data
		2. Shop Drawings
		3. Manufacturer's Certificate
		4. Source Quality-Control Submittals
		5. Field Quality-Control Submittals
		6. Coordination Drawings
		7. Qualifications Statements
400519	Ductile Iron Process Pipe	1. Coordination Drawings
		2. Manufacturer's Certificate
		3. Source Quality-Control Submittals
		4. Field Quality-Control Submittals
		5. Qualifications Statements
		6. AIS compliance certification
		7. Welding certificates
		8. Certified Affidavit of Compliance

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		9. Product Test Reports
		10. Source quality-control reports
		11. Field quality-control reports
		12. Sample warranty
		13. Product Data
		14. Shop Drawings
		15. Product Schedule
400523	Stainless Steel Process Pipe and Tubing	1. Product Data
		2. Shop Drawings
		3. Cleaning Methods
		4. Manufacturer's Certificate
		5. Welder Certificates
		6. Source Quality-Control Submittals
		7. Field Quality-Control Submittals
		8. Qualifications Statements
		9. Coordination Drawings
400524	Steel Process Pipe	1. Product Data
		2. Shop Drawings
		3. Complete schedule of components
		4. Details of pipe coating, wrapping, lining, and painting
		5. Manufacturer's Certificate
		6. Welder Certificates
		7. Source quality-control submittals
		8. Field quality-control submittals
		9. Qualifications statements
		10. Coordination Drawings
400531	Thermoplastic Process Pipe	1. Product Data
		2. Shop Drawings
		3. Manufacturer's Certificate
		4. Manufacturer's recommended butt fusion welding procedures
		5. Source quality-control submittals

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		6. Field quality-control submittals
		7. Coordination Drawings
		8. Qualifications statements
400532	Double Wall Chemical Pipe System	1. Product Data
		2. Shop Drawings
		3. Manufacturer's Certificate
		4. Manufacturer's recommended butt fusion welding procedures
		5. Sample joint for each size pipe
		6. Source quality-control submittals
		7. Field quality-control submittals
		8. Qualifications statements
		9. Coordination Drawings
400551	Common Requirements for Process Valves	1. Valve Schedule
		2. Valve Tags
		3. Power Actuator Data
		4. Shop Drawings
		5. Certified Hydrostatic Test Data
		7.Shop Drawings with design calculations
		8. Manufacturer Instructions
		9. Source Quality-Control Submittals
		10. Field Quality-Control Submittals
		11. Manufacturer Certification of Installation
		12. Qualifications Statement
		13. Coordination Drawings
400553	Identification for Process Piping	1. Product Data
		2. Shop Drawings
		3. Samples
		4. Coordination Drawings
		5. Manufacturer's Certificate
		6. Manufacturer Instructions
		7. Qualifications Statement

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		8. Manufacturer's Certificate
		9. Product Cost Data
400557	Actuators for Process Valves and Gates	1. Product Data
		2. Shop Drawings
		3. Coordination Drawings
		4. Manufacturer's Certificate
		5. Manufacturer Instructions
		6. Source Quality-Control Submittals
		7. Field Quality-Control Submittals
		8. Qualifications Statement
400559.23	Stainless Steel Slide Gates	1. Product Data
		2. Shop Drawings
		3. Coordination Drawings
		4. Manufacturer's Certificate
		5. Manufacturer Instructions
		6. Source Quality-Control Submittals
		7. Field Quality-Control Submittals
		8. Manufacturer Reports
		9. Qualifications Statement
		10. Shop Drawings with design calculations
		11. Copy of PE License of Engineer of Record
400561	Gate Valves	1. Valve Schedule
		2. Valve Tags
		3. Power Actuator Data
		4. Shop Drawings
		5. Certified Hydrostatic Test Data
		6. Coordination Drawings
400561.13	Knife Gate Valves	1. Valve Schedule
		2. Valve Tags
		3. Power Actuator Data
		4. Shop Drawings

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		5. Certified Hydrostatic Test Data
		6. Coordination Drawings
400562	Plug Valves	1. Valve Schedule
		2. Valve Tags
		3. Power Actuator Data
		4. Shop Drawings
		5. Certified Hydrostatic Test Data
		6. Coordination Drawings
400563	Ball Valves	1. Valve Schedule
		2. Valve Tags
		3. Power Actuator Data
		4. Shop Drawings
		5. Certified Hydrostatic Test Data
		6. Coordination Drawings
400565.13	Cone Valves	1. Product Data
		2. Shop Drawings
		3. Coordination Drawings
		4. Source Quality-Control Reports
		5. Qualifications Statement
400567.36	Pressure-Regulating Valves	1. Valve Schedule
		2. Valve Tags
		3. Power Actuator Data
		4. Shop Drawings
		5. Certified Hydrostatic Test Data
		6. Product Data
		7. Manufacturer's Certificate
		8. Manufacturer Instructions
		9. Field Quality-Control Submittals
		10. Qualifications Statement
		11. Coordination Drawings
400567.39	Pressure-Relief Valves	1. Valve Schedule

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		2. Valve Tags
		3. Power Actuator Data
		4. Shop Drawings
		5. Certified Hydrostatic Test Data
		6. Product Data
		7. Shop Drawings
		8. Manufacturer's Certificate
		9. Manufacturer Instructions
		10. Source Quality-Control Submittals
		11. Field Quality-Control Submittals
		12. Qualifications Statement
		13. AIS compliance certification
		14. Coordination Drawings
400576	Hot Tapping Valves and Line Stops	1. Product Data
		2. Shop Drawings
		3. Product Schedule
		4. Qualifications Statement
		1. Coordination Drawings
		2. Qualification Data
		3. Retain "Welding certificates" Paragraph
		4. Product Certificates
		5. Retain test report option 1 if testing in manufacturer facilities and option if by testing agency
		6. Retain "Preconstruction Test Reports" paragraph
		7. Source quality-control reports
		8. Field quality-control reports
		9. Sample Warranty
		10. Coordination Drawings
400578.29	Combination Air Valves for Wastewater Service	1. Manufacturer's Certificate
		2. Product Data
		3. Manufacturer Instructions

		4. Source Quality-Control Submittals
		5. Field Quality-Control Submittals
		6. Manufacturer Reports
		7. Qualifications Statement
		8. Shop Drawings
		9. Coordination Drawings
400852	Solenoid Valves for Process Service	1. Product Data
		2. Manufacturer's Certificate
		3. Manufacturer Instructions
		4. Source Quality-Control Submittals
		5. Field Quality-Control Submittals
		6. Qualifications Statement
		7. Coordination Drawings
400593.13	Medium-Voltage Motor Requirements for Process Equipment	1. Product Data
		2. Shop Drawings
		3. Copy of this specification
		4. System testing plan
		5. Coordination Drawings
		6. Qualification Data
		7. Seismic Qualification Certificates
		8. Product Certificates
		9. Product Test Reports
		10. Source quality-control reports
		11. Field quality-control reports
		12. Sample Warranty
		13. Electronic O&M
		14. Coordination Drawings
406100	Process Control and Enterprise Management Systems General Provisions	1. O&M Manual
		2. Software Maintenance Manual
		3. Operator's Manual
		4. Software and Firmware Operational Documentation

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		5. Electronic O&M
406100	Process Control and Enterprise Management Systems General Provisions	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
406126	Process Control System Training	1. Preliminary Training Plan Submittal
		2. Final Training Plan Submittal
		3. Coordination Drawings
406263	Operator Interface Terminals	1. Product Data
		2. Shop Drawings
		3. Spare Parts
		4. Coordination Drawings
406343	Programmable Logic Controllers	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages

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		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
406613	Switches and Routers	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
`	Industrial Enclosures	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams

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		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407179	Flow Switches	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407223	Radar Level Meters	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal

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		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407276	Level Switches	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407313	Pressure and Differential Pressure Gauges	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal

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		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407326	Gauge-Pressure Transmitters	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407336	Pressure/Differential Pressure Switches	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal

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		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407363	Diaphragm Seals	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407363	Diaphragm Seals	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity

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		13. Electronic O&M
		14. Coordination Drawings
407723	Vibration Monitoring Systems	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407816	Indicating Lights	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M

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		14. Coordination Drawings
407819	Switches and Push Buttons	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407853	Relays	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings

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407856	Isolators, Intrinsically Safe Barriers, and Surge Suppressors	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
407859	Power Supplies	1. Product Data
		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings
432341	End Suction Solids Handling Pumps	1. Product Data

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		2. Shop Drawings
		3. Qualifications Submittal
		4. Project Plan, Deviation List, Schedule Submittal
		5. Component and Wiring Identification Plan
		6. Input/Output List
		7. Field Instruments
		8. Control System Architecture, Hardware and Software Packages
		9. Panel Layout Drawings/Wiring Diagrams
		10. HMI Submittal
		11. Controller Program Submittal
		12. Testing Plan Submittal
		12. Industrial Control System Cybersecurity
		13. Electronic O&M
		14. Coordination Drawings

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SECTION 013513.24 – SPECIAL PROCEDURES FOR MAINTENANCE OF PLANT OPERATION AND SEQUENCE OF CONSTRUCTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The following index of this Section is presented for convenience:

Article Title Page

PART 1 - GENERAL 1
1.1 RELATED DOCUMENTS 1
1.2 SUMMARY 1
1.3 ACTION SUBMITTALS 2
1.4 EXISTING PLANT OPERATIONS 6
1.5 GENERAL CRITERIA AND RESTRICTIONS 9
1.6 WORK DURING DRY WEATHER AND LOW FLOW CONDITIONS 12
1.7 CONSTRAINTS DURING CONSTRUCTION 14
1.8 GENERAL SEQUENCE OF CONSTRUCTION NOTES 23
1.9 SUGGESTED SEQUENCE OF CONSTRUCTION 30

PART 2 - PRODUCTS (NOT USED) 58

PART 3 - EXECUTION (NOT USED) 58

B. The Cedar Creek Water Pollution Control Plant (WPCP) operates 24 hours a day, seven days a week. The existing facility must be maintained in continuous operation at all times during the entire construction period, except for periods specifically delineated within this Section.

C. The detailed sequence of construction shall be based upon the Contractor's Construction Schedule prepared pursuant to Section 01 32 00 "Construction Progress Documentation." However, as a guide for bidders in the preparation of their bid and for the Contractor in the preparation of their schedule, a suggested sequence of construction is provided herein in Part 1.9. A phased construction sequence is required to maintain continuous plant operations during construction. This Section outlines specific constraints and steps intended to guide development of the Contractor's detailed work plan and maintenance of plant operations procedures. The

sequence may be altered as approved by the Engineer provided that plant operations are maintained.

D. The proposed work has various impacts on the Owner's influent screening and influent pumping operations essential for maintaining compliance with the facility's NYSDEC State Pollutant Discharge Elimination System (SPDES) permit. Where construction impacts operations, support the Owner as needed to maintain compliance.

E. Related Requirements:

1. Section 01 32 00 'Construction Progress Documentation'grondwat
2. Section 01 50 00 'Temporary Facilities and Controls'
3. Section 01 57 28 'Temporary Bypass Pumping Systems'
4. Section 01 91 13 'General Commissioning Requirements'

1.3 ACTION SUBMITTALS

A. Procedures for Maintenance of Plant Operation:

1. Within 30 calendar days of the Notice to Proceed, submit complete descriptions of procedures to maintain plant operation at all times including:

a. Step-by-step procedures, required durations, and specific procedures required to be performed by the Contractor; as well as assistance from the Owner's personnel that the Contractor will request.

1) Label each set of procedures with the corresponding construction schedule activity numbers.
2) Do not assume that requests for assistance from Owner's personnel will be granted.
3) A minimum of two weeks' advanced notification to the Owner is required for any operations or alterations that affect operation of the treatment facility.
4) Activities affecting operation of the treatment facility will only be permitted by Owner where there are no alternatives that avoid any effect on operations.
5) Clearly identify all interferences with the existing facilities and processes. Provide narratives explaining why interferences cannot be avoided. If interferences arise from proposed alternative sequences, provide narratives explaining why the alternative sequences cannot avoid interferences to the plant's operation.
6) Define the total available and backup influent screening and influent pumping capacities available in every construction sequence step. Where the total capacity of influent screening and influent pumping systems is less than 150 MGD with the largest screen and pump unavailable:

a) Provide confirmation that temporary systems deployed by the Contractor will incorporate redundancy so that no singular equipment failure such as loss of a pump, pipe leak, generator failure, power

distribution equipment failure, or damaged cable will compromise capacity of temporary systems.

b) Define the contingency plan to be implemented to promptly restore 150 MGD screening and pumping capacity if and where directed by the Owner. Include specific direction on where Owner assistance would be required, assumptions on Owner response times, and a worst-case estimate for the timeframe required to implement the plan.

b. Plans of temporary systems including but not limited to those specified in Section 01 50 00 "Temporary Facilities and Controls" required as part of this Contract to maintain plant operations. Clearly delineate the following on plans and supplement with narratives and data sheets as needed:

1) The intended location of temporary systems.
2) The proposed methods for phasing from existing to temporary to completed facilities.
3) Planned disruptions to Owner's normal access to process areas and proposed temporary measures to maintain uninterrupted access.
4) All connections to existing and relocated systems, including coordination activities performed by Contractor and Owner.
5) All methods of flow maintenance. Include the method of interruption of flow, anticipated duration of interruption of flow, and detailed procedure for accomplishing the work including the interruption of flow. If a bypass plan is required, prepare and submit a specific, detailed description of the proposed system, according to Section 01 57 28 "Temporary Bypass Pumping Systems".

c. Floor plans and site plans, as applicable, depicting proposed work areas, identifying any temporary measures proposed to maintain access within those work areas, and any other special access considerations such as impacts to emergency egress routes. Provide supplemental details or sections where necessary.

2. Submit these procedures simultaneously with the construction schedule developed in accordance with Section 01 32 00 "Construction Progress Documentation."
3. Coordinate development of this sequence with the Owner and the Engineer. Work cannot commence unless the procedures have been approved.

B. Procedures for Maintenance of Plant Operation Updates: If any revisions to procedures for Maintenance of Plant Operation are proposed, immediately notify the Owner, Engineer, and the Owner's Contract Operator (OCO), and submit revised Procedures for Maintenance of Plant Operation as soon as possible for review.

1. Content requirements are the same as the above Procedures for Maintenance of Plant Operation.
2. Provide a narrative and documents describing the proposed revisions in a format agreed upon by the Contractor and the OCO.
3. Work requiring revised procedures cannot commence unless the revised procedures are approved.

C. Flow Isolation Plans (FIP)

1. Submit a FIP for each instance of work requiring isolation or disruption of flows in wet wells, pipes, channels, conduits, or tanks. Include the following:

    a. General information:

        1) Type of flow impacted (e.g. screened sewage)
        2) Brief description of proposed flow isolation or disruption.
        3) Contact information for parties involved in implementation of the FIP.

    b. Schedule forecast:

        1) Start date
        2) End date
        3) Minimum duration
        4) Expected duration
        5) Maximum duration
        6) Dates on which other parties such as the Owner, Owner's Contract Operator, and Engineer are required to support proposed activities.

    c. Description:

        1) Sequence of proposed activities for implementation, removal, and restoration for the flow isolation or disruption activity. Itemize the sequence to delineate specific roles and responsibilities for all parties required to support the activities. Indicate where Owner support is required for activities such as operation of existing valves, gates, pumps, or other equipment; temporary shut-downs; and LOTO.
        2) Plans indicating location(s) of proposed isolation or disruption. Where plugs are proposed, indicate tie-off locations. Redundant tie-off locations are required.
        3) For each location requiring isolation of flow, description of the device or method of isolating flow including size, type, material, method of installation, staging, testing, and monitoring of the flow isolation device.
        4) Description of the impact of proposed isolation or disruption on operations.

    d. Inspection and Monitoring Plans:

        1) Checklists for inspection of installation, regular monitoring, and removal of proposed flow isolation or disruption systems. Incorporate recommendations from manufacturer representatives and designers.
        2) If and where plugs are proposed, plugs must be monitored continuously 24-hours per day during their use.
        3) Proposed frequency of inspection and monitoring activities. Frequency must be appropriate when considering the risk of failure and estimated duration required to implement emergency response plans.

    e. Emergency Response Plan

        1) Description of the nature, duration, and support required for the Contractor to implement corrective actions in the event of critical failures, such as loss of pressure for a plug.

2) Sequence of activities and estimated duration to promptly restore flow if and where directed by the Owner. Include specific direction on where Owner assistance would be required, assumptions on Owner response times, and a worst-case estimate for the timeframe required to implement the plan.

f. Calculations:

1) Provide calculations and design drawings for each location where isolation or disruption is proposed.
2) Calculations shall demonstrate suitability of proposed methods of flow isolation or disruption and may include information such as design pressures, flow depths, static and dynamic loads where applicable. Where plugs are proposed, at a minimum include:

a) Maximum anticipated pressure on the plug.
b) The tensile force required to restrain the plug prior to plug inflation and during plug removal.
c) Required inflation pressure of the plug.
d) Basis for selection of the plug and, where applicable, sleeve while considering installation conditions, pipe size, and pressure requirements.
e) Design for anchoring, support, and bracing of plugs.
f) Sizing of restraint (cable or chain) using a minimum safety factor of 4. Rope of any kind is not an acceptable material for plug restraint.

3) Calculations must clearly specify relevant assumptions such as flow depths, densities, pressures, and ratings of existing systems or elements.
4) Include written confirmation that any relevant dimensions have been field verified and coordinated with planned new work.
5) Calculations shall be sealed and signed by a professional engineer licensed in the state of New York.

g. Manufacturer's literature:

1) Provide manufacturer's literature, technical data sheets, manuals, and training information where applicable for all materials proposed to be used for the FIP.

D. Temporary Support Systems

1. Provide a design report signed and sealed by a Professional Engineer licensed in the State of New York for each temporary support system (e.g. shoring, bracing, bulkheads, excavation supports, and other temporary structural systems) proposed during construction. Include:

a. A written description of the system
b. Plans, drawings, and details for the system design
c. Design calculations
d. Other documentation necessary to document the basis of the system design

E. Photographs of Wet Well Conditions

1. In addition to periodic construction photographs required in Section 01 32 33 'Photographic Documentation', provide labeled digital photographs for each of the items listed below within the Main Equipment Building's East Wet Well and West Wet Well in sufficient quantity to comprehensively document the noted features. See Section 01 32 33 for digital photograph requirements.

    a. Existing conditions of the two 84-inch influent pipelines, their interior as viewed from the wet well, and their connections.
    b. Existing conditions of the entrance and interior of the influent pumps' suction pipes.
    c. Existing conditions of the wet well walls, slabs, and openings.
    d. Intermediate condition of the penetration for Pump P-3 after selective demolition has been completed.
    e. Final condition of the new work for the Pump P-3 suction piping and wall penetration.
    f. If observed, cracks, fractures, delamination, or other visible defects within the wet well.

1.4 EXISTING PLANT OPERATIONS

A. The Cedar Creek WPCP is under the jurisdiction of the Nassau County Department of Public Works and operated by Veolia North America on behalf of Nassau County. The Cedar Creek WPCP Contract Operator must have safe access to all areas that remain in operation at all times.

B. The existing treatment facility was designed with the capacity to handle a peak hour flow of 150 million gallons per day (MGD).

C. Influent Screening Building (Building E)

1. Influent Screening

    a. The Influent Screening Building has four mechanically cleaned bar screens each rated for a maximum flow of 52 MGD.
    b. The plant must have at least three influent screens in operation to screen the peak flow of 150 MGD.
    c. At least one of the downstream 84-inch pipelines connected to the Influent Pumping System must remain in service at all times.
    d. The Influent Pumping System's East and West wet wells cannot be isolated with existing equipment at the Influent Screening Building unless two influent screens are taken out of service. If two influent screens are taken out of service, work must be performed during low flow conditions as defined in Part 1.6. Alternatively, a wet well can be isolated by installing temporary plugs or bulkheads to stop flow through the 84-inch pipeline while maintaining 150 MGD screening capacity.
    e. Use of the Owner's slide gates and the Owner's stop logs with existing frames will be permitted with minimum 2 weeks advanced written notice; however, the Owner makes no guarantees to the condition or performance of its slide gates or stop logs.

2. Slide Gates

a. The Influent Screening Building (E) has nine total slide gates used for isolation of the four screen channels. There are two slide gates per screen channel and an additional common channel gate SG-5.
b. Seating the current slide gates for isolation of the channels is very difficult due to accumulated debris. Use of the existing slide gates for isolation and controlling flows into the wet wells must therefore be preceded by thorough channel cleaning. Plan to utilize a combination of sandbags, sump pumps, and other temporary bulkhead measures to isolate flow for replacement of SG-1 as leakage should be expected even after channel cleaning.
c. Slide Gate SG-1 is currently non-operational.
d. Assume that slide gates will leak when closed and that temporary dewatering and bulkheads or barriers will be required to maintain a dry working environment within isolated channels.
e. Following channel cleaning and slide gate SG-1 replacement, still plan to use a combination of sandbags and/or sump pumps to isolate flow to either wet well from its respective 84-in header. To facilitate wet well isolation, also plan to plug each wet well's 84-inch influent line as isolation may still not be achieved from the screen building channels following select slide gate replacement and cleaning of channels and slide gate inverts.

D. Main Equipment Building (Building B)

1. Influent flows are measured using two 42-inch diameter magnetic flow meters located on each of the existing influent pump discharge force mains. These flow meters are utilized to report plant flows as required by the plant's SPDES permit.
2. East and West Wet Wells

a. The influent pumping system East and West Wet Wells receive screened wastewater from the influent screen chamber via two 84-inch diameter pipes. The two 84-inch diameter influent pipes enter wet well influent channels at an invert elevation of El. -25.00 NGVD29.
b. The East and West Wet Wells are only hydraulically connected through the upstream influent screen chamber and the split suction line for Pump A-2.
c. Flow from each wet well's influent channel/84-inch pipe pairing enters each corresponding wet well via a series of 36-inch diameter ports spaced along the east and west influent channel walls.
d. Influent pump suction piping draws flow through concrete fillets at the base of the wet well at an invert elevation of El. -34.75 NGVD29. At the peak design flow of 150 MGD, the influent wet well level is operated at a water surface elevation (WSE) of El. -18.50' NGVD29 (16.25' deep).

3. Influent Pumping

a. The influent pumps convey flow via two manifolded 48-inch diameter force mains, through the basement of Building B and a below grade pipe gallery, to two grit tank influent boxes.

1) The east grit tank influent box contains a concrete weir wall with a weir crest elevation of El. 15.17' NGVD29 followed by two 84" x 84" sluice gates, which direct flow into Grit Tanks No. 1 and No. 2. The water surface elevation (WSE) in the east grit tank influent box at design peak flow is

El. 19.24’ NGVD29. Flow exits the south side of Grit Tanks No. 1 and No. 2 via an overflow weir with a weir crest elevation of El. 18.25’ NGVD29.

2) The west grit tank influent box contains a concrete weir wall with a weir crest elevation of 15.17’ followed by a single 84” x 84” sluice gate, which directs flow into Grit Tank No. 3. The WSE in the west grit tank influent box at design peak flow is El. 19.29’ NGVD 29. Flow exits the south side of Grit Tank No. 3 via an overflow weir with a weir crest elevation of El. 18.25’ NGVD29.

b. The influent pumping system's suction and discharge piping network includes a variety of valves—cone, gate, ball, swing check, and ball-type—ranging in diameter from 12 to 48 inches.

1) Each raw sewage pump features a suction isolation gate valve installed in a pit below the dry well floor. Due to their location beneath the discharge piping, these suction isolation gate valves are oriented with their bonnets parallel to the floor, which plant operators report makes full closure difficult. These valves are equipped with electric actuators, although they may not be operable, and can also be manually operated via handwheels, requiring personnel to enter the confined space of the valve pits.
2) Each raw sewage pump is equipped with a valve on the discharge side to prevent backflow from the discharge headers. These include cone valves with hydraulic actuators on Pumps A-1, A-2, and A-3; ball valves with hydraulic actuators on Pumps A-6 and A-7; and check valves on Pumps A-4 and A-5. The cone and ball valves are controlled by a centralized hydraulic system located at elevation -6.50’ NGVD29, which distributes hydraulic fluid through a network of supply and exhaust lines. Each raw sewage pump also has an isolation gate valve installed upstream of its connection to the discharge headers.
3) Both the upper and lower 48-inch discharge headers are equipped with 48-inch gate valves that allow isolation of the respective 48-inch force mains from the influent pumping system.
4) Existing influent pumping system valve components are in poor condition. It is reported that most of the pump suction isolation valves are unreliable, aside from GV-2E and GV-2W, and that nearly all the discharge isolation valves are unreliable. Due to their deteriorated state, most valves, aside from GV-2E and GV-2W cannot be relied upon to isolate pumps without first dewatering the wet well.
5) Suction gate valves GV-2E and GV-2W, upstream of pump A-2, are operable and reportedly used to isolate the west and east wet wells for maintenance. The construction sequence steps presented herein require operation of these isolation valves as part of Phase 1. All other system valves are assumed to be non-operational.

4. Hazardous Materials

a. Asbestos Containing Materials (ACM) were found throughout Building B on multiple levels.

1) In the basement of the building, gasket material at the flanges in the 48-in. force main, vibration dampening cloth on the exhaust units, and

cementitious pipe insulation above the plant drain piping are all assumed to contain ACM.

2) Cementitious pipe insulation is present throughout the entire building, with more being found at El. -6.50 and the main floor at El. 15.50.
3) The electrical cabinets behind the pump motors on the main floor are assumed to have ACM within the backer board.
4) See Section 028200 “Asbestos Removal” for more information and asbestos removal procedures.

b. Lead Based Paint/Lead Containing Paint (LBP/LCP)

1) LBP is ubiquitous at the basement level including paint on the pumps, discharge piping, suction piping, elevator door frame, and stairwell.
2) The staircases throughout the entire building use LBP in their handrail painting, with some walls and door frames at El. -6.5 containing LBP as well.
3) See Section 028300 “Removal and Disposal of Lead-Containing Paint” for more information and LBP/LCP removal procedures.

5. Existing Influent Pump Capacity

a. Construction sequencing relies on the performance of existing influent pumps to maintain plant operations. The suggested construction sequence, detailed herein, is contingent on maintaining operation of the three largest existing pumps throughout most of construction, with their replacement occurring in the final steps.
b. Confirm the capacity of the existing pumps in development of the construction work sequence and ahead of taking any existing, temporary, or proposed influent pumps out of service for any reason.
c. Design phase estimates of existing pump capacities under existing conditions are below for reference. However, the actual capacity of pumps will vary depending upon the specifics of their condition, operation, piping configuration, inlet hydraulics, and discharge conditions. These pump capacities were estimated during the design phase using field testing; however, capacity of the existing pumps will need to be confirmed ahead of active construction phasing and before any pumps are taken offline.

Existing Pump No.	Estimated Capacity
Pump A-1	60 MGD
Pump A-2	60 MGD
Pump A-3	30 MGD
Pump A-4	12 MGD
Pump A-5	4 MGD
Pump A-6	30 MGD
Pump A-7	40 MGD

1.5 GENERAL CRITERIA AND RESTRICTIONS

A. Obtain advanced approval from the Owner and the OCO for all disruptions to existing, temporary, or new equipment and systems that are in service.

B. Work sequencing

1. Coordinate and align the work as best as possible with the overall project plan, schedule, and the following construction sequence. Each phase shall be coordinated with other disciplines as appropriate to provide a finalized and properly operating system.
2. The sequence and shutdown of plant systems and process units that are to be taken out of service, modified, have temporary connections, or be demolished and/or rehabilitated are presented in this Section along with the construction of new facilities that connect into existing facilities.
3. Times noted in days herein are meant to be consecutive calendar days including Saturdays, Sundays, and holidays. For times noted in hours, the time is meant to be measured as consecutive hours and not in terms of normal daily working hours.
4. All equipment and materials required must be at the location of work ready for use, and preparation work completed before any construction begins.
5. New units may only be used after specified start-up, testing, and commissioning has been successfully completed, and the Owner has received required documents and accepted the units.
6. Schedule and conduct work such that it will not impede or upset any part of the treatment process, create hazards to operating equipment and/or personnel, nor reduce the quality of the plant finished water or liquid residuals hauling operations. The Contractor must ensure his working schedules and sequenced construction activities are completely compatible with the facility operations.

C. Access

1. Maintain access to and throughout the plant and work areas at all times.
2. Maintain means of egress throughout the facility at all times.
3. Maintain vehicular access to all treatment units and buildings at all times.

    a. It is critical to maintain access to the screening, grit, sludge, and dewatering facilities for the removal of materials or the discharge of materials.
    b. Stage work in these areas in such a manner so that normal operations can be maintained for those facilities.

4. The Owner must have safe access to all areas that remain in operation throughout the construction period. Provide temporary access for the Owner if the normal access is blocked or removed.

D. Facilities and Utilities

1. Keep existing potable water and fire protection systems in operation at all times.
2. Keep sanitary facilities in existing structures in operation until such time as their temporary or permanent replacements have been installed and are operational.
3. Maintain electrical power, lighting service, and communications systems in uninterrupted operation in all areas that remain in service.

    a. Provide temporary electrical and lighting installation where necessary, for the purpose of maintaining plant operations.
    b. Electrical and lighting installations shall conform to the National Electrical Code.

4. Maintain all existing sumps in operating condition with either the existing pumps or temporary pumps. If the Contract requires the temporary removal of a sump pump, provide a temporary system.
5. Redundancy

    a. Many of the phases presented in the suggested construction sequence herein meet capacity requirements of the influent pumping system with limited or no redundancy. Therefore, in the event that an existing pump required for the sequence is unexpectedly out of service, request that the Owner provide written direction on whether alternative sequencing or additional bypass pumping capacity is required.

E. Interruptions to systems and services

1. The work specified herein, and any other work required by the Engineer, which may interrupt normal plant operations, shall be accomplished at such times that are convenient to the Owner. Overtime, weekend and overnight work for the Contractor to conform to these requirements will be considered as normal procedure under this Contract, and the Contractor shall not be eligible for extra compensation as a result thereof.
2. When the connection of a new pipeline or channel to an existing structure or pipeline requires a shutdown of the existing structure or pipeline; complete and test the new pipeline or channel, except for the final connection, prior to proceeding with the shutdown unless otherwise noted. When the final connection is completed, test the entire pipeline or channel unless otherwise determined by the Engineer.
3. The Contractor shall follow the Owner's Lockout/Tagout (LOTO) procedures. A copy of these procedures will be made available by the Owner upon request.
4. Any modification to, connection to or shutdown of an existing asset such as a tank, wet well, conduit, channel, or pipe, cannot be scheduled or occur without written approval of the Owner.
5. At the Contractor's request and if all temporary measures to maintain plant/system operation/access have been provided and tested, the Owner shall shutdown existing systems.

    a. The Contractor must follow and implement the appropriate LOTO procedures for systems de-energized or shutdown by the Owner. This shall include checking of cables and wires to be sure that they are de-energized and releasing any stored energy in pipelines or mechanical systems including air, gas, steam, water pressure, springs, rotating flywheels and hydraulic systems. This may be accomplished by dissipating the energy through draining the lines or through restraining methods such as repositioning, blocking, bleeding, etc. before work begins.
    b. All equipment and piping to be worked on must be in a zero-energy state with all potentially hazardous stored or residual energy released.
    c. Upon completion of the work that necessitated the shutdown, remove Contractor locks and advise the Engineer that the facilities are available for use. Re-energizing the system shall be performed only by the Owner.

F. Safe work environment

1. In the event that piping or utilities are encountered that are not shown on the drawings, promptly notify the Owner and the Owner's representatives. Such piping and utilities shall not be disturbed without prior approval of the Owner.
2. Provide lighting such that construction areas, roadways, offices, shops, corridors, process areas, storage areas, etc. are illuminated in conformance with OSHA (Electrical, Construction Part 1926) to not less than the minimum illumination intensities (foot candles) listed in Table D.3 while any work is in progress.
3. Pipelines, conduits, channels, wet wells, and tanks may contain accumulations of putrescible materials which will remain on the walls and inverts. These materials may emit noxious, odorous, and hazardous gases such as hydrogen sulfide and methane. Ventilate and test the air of all confined spaces prior to entry in accordance with OSHA and the Site Safety Plan.
4. Flush and clean all process channels, conduits, wet wells, manholes, pipelines and tanks, etc. after they have been removed from service and dewatered. Provide a safe work environment for workers in compliance with OSHA and other site safety requirements. This may require disinfection of surfaces.

G. Noise control

1. Provide necessary sound attenuation devices around equipment necessary for maintenance of plant operations. Equipment requiring sound attenuation includes, but is not limited to, pumps, generators, and blowers. Sound attenuation shall be such that the noise level at the property line shall not exceed 50 dBA.

1.6 WORK DURING DRY WEATHER AND LOW FLOW CONDITIONS

A. Perform the work specified herein at such times that are acceptable or agreed to by the Owner and in accordance with the General Conditions. As explained below, additional timing restrictions apply where specified and where work reduces the capacity of either the Influent Screening Building and Influent Pumping System.

B. Coordinate with and obtain approval from the Owner and Engineer prior to scheduling and commencing work during dry weather, low flow, and very low flow conditions. A contingency plan must be submitted for restoring full 150 MGD pumping and screening capacity for each step of the work to be performed whenever there is reduced screening or conveyance capacity.

C. In the event that influent flows exceed the capacity of the influent pumping system at any time during construction, immediately implement contingency plans (e.g. remove plugs to return wet wells to service or reconnect piping) to restore influent pumping system capacity.

D. Dry Weather Conditions

1. Work must be performed during dry weather conditions where specified or else when any of the following are true:

a. The total capacity of all of the Influent Pumping System's existing and new pumps in service is less than 140 MGD, excluding the following:

1) The influent bypass pumping system.
2) New pumps that have not been started, tested, and commissioned.

3) New or existing pumps with suction or discharge piping that have not successfully completed testing.
4) If a wet well is out of service, the wet well's corresponding existing and new pumps. Pumps may still be considered in the total capacity calculation in this scenario if the wet well can be returned to service within 1 hour of notice from the OCO without compromising quality of work and without risking damage to pumps.

b. Only one of the Influent Pumping System's two force mains – East Force Main and West Force Main – is in service.
c. Only two of the Influent Screening Building's influent screens are in service. Further timing restrictions, below, apply in this condition.

2. Dry weather conditions must satisfy all of the following:

a. Average daily pumped influent flow rate over the previous 48 hours is less than 60 MGD.
b. Less than 1-inch cumulative rainfall is recorded in the facility's service area in the previous 72 hours.
c. No rain is forecast in the facility's service area for either the upcoming 72 hours or forecast duration of work to be performed during dry weather, whichever is longer.

E. Low Flow Conditions

1. Work is to be performed during low flow conditions where specified or else when any of the following are true:

a. The total capacity of all of the Influent Pumping System's existing and new pumps in service is less than 100 MGD. The same exclusions apply when determining total capacity as noted above for dry weather conditions.
b. Only two of the Influent Screening Building's influent screens are in service.

2. Schedule work to be performed during low flow conditions during dry weather and between the hours of 1:00 am and 9:00 am, excluding holidays. This corresponds to lowest influent flow periods at the facility which are early weekday and weekend mornings.

F. Very Low Flow Conditions

1. Work is to be performed during very low flow conditions where specified or else when the total capacity of all of the Influent Pumping System's existing and new pumps in service is less than 90 MGD. The same exclusions apply when determining total capacity as noted above for dry weather conditions.
2. Schedule work to be performed during very low flow conditions during dry weather and between the hours of 3:00 am and 9:00 am, excluding holidays.

G. Timing constraints for work performed during low flow and very low flow conditions shall not relieve the Contractor from compliance with local noise ordinances and project specific requirements. See Section 011000 "Summary".

H. If and where work during low flow conditions and very low flow conditions cannot be completed in a single day, phase work so that it can be completed across multiple days.

I. Anticipate wet-weather related project delays. Include at least 30 calendar days for wet-weather related project delays in the construction schedule.

1.7 CONSTRAINTS DURING CONSTRUCTION

A. Access for lower levels in Main Equipment Building (Building B)

1. The Contractor may request from the Owner, the use of the existing overhead Bridge Crane for installation and demolition purposes of the work within the Main Equipment Building. Availability of the Bridge Crane will be contingent on the condition of the crane at the time the work is being conducted and will need to be coordinated with the Owner a minimum of 30 days prior to the scheduled date of any work requiring use of the crane. The Owner does not make any guarantee as to the condition, availability or operability of the bridge crane. Should the bridge crane not be operable or available for use, the Contractor shall provide alternate means to perform the work for which the crane was requested at no additional cost.

    a. Use of the Owner's bridge crane will require confirmation of its load capacity and/or operability. See Supplementary Conditions. Inspection and certification of the bridge crane must be conducted at least six months in advance of use. A timeline for testing and potential repairs should be included in the construction schedule.

2. Engage the services of a licensed rigger and/or New York State licensed crane operator where necessary to perform the work.
3. A single access opening is available for lowering large equipment and materials down into the below grade levels of the Main Equipment Building via an existing bridge crane.

    a. The clear opening at El. 15.50 is approximately 12.7-ft x 21.9-ft.
    b. The clear opening is reduced to approximately 10.0-ft x 12.9-ft at El. 4.50 excluding obstruction by the existing low pressure steam pipe which is to be partially relocated.
    c. The clear opening is further reduced to approximately 10.0-ft x 11.5-ft at El. -6.50.

4. A bridge crane is not available in the pump dry well. Provide temporary materials and equipment for construction as necessary. If chain falls are required to lift, align, or hold heavy loads such as piping, valves, and pumps, the top hook can be attached to existing exposed beams.
5. Prior to picking large loads (e.g. use of bridge crane), placing heavy loads (e.g. pipes and pumps), or temporary connections to new or existing facilities (e.g. rigging with chain falls) within buildings, prepare and submit calculations signed and sealed by a Professional Engineer registered in the State of New York confirming the existing structure's or equipment's capacity for the proposed work. Any wear or damage to existing structures or equipment must be promptly restored to pre-existing condition at no additional cost.

B. Facilities Operations

1. The OCO will operate valves and equipment as necessary for diverting flow, draining tanks, etc. Provide a minimum 2 weeks notice where the OCO operation is required. However, it is emphasized that the operations of the existing facilities take precedence over all construction activities. Operational assistance given to the Contractor by the OCO will be provided when the OCO's schedule and manpower permit. Such assistance by the Owner may be limited on specific occasions because of process limitations, wet weather flows or unavailability of personnel. Delays caused by such limitations shall be expected and shall not be the basis for claim of extra costs by the Contractor.
2. All work connecting with, cutting into, and reconstructing existing pipes, duct, or structures shall be planned to minimize the impact on the operation of the existing facilities. Anticipate that these activities may need to be scheduled when the demands on the facilities best permit such interference, even though it may be necessary to work outside of normal working hours to meet these requirements.
3. Portions of some pipelines must be in service while alterations are being made on other portions. Provide blind flanges, plugs, caps, and other piping and fittings as necessary to seal all open ends of piping systems to be in service. Valve closure alone will not be considered sufficient for sealing open ends of piping systems. All temporary piping and supports required to keep piping systems in service shall be provided by the Contractor. The Contractor is responsible for the stability of all partial piping systems and shall provide temporary bracing as required, especially where modifications are required around unrestrained couplings.
4. All wastewater within pipes to be opened shall be collected and discharged into the plant influent system. Wastewater shall not be pumped to nor allowed to flow to any of the existing storm drainage system, overland to adjacent water bodies, or into the Owner's sump/collection systems.
5. Before starting work that will interfere with the operation of existing facilities, do all possible preparatory work and see that all labor, tools, materials, and equipment are made ready. Also assist in instructing operations and maintenance personnel in all new operating procedures.
6. Heating, ventilation, and, if needed, air conditioning shall be provided for and maintained in the existing buildings and temporary facilities. Temperatures to be maintained in any areas occupied by WPCP operating personnel shall be at least 65 degrees F in cold weather months and maximum of 78 degrees F in warm weather months unless otherwise noted. The temperatures to be maintained in all other interior WPCP areas, whether new, existing, or temporary, shall be a minimum of 55 degrees F and a maximum of 104 degrees F. Electrical Rooms shall be maintained at a maximum temperature of 85 degrees F.
7. New equipment and/or treatment units may not be used until specified testing and acceptance procedures are completed and written authorization for use is given by the Engineer, Owner, and OCO.

C. Disruptions to Facilities Operations

1. Conveyance and treatment of flows to and through the treatment facility shall not be interrupted in any capacity except as stipulated in this Contract or otherwise approved by the Owner. All shutdowns or limited capacity periods shall occur only upon written request and with prior written authorization from the Owner and the OCO. Such authorizations will be limited to times when the capacities of units remaining in service permit.

2. Execute the work in the most expeditious manner when work requires limiting influent pumping capacity or shutdown of a portion of the plant. Plan the work by taking into consideration all potential problems that may be encountered.
3. Maintain readily available spare pumps, pipe and fittings, and all other equipment appropriate for the work for use in an emergency. Be prepared to work continuously (24 hours per day, 7 days per week) during the time when any units or pipelines are out of service that affect the treatment or conveyance processes.
4. Provide, maintain, and operate all temporary facilities such as dams, pumping equipment, conduits, and all other labor and equipment necessary to intercept sewage flow before it reaches the points where it would interfere with work, carry it past the area of work, and return it to the system after the area of work.
5. Existing plumbing and ventilation systems shall be kept in operation at all times. Systems to be removed or replaced shall be kept in operation until temporary and/or new systems have been tested, accepted and authorized for use. If sewers or drains must be taken out of service to facilitate construction operations, alternative provisions shall be made to collect wastewater or drainage and dispose of them. Such wastewater shall be discharged within the treatment plant upstream of screening removal as approved by the Owner.
6. Unless specified differently, when open tanks and channels have to be taken offline to accommodate the construction, the Owner will operate the necessary gates and valves to accomplish this work. The Contract Operator is responsible for draining and refilling tanks and channels. The Contractor is responsible for removal and disposal of accumulated solids out of the bottom of the tanks and channels and cleaning and disinfecting tanks and channels prior to making modifications.
7. Electric power (i.e., both normal utility power and standby generator power), as well as lighting service shall be uninterrupted in all areas that remain in operation except as otherwise specified herein.
8. Existing instrumentation and controls shall remain fully functional except as otherwise specified herein.
9. Prior to every instance of removing an influent pump from service, test the total capacity of the influent pumps to remain in service. Obtain written acknowledgement of the test results and authorization for removal of the influent pump from service from the Engineer, Owner, and OCO.
10. All new pumps must be installed with piping, conduit and wire and controls to the fullest extent possible such that when the discharge piping connection, wet well connection or suction pipe connection are ready to be made, and are isolated by the Owner, there is minimal work to be completed to allow the wet well, discharge piping or suction piping to be put back into service within the time frames allowed under each activity and in accordance with the approved sequence of operation.

D. Normal Working Hours

1. The facility's normal working hours are Monday through Friday, 7:00 a.m. to 3:30 p.m. During this time, the plant is fully staffed. The plant is minimally staffed between 3:30 p.m. and 7:00 a.m. Contractor will plan and schedule their regular construction activities during normal working hours, to the extent practicable. Should it be necessary for the Contractor to perform work outside normal working hours, notify the Engineer at least 2 weeks prior to conducting such work to allow for any required coordination and/or effort from the OCO or modifications to the plant operations.

E. Staging and Temporary Facilities

1. All temporary systems and facilities provided by the Contractor shall be demonstrated to be operational to the satisfaction of the Engineer, Owner and OCO before any existing systems can be removed from use, see Section 01 50 00 “Temporary Facilities and Controls”. The temporary facilities are critical to the operation of the wastewater treatment facilities.
2. Availability of the facilities must be maintained at all times. Respond to requests from the Engineer for repair and maintenance of temporary facilities immediately within 60 minutes (7 days per week, 24 hours per day, including holidays). If the Contractor fails to immediately respond to requests for repair and maintenance within 60 minutes, such repair and maintenance may be performed by the OCO. All costs associated with such repair and maintenance performed by the OCO shall be the responsibility of the Contractor, including the costs of the Engineer and the Owner’s own staff.
3. Screened Influent Bypass Pumping System:

    a. The construction sequence is such that spare (e.g. N+1) influent pumping capacity will not be continuously available throughout the work.
    b. Install and maintain a supplementary bypass pump system to convey a minimum of 30 MGD of flow from the Influent Screening Building (E) to the Grit Tanks ahead of any step that does not meet 150 MGD capacity with the highest capacity active existing or new influent pump out of service. The OCO will operate the supplementary bypass pumping system. Promptly provide and fill equipment with fuel when requested by the OCO.
    c. See Section 01 57 28 “Temporary Bypass Pumping Systems” and Drawing G-005.

4. When existing heating, ventilation, and cooling systems are demolished, provide temporary heating, ventilation, and cooling systems as necessary to comply with above temperature requirements and to maintain a safe atmosphere for personnel to inspect, maintain, and operate existing facilities.
5. Any Contractor staging areas used on-site shall not disrupt current plant operations. All facility access roads shall remain unobstructed throughout construction for staff use, sludge hauling, septage truck deliveries, chemical deliveries, emergency vehicles, and any other purpose required by plant activities except as required for specific stages of the Work. Access to/from the site shall be maintained as specified in Section 011000 “Summary.”

F. Service interruptions for utility relocations:

1. The utilities listed in the following table will be rerouted as part of the project, requiring temporary interruption of service. The following paragraphs summarize limitations related to outages for each service including the maximum allowable shutdown duration.
2. The Contractor shall construct new service piping, supports and appurtenances as completely as possible prior to shutdown and tie in to minimize the duration of the service outage. Each service shall be placed back into service within the time frames indicated herein.
3. The Contractor shall coordinate with and obtain approval from the Engineer, Owner and OCO ahead of any service shutdown. The Contractor shall engage the OCO to isolate and/or remove any service from operation.
4. If interruption of any services not listed below is proposed, promptly notify the Owner and the OCO and request information on constraints for the service interruption. Except where otherwise specified, assume that services cannot be interrupted for more than 8 hours.

5. Sizes of services listed below are strictly for reference as the predominant size anticipated to be interrupted for proposed work. Impacts, allowable shutdown durations, construction actions, timing of actions, and special considerations are independent of sizes listed unless expressly noted otherwise.
6. 3" Sodium Hypochlorite piping

    a. Location: Main Equipment Building B
    b. Source: Generator Building
    c. Impacts: Screen Building influent channel odor control
    d. Maximum allowable shutdown duration: 2 days. Make temporary provisions and obtain approval from Owner, Engineer, and OCO for longer duration.
    e. Construction action: Reroute piping.
    f. Timing of action: Piping reroute to be completed prior to Phase G2 (see Section 1.9 below)
    g. Special Considerations:

        1) No special considerations.

7. 6" and 8" Hydraulic Oil supply and return piping

    a. Location: Main Equipment Building B
    b. Source: Hydraulic oil tank
    c. Impacts: Cone valve actuators
    d. Maximum allowable shutdown duration: The lesser of 6 hours or until an influent pump either has started or stopped. Make temporary provisions and obtain approval from Owner, Engineer, and OCO for longer duration.
    e. Construction action: Temporarily reroute piping and demolish.
    f. Timing of action: Piping reroute to be completed prior to Phase G2 (see Section 1.9 below). Demolition to be completed upon demolition of all existing cone valves.
    g. Special Considerations:

        1) Hydraulic Oil Supply: Relatively critical system. If there is a power loss or a need to change a raw sewage pump, the action cannot be performed.
        2) Hydraulic Oil Return: Relatively critical system. Provide multiple tie-in points for each pipe and provide auxiliary hydraulic units as needed to maintain operation with one hydraulic unit available in standby at all times.

8. 6" Low Pressure Air

    a. Location: Main Equipment Building B
    b. Source: Blowers
    c. Impacts: Influent screening chamber air (bubblers, air diffusers, gate seals, instrument air)
    d. Maximum allowable shutdown duration: 2-3 weeks. Make temporary provisions and obtain approval from Owner, Engineer, and OCO for longer duration.
    e. Construction action: Permanent reroute
    f. Timing of action: Piping reroute to be completed prior to Phase G1 (see Section 1.9 below).
    g. Special Considerations:

1) No special considerations.

9. 16” Low Pressure Steam

a. Location: Main Equipment Building B
b. Source: Engine Heat Recovery System
c. Impacts: Steam to Fuel Oil Heat Exchanger, Steam to Water Heat Exchanger, Absorption Chillers.
d. Maximum allowable shutdown duration: 2 weeks per year. Make temporary provisions and obtain approval from Owner, Engineer, and OCO for longer durations if needed.
e. Construction action: Permanent reroute
f. Timing of action: Piping reroute to be completed prior to Phase G2 (see Section 1.9 below).
g. Special Considerations:

1) Low pressure steam service cannot be disrupted when there is a likelihood of below-freezing outside air temperatures. The Owner prefers this work is performed during summer or spring in order to limit impacts.
2) Low pressure steam service cannot be disrupted simultaneously with the boiler feedwater line.
3) When this service is disrupted, there is a potential hazard since the steam relief goes out through the roof and may require the Owner to publish notice to the public several weeks in advance. For work requiring disruption of the low pressure steam service, submit a detailed procedure for proposed work, indicate the estimated durations of the disruption, and identify contingency plans for promptly reinstating service if requested by the Owner.

10. 8” Screened Effluent

a. Location: Main Equipment Building B
b. Source: Generator Building
c. Impacts: Hydrant and cooling water for blowers.
d. Maximum allowable shutdown duration: 30 min.
e. Construction action: Permanent reroute
f. Timing of action: Piping reroute to be completed prior to Phase G2 (see Section 1.9 below).
g. Special Considerations:

1) Extremely critical. Interrupting the blower cooling requires shutting down equipment that is extremely critical for the process.
2) Where longer shutdowns are required, obtain approval from Owner, Engineer, and OCO for the Contractor to make temporary provisions to supply hydrant and cooling water from an alternative source.

11. 3” Boiler Feedwater

a. Location: Main Equipment Building B
b. Source: Employee Building
c. Impacts: Engine Heat Recovery System

d. Maximum allowable shutdown duration: 24 hours. Make temporary provisions and obtain approval from Owner, Engineer, and OCO.
e. Construction action: Permanent reroute
f. Timing of action: Piping reroute to be completed prior to Phase G2 (see Section 1.9 below).
g. Special Considerations:

1) Critical system. A temporary water source (at least 100°F) is required.
2) Coordination with the OCO is needed to drain the line.
3) Cannot occur at the same time as the reroute of the low pressure steam line.

12. 3” Condensate Return

a. Location: Main Equipment Building B
b. Source: Steam to Fuel Oil Heat Exchanger, Steam to Water Heat Exchangers, and Steam Traps
c. Impacts: Engine Heat Recovery System
d. Maximum allowable shutdown duration: 2-3 weeks. Make temporary provisions and obtain approval from Owner, Engineer, and OCO for longer duration.
e. Construction action: Permanent reroute
f. Timing of action: Piping reroute to be completed prior to Phase G2 (see Section 1.9 below).
g. Special Considerations:

1) Coordination with the OCO is needed to drain the line.

13. 1.5” Protected Water

a. Location: Main Equipment Building B
b. Source: Main Equipment Building B
c. Impacts: Protected water heater
d. Maximum allowable shutdown duration: 1 week. Make temporary provisions and obtain approval from Owner, Engineer, and OCO for longer duration.
e. Construction action: Demolition.
f. Timing of action: Demolition to be completed prior to Phase G6 (see Section 1.9 below).
g. Special Consideration:

1) This should occur prior to any pump demolition. As long as the operating pumps can be swapped out, the shutdown should not be critical.

14. Pump Room Sump Pumps and Discharge Piping

a. Location: Main Equipment Building B
b. Source: Pump Room Sump Pits
c. Impacts: Pump Room dewatering
d. Maximum allowable shutdown duration: This system must operate continuously.

1) Remove at most one of two sump pump systems at a time. If both sump pump systems must be removed simultaneously, make temporary sump pump provisions and obtain approval from Owner, Engineer, and OCO.

Temporarily cap piping and coordinate with the Owner to close sump pump system valves as necessary for isolation.

2) Existing isolation valves are available on the piping system. If the valves do not seat watertight, provide supplemental plugs or caps as necessary so that the system can discharge into either the East Wet Well or West Wet Well at all times.

e. Construction action: Selective demolition and replacement
f. Timing of action: As required to maintain operation of existing facilities throughout construction of the work.

15. Influent Pumping System Seal Water

a. Location: Main Equipment Building B
b. Source: Main Equipment Building B
c. Impacts: Influent pumping system
d. Maximum allowable shutdown duration: Pump seal water can only be shutdown when the affected pumps can be taken offline in coordination with the Owner and the OCO. See Part 1.6 for timing restrictions when pumping capacity is reduced, make temporary provisions where necessary, and obtain approval from Owner, Engineer, and OCO.
e. Construction action: Demolition and construction.
f. Timing of action: Demolition of the existing system is to be completed after all existing influent pumps are removed from service. The new system must be in operation prior to new pumps going into service.

16. Influent Pumping Surge Relief

a. Location: Main Equipment Building B
b. Source: Main Equipment Building B
c. Impacts: Influent pumping system
d. Maximum allowable shutdown duration:

1) Surge relief protection is essential for normal operation of the existing and new influent pumping system and cannot be out of service except where strictly necessary to perform work during dry weather conditions as defined in Part 1.6.
2) Provide temporary piping if needed to reinstate surge relief piping as soon as possible. The surge relief system cannot be out of service for more than 8 hours under any circumstance.
3) The surge relief system cannot be taken offline if there are power source or power quality issues which increase the likelihood of pump shutdown due to loss of power.

e. Construction action: Demolition and construction.
f. Timing of action: The existing surge relief system is to be maintained throughout construction until the demolition of existing piping is completed. The new surge relief system is to be maintained in operation as soon as it is necessary for surge relief for new piping.

17. 4” Drain Piping

a. Location: Main Equipment Building B
b. Source: Tunnel Floor Drains, Mechanical Room Floor Drains
c. Impacts: Tunnel, Mechanical Room
d. Maximum allowable shutdown duration: 1 day. Provide temporary provisions for drainage for longer durations.
e. Construction action: Permanent reroute
f. Timing of action: Piping reroute to be completed prior to Phase G2 (see Section 1.9 below).

18. Chilled Water Return

a. Location: Main Equipment Building B
b. Source: HVAC Coils in Generator Building
c. Impacts: Employee Building Chilled Water System
d. Maximum allowable shutdown duration: 8 hours. Provide temporary provisions for chilled water return for longer durations.
e. Construction action: Permanent reroute
f. Timing of action: As required to maintain operation of existing facilities throughout construction of the work.

19. Heating Hot Water Supply

a. Location: Main Equipment Building B
b. Source: Steam to Water Heat Exchangers
c. Impacts: Plant Heating Hot Water System
d. Maximum allowable shutdown duration: 8 hours. Provide temporary provisions for hot water supply for longer durations.
e. Construction action: Permanent reroute
f. Timing of action: As required to maintain operation of existing facilities throughout construction of the work.

20. Heating Hot Water Return

a. Location: Main Equipment Building B
b. Source: HVAC Coils in Main Equipment Building B
c. Impacts: Steam to Water Heat Exchangers
d. Maximum allowable shutdown duration: 8 hours. Provide temporary provisions for heating hot water return for longer durations.
e. Construction action: Permanent reroute
f. Timing of action: As required to maintain operation of existing facilities throughout construction of the work.

21. Wet Well Exhaust Ductwork

a. Location: Main Equipment Building B
b. Source: East and West Wet Wells
c. Impacts: Exhaust to odor control system
d. Maximum allowable shutdown duration: 8 hours.
e. Construction action:

1) Permanent reroute for the West Wet Well exhaust.

2) Temporary reroute and replacement as needed for East Wet Well exhaust.

f. Timing of action: As required to maintain operation of existing facilities throughout construction of the work. Wet well exhaust ductwork can only be taken out of service when the corresponding wet well is isolated from influent flows.

1.8 GENERAL SEQUENCE OF CONSTRUCTION NOTES

A. In review of the proposed work sequence, see the following drawings which provide overviews of major elements of work:

1. Drawings G-006 and G-007 depict the influent pumping system's existing and proposed process flow diagrams.
2. Drawings ED-101 and E-101 depict the existing and proposed electrical 4160V plant distribution one-line diagrams.
3. Drawings HG-004, HG-005, HG-006, and HG-007 depict the existing and proposed HVAC general airflow diagrams.

B. General

1. The Owner and the OCO will continue operating the influent pumping system and its other facilities within the work area throughout construction. It is imperative to maintain accurate red-line as-built drawing markups at all times and regularly submit copies to the Owner, OCO, and Construction Manager.
2. Not all work is detailed within the suggested sequence of construction.
3. In advance of performing any work that reduces the capacity or redundancy of the influent screening or influent pumping system, coordinate with Owner, Engineer, and OCO to determine if the supplementary bypass pump system should be operated.
4. Assume that existing valves, gates, and other devices are inoperable and subject to leaking. The Contractor shall be responsible for designing, furnishing, installing, maintaining, monitoring, and removing all temporary devices, plugs or bulkheads necessary to isolate or dewater pipes, channels, wet wells, or conduits to perform their work.
5. Contractor is responsible for the proper sequencing of the various disciplines of work (e.g. structural pedestal supports must precede pipe installation). Coordinate disciplines' work.
6. The plant has experienced failures in at least one of the dresser couplings on the 48-inch discharge pipe to be demolished under this Contract. The dresser couplings are unrestrained and cannot be relied upon to transfer forces across the piping once the adjacent pipe or supports are removed. Design, furnish, install and remove all temporary supports, thrust blocks, and bracing required to prevent movement of the existing piping throughout construction sequencing and while the pumps are in operation.
7. Owner-Furnished/Contractor-Installed (OFCI) Products

a. The Owner will pre-purchase electrically actuated valves of various sizes which are to be installed under this contract. See Section 011000 "Summary" for Contractor's responsibilities. Coordinate earliest available Owner-furnished delivery dates with the Owner and designate delivery dates in construction schedule.

8. The sequence of construction relies upon operation of new influent pumps in interim configurations. Install new influent pumps and associated equipment such as pump starters, level instruments and control panels such that their operation in interim configurations by the OCO will not void any warranties or guarantees. Coordinate manufacturer inspection of temporary configurations, implement temporary measures, and modify the construction sequence as necessary to maintain warranties and guarantees.

    a. Construction of concrete baffle beams is proposed in Phases G9 and G13. If the new pump manufacturer indicates that proposed interim operation of the new pumps without baffles would void any warranties or guarantees, then construct concrete baffle beams after installation of the bypass pumping systems and before installation of new pumps.

9. Except where otherwise noted in the Contract Documents, the Owner will operate valves and equipment as necessary to support the Contractor's dewatering of existing tanks, wet wells, channels, and pipelines when requested in support of the Contractor's work.

    a. Scheduling of Owner dewatering operations is subject to Owner's availability and to the Owner's receipt of adequate notice from the Contractor.
    b. Assume that the Owner will be unable to fully dewater existing tanks, wet wells, channels, and pipelines. Any remaining water, sludge, grit, solids or other material in wet wells, channels, and pipelines must be tested, removed, hauled, and disposed by the Contractor.
    c. The existing pumps have historically been used to reduce the WSE of the existing wet wells to an approximate WSE of -25.75' (9.0' deep). Further dewatering requires other means.
    d. Provide all materials and equipment such as pumps, piping, controls, instruments, and valves necessary for dewatering, draining, venting, cleaning, and disinfection.
    e. The determination of where the contents of a tank, wet well, conduit, pipe or channel can be discharged is included in each specific MOPO activity or shall be defined by the Owner based on the plant conditions at the time of the work.
    f. If a drain connection is not available on the pipe to be drained, then a wet tap shall be made using a tapping saddle and valve by the Contractor. Wet taps shall be located on piping to be removed unless there is no feasible alternative.
    g. No uncontrolled spillage of contents being dewatered shall be allowed. Immediately wash down and corral any spillage to an appropriate location for dewatering, draining, handling, and disposal as necessary.
    h. If the Owner grants permission to use existing or proposed floor drains, sumps, or sump pumps for the Contractor's dewatering operations, promptly flush the drains, sumps, pumps, and pipelines to prevent clogging or septic conditions.
    i. The Contractor shall be responsible for draining and disposal of hydraulic oil where necessary.

10. Plan to perform dewatering, cleaning and disinfecting of conduits, tanks, pipelines, and channels as many times as necessary to construct systems in accordance with the approved construction schedule.
11. Pump and Equipment Installation

    a. Valve actuator control panels and control stations must be constructed ahead of installation of the corresponding new valves.

b. Cone valves and their respective electro-hydraulic actuator systems must be installed prior to placing the respective pump into operation.
c. Gate valves and their respective electric actuators and actuator control panel must be installed prior to placing the respective pump into operation.
d. Each phase of the Sequence of Work cannot be completed until all equipment is tested and accepted. Perform equipment testing in accordance with but not limited to the following sections:

1) Section 400557 “Actuators for Process Valves and Gates”
2) Section 400565.13 “Cone Valve”
3) Section 400593.13 “Medium-Voltage Motor Requirements for Process Equipment”
4) Section 432341 “End Suction Solids Handling Pumps”

e. All testing for pumps, motors, switches, starters, etc. are to be complete and approved before the pump is considered fully operational.
f. The installation of baffle walls, level monitoring equipment, etc. shall be fully completed in both wet wells, prior to the commissioning of the complete pump system.

12. Unless otherwise approved by the Owner and Engineer, all shutdowns shall be limited and shall be in accordance with this specification.
13. Field verify existing conditions prior to implementing any modifications. Verification shall confirm safe work conditions, minimize required shutdown durations, and ensure a controlled and seamless transition between phases. Immediately report any discrepancies or unforeseen conditions to the Engineer. Contractor shall also verify the condition of existing Controls and field signals to mitigate the disruption of operation of equipment scheduled to remain in service during each stage of construction.
14. Work includes removal of solids from the West Wet Well and East Wet Well. The volume of solids to remove may be substantial. Anticipate that removal of solids will need to be performed over a series of very low flow periods as defined in Part 1.6.
15. Full requirements to start-up, test, inspect, obtain approvals, commission, and submit documentation such as O&Ms as applicable for all temporary and new work prior to placing temporary and new work into service are not explicitly stated in the proposed work sequence for brevity.

C. Demolition

1. Perform all demolition activities in a safe manner and in accordance with governing codes and standards.
2. Prior to commencement of any demolition activity, the Contractor shall complete all preparatory work including installation of temporary supports, barriers, dust containment systems, dewatering or groundwater control systems, and protective measures required to maintain operation of existing facilities. All demolition work shall be performed such that there is no adverse impact to sensitive equipment such as motors, coupling, electrical equipment, etc.
3. Prior to demolishing the existing 48-inch discharge piping and its penetration in the east wall of the Main Equipment Building, drain the pipeline, observe, measure, and report to the Owner whether any other sources of water are infiltrating or leaking into the pipeline. Request Owner direction and support further investigations to determine source of the water if observed.

D. Process Mechanical

1. Where the construction sequence requires operation of existing, temporary, and new equipment, submit a request to the OCO a minimum of two weeks in advance. The OCO shall operate such equipment unless expressly permitted in writing by the OCO and Construction Manager.
2. Except for GV-2W and GV-2E, the existing gate valves on the influent pumping system's suction and discharge piping within the Main Equipment Building are unreliable:

    a. Assume that the unreliable gate valves cannot be used to isolate portions of the system during construction. However, subject to approval of the Owner, OCO, and Engineer, the Contractor may attempt to close valves and check whether they seat adequately watertight. Because of the potential for issues reopening a valve, attempts to close valves will only be permitted when valves no longer need to be open for the remainder of construction.
    b. Hot taps and line stops are proposed on the 48-inch discharge piping to isolate portions of the system in order to maintain pumping operations throughout construction. It is anticipated that line stop deployments will require approximately 20-ft of perpendicular clearance and 10-ft of straight 48-inch diameter to accommodate installation. Coordinate and provide adequate clearance for this work.

3. Initial solids removal from the West Wet Well, East Wet Well, and piping to be plugged may be substantial. Therefore, conduct solids removal over a series of low flow and very low flow periods, as defined in Part 1.6.
4. Maintain the existing seal water system until all pumps are removed from service. The new seal water system shall be constructed before the first pump is brought into service. Each new pump shall be connected into the new seal water system before they are brought into service.
5. Hydraulic oil systems and the necessary connections to existing valves shall be maintained at all times.
6. Service and seal water systems and the necessary connections to existing equipment shall be maintained at all times.
7. All new piping and valves are to be pressure tested in accordance with the Process Interconnection specifications and the pipe schedule prior to being placed in service.
8. Where the East and West force mains must be isolated from the Grit Tank:

    a. The knife gate valves on the grit tanks shall be LOTO when the force mains are taken out of service and dewatered.
    b. If any leakage is seen through these valves, plugs shall be installed in the grit tanks downstream of the valves when needed.
    c. To isolate the East Force Main, close respective valves beneath the grit tank influent boxes. Drain the pipe in the influent pumping system to the active influent wet well.
    d. To isolate the West Force Main, close respective valves beneath the grit tank influent boxes. Drain the pipe in the influent pumping system to the active influent wet well.
    e. Means and methods for safely draining and venting the pipe are to be provided by the Contractor. It is anticipated that the approach will vary depending on the phase of construction and piping configuration.

f. Prior to bringing either force main back into service with pumped flow, fill the force main with plant water and vent air from the piping in order to charge the pipeline and reduce the impact of surging from the grit tanks. The valves near the grit tanks should be opened before flow is pumped through the respective force main to avoid pumping against closed valves.

E. HVAC

1. Maintain operation of building heat and ventilating systems at all existing and new structures.

   a. Where necessary, make provisions to install temporary heating and ventilation systems for existing and new structures in which the operation of existing and new heating and/or ventilation systems must be interrupted.
   b. Maintain minimum and maximum temperatures indicated further above.
   c. Minimum ventilation rates for temporary systems shall be equal to the existing rates or in case of new structures, the permanent ventilation rate.

2. Test and balance new and existing airflow devices throughout construction.

F. Electrical

1. Where the construction sequence requires operation of existing, temporary, and new equipment, submit a request to the OCO a minimum of two weeks in advance. The OCO shall operate such equipment unless expressly permitted in writing by the OCO and Construction Manager.
2. Coordinate with Structural for installation of new equipment pads throughout all phases of work. It is critical that the sequence provides adequate time for new concrete to cure.
3. Implement and strictly enforce LOTO procedures prior to commencing any work. All energy sources shall be identified, isolated, locked and verified to achieve a zero-energy state in accordance with OSHA 29 CFR 1910.147 and project requirements.

G. Instrumentation

1. Influent pumping system's flow rates, including those of the temporary bypass pumping system, must be continuously accurately measured and reported. Provide temporary transit time flow meters and perform temporary integration of flow metering signals as needed to maintain continuous flow monitoring throughout construction.
2. Modifications of existing controls equipment (including but not limited to PLC-ECR control panel wiring, PLC logic, OIT software update and ancillaries) must account for the impact on equipment that will remain in service during construction. Any work that could affect operating equipment shall be approved by and coordinated with the Construction Manager and OCO.
3. Rewiring and modifications of PLC-ECR (E-stops, indicating lights, PLC program and OIT screen displays) shall be coordinated with the Construction Manager, the OCO, and subcontractors, so functionality of controlled equipment (Blowers, and remaining operating Influent Pumps) is not affected.
4. Complete rewiring of E-stops on existing PLC-ECR before installing each Pump Control Panel (PCP).

a. Request PLC-ECR wiring schematics, PLC logic, and OIT display configuration files through the Construction Manager and complete preparatory work before beginning PCP installation.
b. Control panel modifications, proposed activity sequencing, anticipated shutdowns, and potential interferences with other equipment, including blowers, shall be reviewed and approved by the Engineer before implementation.
c. Contractor and Integrator shall coordinate with the Owner's Operator and Construction Manager mitigation plans that minimize disruption of equipment controlled or monitored by PLC-ECR during its upgrades.

5. Installation of Pump Control Panels (PCP-0050-1 through 6) and their ancillary devices shall follow the installation of new pumps as they are installed and put in service, and in accordance with the construction sequences specified herein.
6. Installation of the main Influent Pumping System Control Panel (PLC-IPS) is required for the automatic level control of the wet wells as well as monitoring of multiple new devices (wet well radars, discharge header flowmeters and pressure transmitters) and multiple actuators and field devices. As such, installation of the PLC-IPS shall be coordinated to provide this functionality as shown. Monitoring of wet well levels during construction through the existing-to-remain ultrasonic level transducers via the existing PLC-ECR shall remain at all times of construction. Relocate these instruments and their accessories as required to prevent physical interference with the new radars, their stilling wells, and temporary construction.
7. Once each pump train (with all equipment and ancillaries between and including the isolation gates) is assembled, its components must be fully controllable from its own PCP and PLC-IPS, including complete starting and stopping sequencing logic.
8. Once all pumps are installed and independently tested, the SCADA tie in through PLC-IPS and all its specified control logic shall be tested as specified.
9. The influent pumping system will be operated in various interim configurations:

a. OIT displays and associated programming must be updated continuously throughout construction to reflect the interim configurations such that the Owner and the OCO can operate the influent pumping system at all times without placeholder values, nuisance errors, erroneous alerts, graphical anomalies, inactive buttons/functionality, or other disruptions that could cause confusion for operators. Statuses, values, alarms, notifications, and any relevant functionality must be implemented for any active equipment.
b. Once Logic and OIT Screens are successfully tested on OIT-IPS, these new displays shall be used to update the existing Influent Pump OIT screen displays on OIT-ECR.

H. Structural

1. Contractor shall provide all temporary shoring, bracing, supports, bulkheads, excavation support systems, and temporary structural systems required to complete the Work.
2. Structural activities shall not impair continuous operation of the influent pumping facilities. Structural demolition, concrete removal, drilling, coring, saw cutting, and support installation shall be coordinated with the applicable maintenance of plant operations requirements.
3. Existing structural elements supporting operating equipment, piping, valves, conduits, platforms, stairs, railings, or other systems required for plant operation shall remain in service until replacement systems have been installed, tested and accepted.

4. Concrete equipment pads shall be constructed in sequence with the necessary equipment to be installed in coordination with the sequence presented in this Specification. Contractor shall be responsible to provide temporary access stairs and platforms to the installed equipment as required until the final access stairs and platforms where required per the Contract Documents are installed.
5. All concrete work shall be cured to achieve the specified 28-day compressive strength prior to introducing any temporary or permanent live loads, verified by field prepared cylinders and testing.
6. Contractor is alerted that demolition and construction operations associated with each influent pump suction elbow replacement are below the groundwater table (finished grade approximately EL. +15.50 & bottom of demolition limits approximately EL. -35.75). Groundwater table elevation shall be assumed to be at finished grade and shall be field verified by the Contractor for the groundwater control design criteria. Prior to any demolition of concrete foundation elements, the Contractor shall submit a groundwater control design and procedure signed & sealed by a licensed New York State Professional Engineer, engaged by the Contractor, having experience in similar groundwater control applications. The groundwater control procedure shall be implemented after approval and before commencement of any foundation demolition.

    a. Include in the groundwater control procedure a mechanism for verifying that adequate groundwater control has been achieved prior to commencing demolition of the pump suction elbows, via pressure measurement or some other means. Include a procedure to obtain Owner and Engineer approval prior to starting pump suction elbow demolition work.
    b. If verification of adequate groundwater control cannot be achieved in accordance with the approved groundwater control design procedure, the Contractor shall stop work until the treatment or control approach is reassessed and procedures are revised and approved by the Owner and Engineer.
7. Wet Well Improvements

    a. Structural work within the East and West Wet Wells shall be performed only during the mechanical shutdown periods identified in this Specification. This includes, but is not limited to:

        1) Concrete fillet at suction pipe in East Wet Well,
        2) Concrete baffle beams,
        3) Wall pipe penetrations and sealing of existing openings,
        4) Miscellaneous concrete rehabilitation and repairs.

    b. For construction of the surge relief pipe penetration between West and East Wet Well:

        1) When one Wet Well is taken offline and dewatered, install temporary watertight bulkhead, designed by Professional Engineer registered in the State of New York, engaged by the Contractor, at location of wall penetration. Temporary bulkhead shall be designed to prevent wastewater from entering adjacent wet well based on maximum anticipated water surface elevation and to act as formwork for concrete placement around wall pipe penetration.

2) When opposite Wet Well is taken offline and dewatered, demolish existing concrete for new wall pipe penetration, install wall fitting, and restore concrete per Contract Drawings.
3) When Wet Well with temporary bulkhead is taken offline and dewatered, remove previously installed temporary bulkhead. Any anchors to be abandoned in place shall be type 316 stainless steel and cut flush with the wall surface upon completion of this work.

c. Stage work on the 36-inch suction piping for Pump A-3 / P-3 so that either the concrete opening within the wet well or the pipe running between the wet well and dry well, can be plugged at any time by inflatable plugs, blind flanges, watertight cover plates, or other approved method in the event that the East Wet Well is needed for additional pumping capacity.
d. Any new penetration or modification to the concrete wall of the wet well below the maximum wet well operating water level shall be tested for water tightness in accordance with the Specifications.

1.9 SUGGESTED SEQUENCE OF CONSTRUCTION

A. The order of construction shall be subject to the approval of the Engineer; such approval or direction, however, shall in no way relieve the Contractor's responsibility to perform the work in strict accordance with the Contract Documents. The Contractor shall note the requirements of this Section with regard to the operation of the facility and the phasing of construction when developing their work sequence. The Contractor's work sequence shall be specifically detailed in the schedule that is required under Section 01 32 00 "Construction Progress Documentation."

B. Some of the tasks below overlap one another in performance of the work. Numerical and alphabetical identification of the tasks does not necessarily conform with actual order of construction.

C. The work sequence presented herein is a partial outline only and does not purport to cover any sequences necessitated by the actual construction methods. Portions of the work not specifically itemized must be scheduled in accordance with the submittal requirements for the construction sequence. Account for all details in formulating a complete plan for implementation of the project.

D. An overview of the proposed work sequence is provided below. Although this work sequence is presented linearly in phases for clarity, work is to be performed concurrently whenever possible to expedite project completion and reduce downtime of facilities. Furthermore, work reducing the capacity of the influent screening or influent pumping system must be limited to dry weather, low flow conditions, and very low flow conditions as defined above in Part 1.6.

1. Field verify existing dimensions as necessary to support development of submittals.
2. Perform field testing on existing influent pumps in coordination with the OCO to confirm influent pumping capacity in the various configurations relevant to proposed sequence of construction. Document findings and incorporate field verified capacities into the Procedures for Maintenance of Plant Operation submittal.
3. Complete mobilization of the Contractor's workforce and temporary facilities and utilities such as the Engineer's Office and Contractor's Field Office(s).
4. Phase HBM:

a. Perform field sampling and testing for suspected hazardous materials (e.g. lead-based paint, asbestos-containing materials, PCBs, etc.) to supplement the findings included in Appendix D as necessary to classify materials, identify procedures for demolition and handling, and generally inform construction sequencing.
b. Throughout performance of the work, perform hazardous building materials mitigation as indicated on the HBM drawings. Perform this work as early as possible. Major components of mitigation work relate to the existing influent pumping piping, protected water piping, exhaust fans B-E-1 and B-E-2, Main Equipment Building stairwell, bearing access platforms, and all coated surfaces to be disturbed.
c. Not all work within the work areas designated on the HBM drawings can be performed simultaneously. Phase work in coordination with the overall sequence of construction as necessary.
d. The exhaust route indicated on Drawing HBM-103 leads to a hallway with window panels. Assume that these windows cannot be opened and plan to coordinate and perform removal of window assemblies with the Owner and Engineer as needed for installation of exhaust manifolds. Restore any disturbances in-kind to existing conditions upon completion of work.
e. This work must be closely coordinated with the Owner and the OCO since they will be unable to access the areas within the decontamination enclosure and Work Area during construction.
f. Before starting work that will interfere with the operation of existing facilities, do all possible preparatory work and see that all labor, tools, materials, and equipment are made ready. Assist in instructing operations and maintenance personnel in all new operating procedures.
g. Refer to Section 028200 “Asbestos Removal”, Subsection 3.05 for Work Area Preparation.

5. Phase S1:

a. Perform this Phase’s work incrementally throughout construction in coordination with other new and temporary work. For example, the shaft bearing access platforms for Pump A-2 must remain until Pump A-2 is demolished.
b. Reinforce the existing concrete beams. This must be completed prior to introducing any loads associated with the proposed new piping. See Drawings S-104, S-110, S-111, S-118, and S-122.
c. Demolish and install new railing, stairs, ladders, and grating in the Main Equipment Building. See Drawings AG-001, AD-010, AD-011, AD-012, AD-013, A-101, A-102, A-103, A-200, A-204, SG-004, SG-006, SD-102, SD-103, SD-104, SD-105, SD-107, S-102, S-104, S-110, and S-111.

    1) Perform selective structural demolition of concrete slabs, curbs, etc. where indicated. Protect existing structural elements to remain.
    2) Provide temporary platforms and fall protection for interim work when necessary for safety and to maintain access.

d. Perform crack injection repairs of existing cracks in the stairwell concrete wall. See Drawing SG-008.
e. Infill the 24” hole in the existing slab at elevation -6.50 ft. See Drawing S-104.

f. Demolish the wet well concrete walls and install new wall pipes for surge relief piping, venting piping, Plant Drain piping, and duct penetrations as well as piping within the wet well.

1) The Plant Drain piping work interior to the East and West Wet Wells must be completed by Phase G10 so that the new Plant Drain piping can be completed and the Plant Drain bypass pumping system can be demobilized.
2) Surge and force main vent piping interior to the wet well must be installed prior to use of those systems in subsequent steps.

g. Perform floor restoration where terrazzo finish is disturbed at elevation 15.50.
h. Install temporary pipe supports, bracing, thrust blocks, and restraints as needed to prevent movement of the existing and new piping systems while operating in interim configurations during construction. This is especially important when the influent pumping system's existing 48-inch discharge header is being demolished and the new 48-inch discharge header is being constructed.
i. Pipe support systems must be fully installed and, where applicable, tested prior to any corresponding pipelines being placed into service.
j. Demolish existing and construct new reinforced concrete equipment pads for electrical, HVAC, process mechanical, and other trades' equipment as shown on the drawings or otherwise required in the specifications.

1) Proposed new equipment pads, even when drawn continuously, often overlap with existing features – such as the existing pump starters and their pads – and may require incremental demolition and construction.

a) As noted further above, all concrete work must be allowed adequate time to cure. Timing of construction of new equipment pads must therefore be carefully coordinated to facilitate timely completion of the overall work.
b) If construction joints are proposed, submit descriptions to the Engineer for approval. See Section 03 11 13 'Structural Cast-In-Place Forming'.

6. Phase H1: Test existing ductwork.

a. Pretest and submit reports for all ductwork systems to be reused. See Section 230593 'Testing, Adjusting, and Balancing for HVAC' and refer to Drawings HG-004, HG-005, HG-006, and HG-007 for demolition and proposed schematic airflow diagrams.

7. Phase E1: Demolish Temp T3 substation, existing load break switch DT5, and install SWBD-RTU & downstream infrastructure.

a. At existing T1/T2 substation, provide two new circuit breakers (CBs). See Drawing E-104.
b. Demolish temporary substation T3 and MV load break switch DT5, including selective structural demolition and restoration. See Drawings EG-101, ED-101, ED-108, E-108, SD-106, and SD-107.

1) Shutdown Pump A-2 and apply Lock-Out/Tag-Out (LOTO) on DT5 feeder circuit breakers at switchgear S1 and S3.
2) Disconnect the existing motor starter for Pump A-2 from the existing MV load break switch DT5.

    a) Protect the existing motor starter for reuse in a subsequent phase.
    b) Protect all wiring and control circuits associated with operation of Pump A-2.

3) Disconnect Temp T3 Substation from the existing MV load break switch DT5.
4) Disconnect existing DT5 feeders at Switchgears S1 and S3.
5) Demolish existing feeders, MV load break switch DT5, and Temp Substation T3, including all associated conduit, wiring, pads, and ancillary equipment.

c. Remove existing shelving from the mezzanine at el. 34.50 and install the following new equipment including associated wires, cables, raceways, boxes, conduits, grounding, supports, and accessories. See Drawings E-127, E-105, E-101, E-104, and E-112.

1) SWBD-RTU
2) MTS-ECD
3) PP-ECD
4) MTS-GATES
5) PP-GATES
6) XFMR-DIST
7) XFMR-1
8) LP-230 DIST
9) LP-1

8. Phase E1A: Install new load break switch P2/P4 and restore service for Pump A-2. See Drawings EG-005, EG-101, E-108, E-112, E-113, E-126, E-129, E-132, I-005, I-006, I-007, I-008, I-009, and S-106.

a. Construct equipment pad and install new MV SWGR DT5. Install a temporary connection box/splice point to support multiple temporary connections to the new MV SWGR DT5 (P2/P4). See Drawing E-126, SG-003, and S-106, and S-110.
b. Install feeds and connections from existing switchgears S1 and S3 to the new MV SWGR DT5 including replacement of CTs and modification of relays pursuant to the Power System Analysis (PSA) study. See Drawing E-108.

1) Isolate Bus A – S1. Open/cold transitions will result in a full loss of power. Coordinate outages and affected loads with the Owner.

    a) Coordinate with the Owner to transfer loads from S1 Bus A to S3 Bus A. Affected DTs include DT1, DT4, DTT12, DT2, and DT7.
    b) Open S1 tie circuit breaker.
    c) Open S1 tie-to-S3 switchgear circuit breaker.

2) Replace current transformers (CTs) on S1.

a) Demolish existing load-side CTs in the DT5 cubicle.
b) Install new load-side CTs in the DT5 cubicle.

3) Install new feeders between the S1 DT5 cubicle and the new SWGR DT5 (P2/P4).
4) Reprogram protective relays at S1 per the Power System Analysis (PSA) study.
5) Isolate Bus A – S3. Open/cold transitions will result in a full loss of power. Coordinate outages and affected loads with the Owner.

a) Coordinate with the Owner to transfer loads from S3 Bus A to S1 Bus A. Affected DTs include DT1, DT4, DTT12, DT2, and DT7.
b) Close S1 tie circuit breaker to restore power to S1 Bus A.
c) Open S3 tie circuit breaker (CB-309).
d) Open S3 main circuit breaker (CB-301).
e) Open S3 tie-to-S1 switchgear circuit breaker (CB-308).

6) Remove and replace DT5 switchgear S3 circuit breaker (CB-305). Existing circuit breaker to be refurbished and handed over to Owner.
7) Replace CTs on S3.

a) Remove and demolish existing load-side CTs in DT5 cubicle (CB-305).
b) Install new load-side CTs in DT5 cubicle (CB-305).

8) Install a temporary feeder from the new SWGR DT5 (P2/P4) to the existing Pump A-2 motor starter.
9) Install new feeders between the S3 DT5 cubicle (CB-305) and the new SWGR DT5 (P2/P4).
10) Reconfigure electromechanical relays at S3 per the PSA study.

c. Restore power in switchgears S1 and S3 and commission existing Pump A-2.

1) Restore CB-308, CB-309 and CB-301 to normal operating positions.
2) Restore the S1 tie-to-S3 switchgear CB to normal operating position.
3) Remove LOTOs from S1 and S3 and energize the new SWGR DT5 (P2/P4).
4) Commission new CB-305.

d. Install new:

1) Influent Pumping System Control Panel (PLC-IPS)
2) Vibration and Temperature Monitoring Panel (VTMP)
3) Gate Valve Remote Control Station (GV-RCS)
4) Level Relay Panels LRP-0076-1 and LRP-0076-2

9. Phase H2: Demolish equipment in the mezzanine and reroute systems in conflict with proposed work.

a. Demolish an existing fan coil unit and associated condensate piping, refrigerant piping, supply air duct, grilles, and motorized louver. See Drawing HD-104.

b. Incrementally reroute each of the systems listed below including piping, hangers, and accessories. For each relocation, install new piping excluding connections to the existing piping system; schedule temporary shutdown of the system being rerouted; and, during the shutdown, demolish piping to be rerouted and complete new connections to the existing system. See Drawings HG-003, HD-203, HD-303, HD-304, H-101, H-203, H-303, H-304, and E-122.

1) West Wet Well Exhaust duct
2) 8-inch screened effluent
3) 3-inch boiler feedwater piping
4) 6-inch chilled water return piping
5) 16-inch low pressure steam piping with associated low point traps
6) condensate return system including condensate receiver B-CR-2A
7) 3-inch pumped condensate return piping

10. Phase PL1: Coordinate the following work with the demolition and relocation of sodium hypochlorite, low pressure air, and wet well exhaust systems as well as installation of the new influent pumps and their associated piping.

a. In the areaway mechanical rooms, demolish existing floor drains and piping, and cap existing wyes. See Drawings PD-201 and PD-202.
b. Under the pump room ceiling, demolish existing 6-inch drain and install new 6-inch drain relocated to avoid spatial conflict with proposed new 48-inch discharge header. Provide temporary piping for interim configurations as needed. See Drawings PD-101 and P-101.
c. Demolish and install two new sump pump systems connected to the 4” sump pump discharge piping. Interim sump pump systems may be necessary to accommodate installation of new influent pumps and associated piping systems under later phases.

1) Demolish sump pump B-SP-1A, sump pump B-SP-1B, and associated sump cover, piping, check valves, isolation valves and control panels. See Drawings PD-101, PD-301, and ED-103.
2) Install sump pump B-SP-1A, sump pump B-SP-1B and associated sump cover, piping, supports, check valves, isolation valves, and control panel. See Drawings P-101, P-301, E-106, E-122, and I-009.
3) Demolish sump pump B-SP-2A, sump pump B-SP-2B, and associated sump cover, piping, check valves, isolation valves and control panel. See Drawings PD-101, PD-301, and ED-103.

11. Phase H3

a. Demolish existing fans B-E-1 and B-E-2. See Drawings HG-004, HG-005, HD-101, HD-302, HD-303, ED-103, and ED-104.
b. Install new fans B-E-1 and B-E-2. Coordinate this work with the installation of new influent pumps and piping since these two fans constrain available space. Modify HVAC control wiring at MCC-P-10 and MCC-P-11. See Drawings H-101, H-302, H-303, E-106, E-107, E-111, and E-122.

12. Phase H4A

a. Install new hot glycol heat exchangers, pumps, piping, controls and appurtenances on the mezzanine. See Drawings HG-003, HG-010, H-104, H-203, H-204, H-303, S-107, and E-127.

13. Phase H4B

a. Demolish existing roof fans B-RF-5, B-RF-6, and B-RF-9. See Drawings HG-004, HG-005, and HD-105.
b. Install new roof fans B-RF-5 and B-RF-6 and controls. See Drawings AD-105, A-106, H-105 and E-107.
c. Demolish motorized louver B-LM-12 including any electrical connections, conduit, wiring, and disconnect switch. See Drawings A-105, HG-004, and HD-104.
d. Install new air handlers B-S-3, B-S-6, B-S-7, and B-S-11 on the roof and their associated heating coils, filters, dunnage frames, smoke detectors, controls, and ductwork. See Drawings AD-105, A-105, A-106, HG-002, HD-102, H-102, H-103, H-104, H-105, H-303, S-112, FA-001, and FA-002.
e. Install roof hood B-RV-3 using the existing roof curb on the intake for B-AHU-1. See Drawings HG-002, HG-006, and H-105.

14. Phase H4C

a. Demolish fans B-S-1, B-S-2, B-S-3, B-S-4, B-S-5, B-S-6, B-S-7, B-S-8 and associated heating coils, cooling coils, pumps and filters located in the north air handler rooms. See Drawings HG-004, HG-005, HD-102, HD-201, HD-202, HD-301, HD-302, HD-303, HD-304, SD-104, SD-105, and SG-004.
b. Dismantle and remove existing air supply floor grilles. Close and patch floor openings. See Drawing HD-103.
c. Install fans B-S-1, B-S-2, B-S-4, B-S-5, B-S-8 and associated heating coils, cooling coils, pumps, filters, smoke detectors, controls, and ductwork located in the north air handler rooms. Modify HVAC control wiring at MCC-P-10 and MCC-P-11. See Drawings HG-002, HG-003, H-102, H-103, H-201, H-202, H-301, S-104, S-105, S-113, S-114, S-115, S-116, E-106, E-107, E-111, and FA-002.
d. Install and configure managed ethernet switch and network control with B-ATC-51 to integrate new HVAC systems into the existing plant-wide SCADA. See Drawings HG-015, H-104, I-003, and I-004 as well as Section 230923 ‘Direct Digital Control Systems for HVAC’.
e. Complete comprehensive testing, balancing, and commissioning for all new HVAC equipment including coordination for testing and balancing with existing airflow devices.

15. Phase G1 (Drawing G-101): Prepare for isolation of wet wells, replace slide gate in the Influent Screening Building, install bypass pumping systems, replace two 48-inch gate valves and piping, and construct new 48-inch diameter force main upper header.

a. In the Influent Screening Building (Building E), clean the channels, and replace slide gate SG-1. See Drawings MD-200, M-200, E-300, and E-301.

1) Clean and prepare influent screen channels and frames and exercise slide gates to facilitate seating of slide gates and stop log systems for both replacement of SG-1 and isolation of wet wells in subsequent steps. Provide

sandbags, pumps, pipes, valves, plugs, bulkheads, and other temporary systems as necessary to dewater channels in support of cleaning. See Part 1.6 for timing restrictions when influent screens are taken out of service.

2) Owner will take Channel A out of service.

   a) This will limit influent screening capacity to approximately 156 MGD (three screens in operation).
   b) If taking additional channels out of service to complete this work, the plant will not have capacity to screen peak flow and work must comply with Part 1.6 restrictions.

3) Isolate and unwater Channel A.
4) Demolish existing slide gate SG-1, its electric actuator, wiring and conduits for connections to MCC P-12-2 and PMCP, and its framing, bolts, and grout along the channel walls and invert. Repair bolt holes.
5) Install, start-up, test, and commission new slide gate SG-1 with electric actuator and remote control station complete with electrical and control connections to MCC P-12-2 and PMCP.

b. Install Plant Drain temporary bypass pumping system to be able to stop Plant Drain flow into the East Wet Well. See Drawing G-005 and Section 01 57 28 “Temporary Bypass Pumping Systems”. The OCO will operate the Plant Drain Bypass system. Promptly provide and fill equipment with fuel when requested by the OCO. This bypass system must be in operation whenever work requires isolation of the East Wet Well.

c. Install the screened influent bypass pumping system described in Drawing G-005 and Section 01 57 28 “Temporary Bypass Pumping Systems”. The OCO will operate the Supplementary Bypass Pumping System.

d. Demolish existing and install new 48-inch motor-actuated gate valves GV-2E and GV-2W. As outlined below, this involves sequential isolation of wet wells and installation of plugs in the 48-inch suction piping upstream of GV-2E and GV-2W during very low flow conditions, demolition of the two gate valves and upstream piping, and installation of two new gate valves and piping. See Drawings MD-101, MD-110, M-101, M-111, M-113, SD-101, E-122, I-005, and I-010 and see Section 01 50 00 “Temporary Facilities and Controls” for inflatable and mechanical plugs requirements.

   1) Install a plug into the West Wet Well suction wall pipe for Pump A-2, upstream of GV-A2W. The estimated total available pumping capacity during this step is only 82 MGD so work must be performed during very low flow conditions, as defined in Part 1.6:

      a) Implement Pump A-2 LOTO.
      b) Close existing suction gate valves GV-A2E and GV-A2W to prevent interconnection of the East and West Wet Wells during initial dewatering of the West Wet Well. Request that the Owner operate pumps on the East Wet Well to maintain a low wet well level to reduce pressure on aging gate valves GV-A2E and GV-A2W.
      c) Isolate the West Wet Well. Despite replacement of SG-1 and cleaning and exercising of existing slide gates to facilitate seating, assume that a physical plug will need to be inserted into the 84-inch influent line

for isolation of the West Wet Well, and assume that a combination of stop logs, temporary pumping, sandbags, or other temporary bulkhead measures will be required to dewater the screen channels.

d) Once the West Wet Well is isolated, dewater, remove solids from, clean, and disinfect the West Wet Well and piping to be plugged as necessary for plug installation.

e) Visually inspect, photograph, and document the internal condition of the wall pipe upstream of GV-A2W. Verify dimensions and install the plug into the wall pipe upstream of GV-A2W. This pipe is original to the influent pumping system so anticipate substantial removal of solids.

f) Either install and integrate the new radar level indicating transmitter or install and integrate temporary level instrumentation for use operating new pumps with PLC-IPS until the new radar instrumentation is installed in a later phase. If temporary instrumentation is provided, remove the temporary instrumentation and perform in-kind restoration of disturbed areas once the new radar level instrumentation is installed.

g) Put the West Wet Well back into service. Remove Pump A-2 LOTO. Plug inserted into the West Wet Well suction line to Pump A-2, upstream of GV-A2W, to remain in service.

h) The estimated total available pumping capacity is restored to over 150 MGD.

2) Repeat the above procedure except modified for installation of a plug into the East Wet Well suction wall pipe for Pump A-2, upstream of GV-A2E, and do not remove existing Pump A-2 LOTO since both upstream suction pipes will be plugged. The estimated total available pumping capacity during this step is approximately 94 MGD so work must be performed during low flow conditions, as defined in Part 1.6.

3) With Pump A-2 suction lines plugged and the pump out of service, demolish existing gate valves GV-A2W and GV-A2E, the upstream portions of piping, and supports as shown on G-101. The upstream piping shall be demolished through the flange connections closest to the wet well wall. Install new motor-actuated gate valves GV-2W and GV-2E, new upstream piping to connect into the flanges at the wet well walls, pressure gauge and transmitter assemblies, and supports. Successfully pressure test new piping and closed valves before proceeding to the next step.

a) The estimated total available pumping capacity through this step is over 150 MGD.

4) During very low flow conditions, as defined in Part 1.6, shutdown and drain the West Wet Well. Unplug West Wet Well suction line to Pump A-2.

a) The estimated total available pumping capacity during this step is approximately 82 MGD.

b) Contractor to bring wet well back online if needed/if flow exceeds 82 MGD or the largest available pump is taken out of service.

5) Place the West Wet Well back into service. The estimated total available pumping capacity is restored to over 150 MGD.

6) During low flow conditions, as defined in Part 1.6, shutdown and drain the East Wet Well. Request the OCO close new GV-2E. Operate the Plant Drain bypass pumping system. Shutdown and dewater the East Wet Well. Unplug East Wet Well suction line to Pump A-2.

a) The estimated total available pumping capacity during this step is approximately 94 MGD.
b) Contractor to bring wet well back online if needed/if flow exceeds 94 MGD or the largest available pump is taken out of service.

7) Place the East Wet Well back into service and stop the Plant Drain bypass pumping system. The estimated total available pumping capacity is restored to over 150 MGD.

e. Construct a new 48-inch diameter force main header at El. -6.50 NGVD29, including installation and integration of a new 48-inch magnetic flow meter (FE-0065-2), branch lines up to and including new 36-inch motor-actuated knife gate valves KGV-12 and KGV-13, and piping down to the pump level. The new 48-inch pipe must be aligned for connection with the existing 48-inch header and force mains in subsequent steps. Perform pressure testing of the installed components. See Drawings S-109, S-110, S-111, S-120, S-122, M-104, M-105, and M-111.

1) This work can proceed in parallel with the preceding work in this phase.
2) This work must be coordinated with relocation of various utilities in conflict with the proposed new header.
3) The estimated total available pumping capacity through this step exceeds 150 MGD.
4) Verify successful integration of the new flow meter with the OCO and Construction Manager prior to introducing flow through the meter.

f. Construct the vent and drain piping for the influent pumping system's new surge relief and air valves into the East Wet Well and West Wet Well. Coordinate structural demolition in Phase S1. As the surge relief and air valves are installed in subsequent phases, complete connections to these piping systems. Connections must be completed prior to their corresponding valves and pipelines going into service. Work within the East Wet Well and West Wet Well is subject to aforementioned very low flow and low flow condition restrictions.

16. Phase G2 (Drawing G-102): Connect the new 48-inch diameter force main at El. -6.50 NGVD29 to the existing East force main vertical pipe. See Drawings MD-105, MD-113, M-105, M-110, M-115, and M-116 and also Section 400576 "Hot-Tapping Valves and Line Stop".

a. Phases E1 & E1A must be completed before progressing to Phase G2.
b. Install Line Stop 1 on the vertical section of the existing East Force Main. The two 48-inch gate valves downstream on the East Force Main, shown on Drawing M-117, may be temporarily closed during low flow conditions to stop flow through the spool being tapped if needed for installation and/or testing of the line stop.
c. Install and test additional valves, piping, fittings, pumps, and other equipment and instruments as necessary for draining the contents of the East Force Main directly

into one or both of the existing wet wells under subsequent steps. If new taps, saddles, or outlets are needed on the East Force Main for drains and vents, coordinate locations with the OCO. New connections for temporary drains and vents will only be permitted on existing pipes and fittings to be removed in subsequent phases. Comply with dry weather and flow timing restrictions as applicable.

d. Perform selective demolition of existing 48-inch piping downstream of Line Stop 1 and construct the new upper 48-inch header's connection to the East Force Main. Any work disrupting operation of the East Force Main must be performed during dry weather conditions as defined in Part 1.6.

    1) Confirm operability of the screened influent bypass pumping system.
    2) Within the tunnel, upstream of the grit tank influent boxes, close the two 48-inch gate valves on the East Force Main.
    3) Use Line Stop 1 to plug the existing 48-inch pipe.
    4) Drain isolated segment of the East Force Main.
    5) Selectively demolish the existing 48-inch vertical piping and 90-elbow downstream of Line Stop 1.
    6) Install new 48-inch piping, vacuum breaker and air relief assemblies, and temporary knife gate valve KGV-14 to connect the new 48-inch force main upper header to the existing East force main. Once the interconnection is complete, close KGV-12 and KGV-14 and successfully pressure test the new piping and valves before proceeding to the next step.
    7) Once pressure test is complete and successful, remove Line Stop 1, close KGV-12, and open KGV-14 to allow operation of the East Force Main.

17. Phase E2 (Drawing E-108): LOTO DT4 and provide temporary feed to Pump A-1.

    a. Complete prior to Phase G3.
    b. The estimated total available pumping capacity during this step is approximately 86 MGD so perform work during very low flow conditions as defined in Part 1.6.
    c. Shutdown Pumps A-1 and A-6 and apply LOTO to DT4 feeder circuit breakers at S1 and S3.
    d. Shutdown Pump A-2 and P2/P4 MV Switch and de-energize the temporary connection box installed in Phase E1A.
    e. Disconnect the existing motor starter for Pump A-1 from MV load break switch DT4.

        1) Protect the motor starter for reuse in a subsequent phase.
        2) Protect all wiring and control circuits associated with Pump A-1.

    f. Install a temporary feeder from the Pump A-1 motor starter to the temporary connection box.
    g. Energize the P2/P4 MV switch.
    h. Restore operation of Pump A-2.
    i. Restore operation of Pump A-1.
    j. The estimated total available pumping capacity is restored to over 150 MGD.

18. Phase E2A (Drawing E-108): Demolish Load Break Switch DT4 and Pump A-6

    a. Complete this phase in coordination with work under Phase G3.

b. Disconnect existing DT4 feeders at switchgear S1 and S3.
c. Demolish existing feeders, MV load break switch DT4, and the motor starter for Pump A-6, including all associated conduit, wiring, and ancillary equipment.

19. Phase G3 (Drawing G-103): Utilize hot tap and line stop to demolish Pump A-6, a portion of the 60 MGD Pump A-1 discharge piping, and Pump A-5 suction piping. See Drawings MD-101 and MD-102 and also Section 400576 “Hot-Tapping Valves and Line Stop”.

a. Confirm existing GV-B9 is open to equalize flow between the existing discharge headers and prevent over pressurization of headers during line stop installation.

1) The estimated total available pumping capacity through this step exceeds 150 MGD.

b. Close and LOTO GV-2W. Isolate, drain, clean, and disinfect the West Wet Well. Assume that a physical plug will need to be inserted into the 84-inch influent line for isolation of the West Wet Well. Drain Pump A-6 and A-5 suction piping, install a plug on the Pump A-6 and A-5 suction lines from inside the West Wet Well, and remove a portion of each line and install blind flanges on the dry-well side at the wall.

1) The estimated total available pumping capacity through this step is approximately 142 MGD.
2) If GV-2E is closed for redundant isolation of the West Wet Well, the estimated available pumping capacity will be reduced to approximately 82 MGD and work will be constrained to very low flow conditions as defined in Part 1.6.

c. Place the West Wet Well back into service.

1) The estimated total available pumping capacity is restored to exceed 150 MGD.

d. Remove existing Pumps A-1, A-5, and A-6 from service and deploy Line Stop 2, on the discharge header between Pumps A-1 and A-5.

1) The estimated total available pumping capacity is approximately 142 MGD.

e. Demolish isolated portions of the influent pumping system suction and discharge piping. To minimize risk of damage while the surge relief piping is temporarily disconnected, perform this work during dry weather as defined in Part 1.6 and when there is no increased likelihood of pump shutdowns. Reinstate the surge relief with new or temporary piping as soon as possible to minimize downtime.

1) The estimated total available pumping capacity is approximately 142 MGD.
2) Request that the OCO temporarily close both 10-inch isolation valves on the surge relief piping, and request that they operate the pumps to limit pressure fluctuations in the pipeline while the surge relief is out of service.
3) Drain the 48-inch piping west of Line Stop 2 through the 6-inch drain located at the west-most end of the header, at the Pump A-6 discharge tee.

4) Demolish the discharge tee downstream of Pump A-1 and the vertical 14-inch surge relief pipe connected to the 10-inch surge relief header.
5) Install a blind flange at the flange connection to the west of the Line Stop 2 tapping saddle, then remove Line Stop 2 plug and equipment, and close the tapping valve.
6) Install a new 10-inch surge relief pipe from the Line Stop 2 tapping valve to the existing 10" surge relief pipes into the West Wet Well. Successfully pressure test the new surge relief piping. Upon completion of successful pressure test, open the Line Stop 2 tapping valve to reinstate surge relief system.

f. Deenergize Pump A-6. Demolish existing Pump A-6 and all associated suction and discharge piping as indicated including valves GV-A6, and BCV-A6.
g. Demolish a portion of Pump A-1's discharge piping including GV-B1 and GV-B6, to facilitate connection of Pump A-1 to the new force main.
h. Demolish Pump A-5 suction piping as indicated including valve GV-A5.

1) The estimated total available pumping capacity is approximately 142 MGD.

20. Phase G4 (Drawing G-104): Extend the new 48-inch force main header to the dry well area to facilitate permanent installation of Pump P-6 and temporarily tie in Pump A-1. Pump A-1 will temporarily operate utilizing the new 48-inch force main until removal from service later in the construction sequence.

a. Confirm KGV-12 and KGV-13 are closed for isolation of the new 48-inch diameter force main header. Continue to operate all remaining pumps, besides A-1 and A-5, through the existing East and West Force Mains.
b. The estimated total available pumping capacity is approximately 142 MGD.
c. Continue construction of the new 48-inch force main header in the lower dry well up to KGV-15 and KGV-16.
d. Temporarily tie in existing Pump A-1 discharge piping to the new 48-inch force main header using two 36-inch diameter 45-degree elbows, a 36-inch x 48-inch reducer, spools, and other temporary piping and fittings as needed.
e. Install temporary pipe supports, bracing, thrust blocks as needed to restrain the existing header for operation.
f. Successfully pressure test the new piping from Pump A-1 through KGV-12 and KGV-13, including the surge relief system.
g. Upon completion of successful pressure test, open KGV-12 and start-up, test, and commission Pump A-1. Pump A-1 will be operated by the OCO through the new 48-inch force main and the East Force Main only while the remaining pumps continue to operate through existing piping.
h. The estimated total available pumping capacity is restored to exceed 150 MGD.

21. Phase E2B (Drawing E-108): Demolish existing Pump A-5; install new load break switch P5/P6 and new pump P6; and reconnect Pump A-1.

a. This work is to be performed in coordination with work under Phase G5.
b. Install new MV Load Break Switch P5/P6 at the former DT4 location.
c. Install new Pump P-6 motor starter.
d. Perform permanent termination of the P6 motor starter to the P5/P6 MV switch.
e. Apply LOTO to MCC-P1-1 motor starter for Pump A-5.

f. Demolish Pump A-5, including all conduit and wiring between the pump and the MCC motor starter bucket, as well as all associated ancillary equipment.

1) Repurpose and relabel the MCC bucket as a spare cubicle.

g. Isolate Bus A – S3. Coordinate with the OCO to verify that no loads shall be operating from this bus. Transfer loads in coordination with the OCO as necessary so that all loads are energized from Bus A – S1.

1) Open S3 Tie circuit breaker (CB-309).
2) Open S3 Main circuit breaker (CB-301).
3) Open S1 to S3 Tie circuit breaker (CB-308).

h. Replace DT4 switchgear S3 circuit breaker (CB-306)

1) Remove and replace with new circuit breaker (CB-306)
2) Refurbish existing circuit breaker and deliver it to the Owner.

i. Replace CTs on S3.

1) Remove and demolish existing load-side CTs in DT4 cubicle (CB-306).
2) Install new load-side CTs in DT4 cubicle (CB-306).

j. Install new feeders between the S3 DT4 cubicle (CB-306) and the new P5/P6 MV switch.
k. Reconfigure electromechanical relays at S3 per the PSA study.
l. Restore S3 circuit breakers CB-309, CB-301, and CB-308 to normal operating conditions.
m. Isolate Bus A – S1. Be advised that open/cold transitions will result in a full loss of power. Coordinate outages and affected loads with the OCO.

1) Coordinate with the OCO to transfer Bus A loads from S1 to Bus A on S3. Affected DTs include DT1, DT5, DTT12, DT2, and DT7.
2) Open S1 Tie circuit breaker.
3) Open S1 tie-to-S3 switchgear circuit breaker.

n. Replace CTs on S1.

1) Remove and demolish existing load-side CTs in the DT4 cubicle.
2) Install new load-side CTs in the DT4 cubicle.

o. Install new feeder from the new SWGR DT4 (P5/P6) to new Pump P-6 motor starter.
p. Perform permanent terminations for new Pump P-6 and at new P5/P6 MV switch.
q. Install new feeders between the S1 DT4 cubicle and the new P5/P6 MV switch.
r. Reprogram protective relays at S1 per the PSA study.
s. Return all S1 buses to normal operating conditions.

1) Close S1 Tie circuit breaker.
2) Close S1 tie-to-S3 switchgear circuit breaker.

t. Transfer Pump A-1 from P2/P4 to P5/P6.

1) The estimated total available pumping capacity through this step is approximately 82 MGD.
2) Shutdown Pump A-1 and A-2 and apply LOTO at SWGR S1 and S3 DT5 feeder CB.
3) Disconnect Pump A-1 from the P2/P4 MV switch.
4) Reuse the temporary feeder to temporarily terminate Pump A-1 at the P5/P6 MV switch.
5) Remove LOTOs from S1 and S3 and energize the new SWGR DT4 (P5/P6).
6) Restore power and return Pumps A-1 and A-2 to operation.
7) The estimated total available pumping capacity is restored to over 150 MGD.

u. Start-up, test, and commission new Pump P-6.

22. Phase G5 (Drawing G-105): Install Pump P-6 and all associated equipment, including motor/drive, shaft, pump controls, suction and discharge piping/valves, isolation valves, cone valves, valve controls, and seal water. Demolish pipe directly west of Pump A-2's discharge tee and install a temporary blind flange. Demolish Pump A-5 and a section of discharge header between Pumps A-1 and A-2.

a. Install new Pump P-6 and all associated structural supports and ancillary equipment including motor/drive, shaft, electrical systems and controls. Install all associated suction and discharge piping through KGV-15, new gate valve GV-6, new cone valve CONV-6, and all associated supports, electrical systems, and controls. Successfully pressure test the new piping between GV-6 and KGV-15.

1) The estimated total available pumping capacity exceeds 150 MGD.
2) Work under Electrical Phase E2B must be completed before start-up of Pump P-6.

b. Remove the plug from the Pump P-6 suction piping from within the Wet Well.

1) The estimated total available pumping capacity is approximately 142 MGD when the West Wet Well is out of service for the plug removal.

c. Place the West Wet Well back into service and temporarily close KGV-14 for initial start-up and testing of Pump P-6.

1) The estimated total available pumping capacity exceeds 150 MGD.

d. Upon completion of successful pressure testing, open GV-6 and KGV-15 and start up new Pump P-6 via the new 48-inch force main header. Complete start-up, testing, and commissioning of Pump P-6. The OCO will operate pumps A-1 and P-6 through the new 48-inch force main header and continue to operate the remaining pumps through the existing system as modified.

1) The estimated total available pumping capacity exceeds 150 MGD.
2) Phase E2B must be completed before start-up and testing of Pump P-6.

e. Demolish header and discharge piping upstream of the Pump A-2 tee during low flow conditions as defined in Part 1.6.

1) The estimated total available pumping capacity is approximately 97.5 MGD during this step. Prioritize work necessary for installation of the blind flange with surge relief system connection on Pump A-2's discharge tee so that Pumps A-2, A-3, A-4, and A-7 can be returned to service as soon as possible.
2) Close KGV-14 and have the OCO take pumps A-2, A-3, A-4, A-5, and A-7 out of service.
3) Drain the Lower/East Force Main header.
4) Demolish pipe directly west of Pump A-2's discharge tee.
5) Install a blind flange with a connection for the 10" surge relief system on the west end of Pump A-2's discharge tee.
6) Demolish the old discharge header from A-5, through the pipe tapping saddle for Line Stop 2. Demolish a portion of the 14-inch surge relief piping through its isolation valve as shown on the drawings.
7) Open KGV-14 and bring pumps A-2, A-3, A-4, and A-7 back into service.
8) The estimated total available pumping capacity exceeds 150 MGD.
9) Close KGV-16 and take Pump A-1 out of service. Drain and demolish the discharge piping of Pump A-1 up to flange downstream of its existing cone valve.

f. Demolish existing Pump A-5 and associated suction and discharge piping, fittings, check valve SCV-A5, GV-B5, shaft, motor, eddy current drive, and accessories.

1) Phase E2B must be completed before demolition of Pump A-5.

23. Phase E3 (Drawing E-108): Install New Pump P-4.

a. Complete in coordination with work under Phase G6.
b. Install new Pump P-4 and associated motor starter.
c. Terminate the Pump P-4 motor starter to the P2/P4 MV switch DT5.

1) The estimated total available pumping capacity is approximately 119.5 MGD during this step.
2) LOTO the P2/P4 MV switch DT5.
3) Perform termination of the P4 motor starter to the P2/P4 MV switch.
4) Remove LOTOs from the P2/P4 MV switch DT5.
5) Energize Pumps A-2 and P-4. The estimated total available pumping capacity exceeds 150 MGD.
6) Start-up, test, and commission new Pump P-4 under Phase G6.

24. Phase G6 (Drawing G-106): Continue with installation of new 36-inch and 48-inch piping, fittings, valves, and other equipment as well as installation of Pump P-4 and all associated piping, cone valve CONV-4, electrical, controls, and appurtenances.

a. Install new 48-inch diameter lower header from KGV-16 to the temporary blind flange upstream of KGV-18.

1) The estimated total available pumping capacity exceeds 150 MGD for most of this step. The pumping capacity will be reduced to approximately 142 MGD when Pump P-6 is taken out of service to connect new piping to KGV-16.

b. Install new 36-inch diameter piping including knife gate valves KGV-24 and KGV-17.
c. Successfully pressure test new piping.
d. Following successful pressure test of new piping, request the OCO close valve KGV-17, close valve KGV-18, open valve KGV-24, and return Pump A-1 into service. The OCO will operate the system with Pump P-6 and Pump A-1 discharging through the new upper header while Pumps A-2, A-3, A-4 & A-7 discharge to both existing force mains with KGV-14 open.

1) The estimated total available pumping capacity exceeds 150 MGD.

e. Install new Pump P-4 and all associated structural supports and ancillary equipment including motor/drive, shaft, electrical systems, and controls. Install all associated suction and discharge piping through KGV-17, new gate valve GV-4, new cone valve CONV-4, and all associated supports, electrical, and controls. Successfully pressure test the new piping between GV-4 and KGV-17.

1) The estimated total available pumping capacity exceeds 150 MGD.

f. Temporarily shutdown the West Wet Well. Remove plug from P-4 suction piping.

1) The estimated total available pumping capacity is approximately 142 MGD.
2) If GV-2E is closed for redundant isolation of the West Wet Well, the estimated available pumping capacity will be reduced to approximately 82 MGD and work will be constrained to very low flow conditions as defined in Part 1.6.

g. Place the West Wet Well back into service.

1) The estimated total available pumping capacity is restored to exceed 150 MGD.

h. Request the OCO open GV-4 and KGV-17.
i. Start-up, test, and commission new Pump P-4 via the new 48-inch force main header.
j. The OCO will operate pumps A-1, P-4, and P-6 through the new 48-inch force main header and continue operating Pumps A-2, A-3, A-4 & A-7 as previously noted.

1) Phase E3 work must be completed before start-up and testing of Pump P-4.

k. Construct temporary 36-inch diameter vertical piping, including temporary KGV-19, to the upper header.

1) The estimated total available pumping capacity is reduced to approximately 112 MGD when the temporary piping is connected to the upper header

assuming that KGV-12, KGV-14, and East Force Main valves at the grit tank are closed. Coordinate operation of valves with the OCO.

l. Construct temporary 36-inch diameter horizontal piping at El. -6.50 including temporary KGV-25 and temporary flow meter, to the West Force Main tee at KGV-13.

1) Use an analog spare point to connect the temporary flow meter's field signal to the existing PLC-ECR. Update the OIT-ECR main display to prominently display the measurement. Once the transit time flowmeter is removed under later steps, update the OIT-ECR display to delete the temporary signal.
2) Coordinate with the OCO and Construction Manager to record temporary flow meter's historical flow data into the SCADA Historian system and the HACH Water Information Management System (WIMS) for regulatory purposes.

m. Coordinate closure of both 36-inch valves on the temporary piping with the OCO. The OCO will operate Pumps A-1, A-2, A-3, A-4, A-7, P-6, and P-4 with both the East and West Force Mains. Use of KGV-14 to isolate mains will be at the OCO's discretion except where otherwise needed for construction sequencing.

25. Phase G7 (Drawing G-107): Demolish a portion of West Force Main piping and tie in upper header from KGV-13 to the West Force Main.

a. The estimated total available pumping capacity in this step is reduced to approximately 112 MGD when the West Force Main is taken out of service so work must be completed during dry weather conditions as defined in Part 1.6. Confirm that the bypass pumping system is operational prior to this work. It is critical that the West Force Main be returned to service as soon as possible to restore full capacity.
b. Install and test additional valves, piping, fittings, pumps, and other equipment and instruments as necessary for draining the contents of the West Force Main directly into one or both of the existing wet wells under subsequent steps. If new taps, saddles, or outlets are needed on the West Force Main for drains and vents, coordinate locations with the OCO. New connections for temporary drains and vents will only be permitted on existing pipes and fittings to be removed in subsequent phases. Comply with dry weather and flow timing restrictions as applicable.
c. Request the OCO take pumps A-2, A-3, A-4, and A-7 out of service, close valves KGV-13, KGV-14, KGV-25, and GV-B10, and close the West Force Main's two isolation valves at the grit tank while this phase's work is ongoing. The OCO will meanwhile operate Pumps P-6, A-1, and P-4 using the upper header and the East Force Main.

1) Be advised that KGV-14 is being closed since the condition of GV-B10 is unreliable and it may not seat watertight.

d. Drain the West Force Main.
e. Remove elbow and vertical pipe on West Force Main and interconnect the new tee downstream of KGV-13 on the header at El. -6.50' to the existing West Force

Main. Demolish remaining piping back to GV-B10 and install a blind flange at GV-B10.

1) Update the OIT-ECR main display to reflect the demolition of the existing flow meter.
2) Coordinate with the OCO and Construction Manager to update the SCADA Historian and the HACH WIMS as necessary for regulatory purposes.

f. Coordinate with the OCO to return pumps A-2, A-3, A-4, and A-7 to service and open valves KGV-13, KGV-14, and KGV-25.

1) The estimated total available pumping capacity exceeds 150 MGD.

26. Phase G8 (Drawing G-108): Connect existing Pump A-2 to the new discharge header and continue with demolition of the existing 48-inch and 36-inch discharge piping systems.

a. During dry weather conditions as defined in Part 1.6, request that the OCO take Pumps A-2, A-3, A-4, and A-7 out of service and close valves KGV-14, KGV-18, and KGV-19 while this phase's work is ongoing. The OCO will meanwhile operate the remaining Pumps A-1, P-4, and P-6 with the East and West Force Mains.

1) The estimated total available pumping capacity in this step is reduced to approximately 135 MGD.
2) Pumps A-3, A-4, and A-7 are to remain out of service and be demolished in the subsequent phase. However, be prepared to install blind flanges and temporarily reinstate one or more of these pumps if needed during either this phase or the subsequent phase as a contingency in the event of unanticipated wet weather.

b. Drain the existing upper and lower headers in the pump room that include GV-B10, KGV-14, Pump A-2, Pump A-3, Pump A-4 and Pump A-7.
c. Remove the two tees adjacent to GV-B9 and Pump A-2's discharge tee.
d. Install blind flange on the eastern side of the Pump A-2 discharge tee.
e. Remove the blind flange and associated surge relief piping from the west side of Pump A-2's discharge tee
f. Drain the 48-inch header at KGV-19 and remove the blind flange from the east side of KGV-19.
g. Install temporary 48-inch spool connecting the new 48-inch header and the Pump A-2 discharge tee. Construct temporary connection for the new eastern 10" surge relief piping.
h. Coordinate with the OCO to open valves KGV-18 and KGV-19 and to return Pump A-2 to service. Valve KGV-14 is to remain closed for isolation of piping under subsequent phases.

1) The estimated total available pumping capacity exceeds 150 MGD.

i. Complete demolition of existing 48-inch header piping between Pumps A-2 and A-3 as indicated on the Drawing G-108 including valves GV-B9 and GV-B3.

27. Phase E4 (Drawing E-109): Demolish Existing Pumps A-3, A-4, A-7 and Load Break Switch DT6.

    a. Complete work in coordination with Phase G9.
    b. Shutdown Pumps A-3 and A-7 and apply LOTO to DT6 feeder circuit breakers at S1 and S3.
    c. Disconnect existing DT6 feeders at switchgear S1 and S3.
    d. Demolish existing feeders, MV load break switch DT6, and motor starters for Pumps A-3 and A-7, including all associated conduit, wiring, and ancillary equipment.
    e. Apply LOTO to MCC-P1-2 motor starter for Pump A-4.
    f. Demolish Pump A-4, including all conduit and wiring between the pump and MCC motor starter bucket, as well as all ancillary equipment.

        1) Repurpose and relabel the MCC bucket as a spare cubicle.

28. Phase G9 (Drawing G-109):

    a. The estimated total available pumping capacity exceeds 150 MGD in this step assuming that Pumps A-1, A-2, P-4, and P-6 and both the East and West Force Mains remain in service.

        1) If any disruptions to those pumps or force mains are proposed, additional constraints may apply. See Part 1.6.
        2) The influent pumping system will not have redundancy to convey 150 MGD if the largest pump is out of service until new pumps are installed in Phase G12. In order to reduce operational risks, minimize the time between demolition of Pump A-7 in this phase and installation of new Pump P-1 in Phase G12.

            a) In this phase, sequence demolition to progress from the west to the east and upstream to downstream such that Pump A-7 can be returned to service with fewer modifications if needed in the event of a failure of one of the active pumps.
            b) Commence Phase G11 work as soon as the existing header is demolished up to valve KGV-14.
            c) Commence Phase G12 demolition of the Pump A-3 suction piping.

    b. Request the OCO close valve GV-2E.
    c. Operate the Plant Drain bypass pumping system.
    d. Isolate, drain, remove solids from, clean, and disinfect the East Wet Well and remove it from service. Isolate the East Wet Well. Assume that a physical plug will need to be inserted into the 84-inch influent line for isolation of the East Wet Well.
    e. Drain all suction and discharge piping supporting pumps A-3, A-4, and A-7 and their common header up to KGV-14. KGV-14 will remain closed, however it may be necessary to plug the existing 48-inch header at Line Stop 1 to improve isolation and safety for demolition of the upstream portions of the existing header.
    f. Deenergize Pump A-3. Demolish existing Pump A-3 and all associated suction and discharge piping through and including discharge GV-B8, suction GV-A3 and the 24” discharge cone valve CONV-A3.

g. Deenergize Pump A-4. Demolish existing Pump A-4 and all associated suction and discharge piping through and including discharge GV-B11, suction GV-A4, the 20" discharge check valve SCV-A4, the 20" discharge flow meter, and discharge gate valve GV-B4.
h. Construct wet well modifications in the East Wet Well including expansion of the future Pump P-3 suction fillet opening, interior baffles, any remaining wall penetrations for new piping, selective demolition and rerouting of the mechanical areaway room drain piping, and any identified concrete repairs as directed by the Engineer.
i. Deenergize Pump A-7. Demolish existing Pump A-7 and all associated suction and discharge piping through and including discharge GV-B10, suction GV-A7, discharge GV-B7, and the 36-inch discharge check valve BCV-A7.
j. Complete demolition of the existing 48-inch discharge header up to KGV-14 including the flow meter and Line Stop 1. Install temporary blind flange and other materials as needed to seal the open end of KGV-14.

    1) Update the OIT-ECR main display to reflect the demolition of the existing flow meter.
    2) Coordinate with the OCO and Construction Manager to update the SCADA Historian and the HACH WIMS as necessary for regulatory purposes.

29. Phase G10 (Drawing G-110): Construct 24" plant drain piping and all associated valves and supports.

    a. The estimated total available pumping capacity exceeds 150 MGD in this step assuming that Pumps A-1, A-2, P-4, and P-6 and both the East and West Force Mains remain in service.
    b. Continue operation of the Plant Drain bypass pumping system.
    c. Install blind flanges at the suction line connections associated with previous Pumps A-3, A-4, and A-7 in case the East Wet Well has to be put back into service.
    d. Construct new 24" diameter plant drain piping extension from the existing 24-inch pipe within the East Wet Well through the pump room and up to the new wall pipes for connections to the West Wet Well and East Wet Well as shown in Drawings M-103 and M-113. Successfully pressure test new 24" diameter plant drain piping.
    e. Once the 24" plant drain piping has been successfully pressure tested, demobilize the plant drain bypass system, place the new plant drain piping into service, and perform restoration of disturbed areas. Isolate wet wells as necessary using the plant drain isolation valves to support maintenance of plant operations.

30. Phase G11 (Drawing G-111): Install vertical piping from KGV-14 to base elbow. Construct lower header from flow meter FE-0065-1 through pump A-2 tee. Install future pump discharge valves KGV-23, KGV-21 and KGV-20.

    a. The following steps assume that the new discharge header for the eastern pumps is constructed while KGV-14 remains closed, and KGV-14 is then relocated to its final position as KGV-22 in Phase G12. However, it is also acceptable to relocate KGV-14 in this phase provided that work complies with constraints described in Phase G12 and the Contractor is prepared to install a blind flange on the open connection to the East Force Main when needed.

b. The estimated total available pumping capacity exceeds 150 MGD in this step assuming that Pumps A-1, A-2, P-4, and P-6 and both the East and West Force Mains remain in service.
c. In place of KGV-22, install temporary piping for alignment only (KGV-14 will be relocated to KGV-22 location after piping is in place).
d. With KGV-14 closed, install vertical piping from KGV-14 to base elbow.
e. Install new horizontal 48-inch piping and new 48-inch magnetic flow meter FE-0065-1 from the 48-inch base elbow up to but excluding the blind flange on the east side of Pump A-2's tee. Do not connect into Pump A-2's tee at this step.
f. Further extend the new 48-inch force main header through 36-inch diameter discharge valves KGV-23, KGV-21 and KGV-20 to support installation of new Pumps P-1, P-2 and P-3 in the next phase.
g. Successfully pressure test the new piping upstream of KGV-14.

31. Phase E5 (Drawing E-109): Install New MV Switch P1/P3 and Pumps P-1, P-2, and P-3.

a. Complete this work in coordination with work under Phase G12.
b. Install new MV Load Break Switch P1/P3 at the former DT6 location.
c. Install new Pump P-1 motor starter.
d. Install new Pump P-3 motor starter.
e. Perform permanent termination of the P1 and P3 motor starters to the P1/P3 MV switch.
f. Install new Pump P-2 motor starter.
g. Apply LOTO to DT5 feeder CB at S1 and S3.
h. Install new feeder between P2 motor starter and P2/P4 MV switch.
i. Perform permanent termination of the P2 motor starter to the P2/P4 MV switch.

    1) Electrically and mechanically interlock the P2/P4 MV switch such that no more than two motors may operate simultaneously.

j. Remove LOTO from DT5 feeder CB at S1 and S3.
k. Isolate Bus B – S3. Open/cold transitions will result in a full loss of power. Coordinate outages and affected loads with the Owner.

    1) Coordinate with the Owner to transfer Bus B loads from S3 to Bus B on S1. Affected DTs include: DTT1, DTT4, DTT11, DT3, and DTT13.
    2) Open S3 Tie circuit breaker (CB-309).
    3) Confirm Tie to S3 SWGR CB on S1 is closed.
    4) Confirm Tie to S1 SWGR CB on S3 is closed (CB-308).
    5) Open S3 Main circuit breaker that ties to S4.

l. Remove and replace existing DT6 switchgear S3 circuit breaker with new circuit breaker (CB-313). Existing circuit breaker to be refurbished and handed over to owner.
m. Replace CTs on S3.

    1) Remove and demolish existing load-side CTs in the DT6 cubicle.
    2) Install new load-side CTs in the DT6 cubicle.

n. Install new feeders between the S3 DT6 cubicle and the new P1/P3 MV switch.
o. Reconfigure electromechanical relays at S3 per the PSA study.

p. Restore non-isolation conditions.

1) Close S3 Tie circuit breaker (CB-309).
2) Close S3 Main circuit breaker tying to S4.
3) Confirm Tie to S3 SWGR CB on S1 is closed.
4) Confirm Tie to S1 SWGR CB on S3 is closed (CB-308).

q. Isolate Bus B – S1. Open/cold transitions will result in a full loss of power. Coordinate outages and affected loads with the Owner.

1) Coordinate with the Owner to transfer Bus B loads from S1 to Bus B on S3. Affected DTs include: DTT1, DTT4, DTT11, DT3, and DTT13.
2) Open S1 Tie circuit breaker.
3) Open S1 tie-to-S4 switchgear circuit breaker (generator feeders).
4) Confirm Tie to S3 SWGR CB on S1 is closed.
5) Confirm Tie to S1 SWGR CB on S3 is closed (CB-308).

r. Replace CTs on S1.

1) Remove and demolish existing load-side CTs in the DT6 cubicle.
2) Install new load-side CTs in the DT6 cubicle.

s. Install new feeders between the S1 DT6 cubicle and the new P1/P3 MV switch.
t. Perform permanent terminations at P1/P3 MV switch and S1 and S3.
u. Reprogram protective relays at S1 per the PSA study.
v. Restore all circuit breakers at S1, S3, and S4 to normal operating conditions.

1) Confirm final circuit breaker settings align with original operating conditions.

w. Remove LOTO from DT6 feeder CB at S1 and S3.
x. Re-energize the P1/P3 MV switch.
y. Start-up, test, and commission new Pumps P-1, P-2, and P-3.

32. Phase G12 (Drawing G-112): Relocate KGV-14 to the location of KGV-22; install new pumps P-1, P-2, and P-3; and demolish the temporary 36-inch force mains.

a. During dry weather conditions, defined in Part 1.6, close KGV-12 and drain the East Force Main. Relocate KGV-14 to a new position as KGV-22 and keep KGV-22 closed. Replace the relocated KGV-14 with a spool piece and a restrained dismantling joint. Close valve KGV-12 and the East Force Main's two valves at the grit tank and then successfully pressure test the East Force Main downstream of valve KGV-22.

1) The estimated total available pumping capacity in this step is reduced to approximately 112 MGD since the East Force Main is taken out of service so work must be completed during dry weather conditions as defined in Part 1.6. Confirm that the bypass pumping system is operational prior to this work. It is critical that the East Force Main be returned to service as soon as possible to restore full capacity.

b. Upon performing a successful pressure test of the East Force Main, open KGV-12 and bring the East Force Main back into service. Keep KGV-22 closed.

1) The estimated total available pumping capacity exceeds 150 MGD.

c. Install new Pump P-3 and all associated structural supports and ancillary equipment including motor/drive, shaft, electrical systems and controls. Install all associated suction and discharge piping up to KGV-20, new gate valve GV-3, new cone valve CONV-3, and all associated supports, electrical, and controls. Successfully pressure test the new piping between GV-3 and KGV-20.

1) The estimated total available pumping capacity exceeds 150 MGD.
2) Phase E5 installation of the P1/P3 switchgear and P3 motor starter must be completed to power new Pump P-3.

d. Install new Pump P-2 and all associated structural supports and ancillary equipment including motor/drive, shaft, electrical systems, and controls. Install all associated suction and discharge piping up to KGV-21, new gate valve GV-2, new cone valve CONV-2, and all associated supports, electrical systems, and controls. Successfully pressure test the new piping between GV-2 and KGV-21.

1) The estimated total available pumping capacity exceeds 150 MGD.
2) Phase E3 installation of the P2/P4 switchgear and Phase E5 installation of P2 motor starter must be completed to power new Pump P-2.
3) The P2/P4 switchgear will be temporarily feeding three pumps: A-2, P-2 and P-4. Only two pumps will be capable of operation at any time until Pump A-2 is demolished in Phase G14.

e. Install new Pump P-1 and all associated structural supports and ancillary equipment including motor/drive, shaft, electrical systems, and controls. Install all associated suction and discharge piping up to KGV-23, new gate valve GV-1, new cone valve CONV-1, and all associated supports, electrical systems, and controls. Successfully pressure test the new piping between GV-1 and KGV-23.

1) The estimated total available pumping capacity exceeds 150 MGD.
2) Phase E5 installation of the P1/P3 switchgear and P1 motor starter must be completed to power new Pump P-1.
3) The P2/P4 switchgear will be temporarily feeding three pumps: A-2, P-2 and P-4. Only two pumps will be capable of operation at a time until Pump A-2 is demolished in Phase G14.

f. Upon completion of successful pressure testing, remove all plugs, coordinate with the OCO to bring the East Wet Well back into service, and start up new Pumps P-1, P-2, and P-3.

1) The estimated total available pumping capacity exceeds 150 MGD.
2) Verify there is no leakage at or upstream of valves GV-1, GV-2, and GV-3.
3) Open valves GV-1, KGV-23 and KGV-22.
4) Start-up, test, and commission new Pump P-1.
5) Open valves GV-2 and KGV-21.
6) Start-up, test, and commission new Pump P-2.

7) Open valves GV-3 and KGV-20.
8) Start-up, test, and commission new Pump P-3.

g. During dry weather conditions, defined in Part 1.6, demolish temporary 48-inch piping on the lower and upper headers.

1) Confirm that the bypass pumping system is operational prior to this work. The estimated total available pumping capacity in this step is approximately 112 MGD with Pumps P-1, P-2, and P-3 and only the East Force Main in service.
2) Close valve KGV-12 and drain the West Force Main and the isolated discharge headers.
3) On the lower header, demolish KGV-19 and the adjacent spool and then install a blind flange on the open branch of the 48-inch tee.
4) On the upper header, demolish the two adjoining 48-inch tees used for the temporary header and metering connections, and install new 48-inch piping to reflect final conditions as shown on Drawing M-104.
5) On the upper header, demolish the temporary 36-inch piping connecting to the 48-inch tee immediately downstream of valve KGV-13, and then install a blind flange on the open branch of the tee.
6) Open valve KGV-12 and coordinate with the OCO to return Pumps A-1, P-4, and P-6 to service.
7) The estimated total available pumping capacity is restored to over 150 MGD.
8) Complete demolition of the remainder of the temporary force mains between the areas demolished above.

h. During dry weather conditions, defined in Part 1.6, close valves KGV-22 and KGV-18. Remove blind flanges at and adjacent to the Pump A-2 discharge tee and interconnect the two new lower headers. Successfully pressure test the pipe assembly from KGV-22 through Pump A-2's new tee fitting and KGV-18.

1) The estimated total available pumping capacity is approximately 135 MGD.

33. Phase E6 (Drawing E-109): Demolish existing Pump A-1.

a. Complete this work in coordination with work under Phase G13.
b. Shutdown Pumps A-1 and P-6 and apply LOTO at the P5/P6 MV switch.
c. Demolish Pump A-1 and its associated motor starter, including all conduit, wiring, and ancillary equipment.

34. Phase G13 (Drawing G-113): Construct West Wet Well baffles, demolish Pump A-1, and perform concrete repairs in the West Wet Well.

a. The estimated total available pumping capacity exceeds 150 MGD in this step assuming that Pumps A-2, P-1, P-2, and P-3 and both the East and West Force Mains remain in service.

1) The influent pumping system will not have redundancy to convey 150 MGD if the largest pump is out of service until the West Wet Well is returned to

service. In order to reduce operational risks, expedite the construction of the wet well baffles once the West Wet Well is taken offline.

b. Close GV-2W and temporarily drain the West Wet Well to remove it from service. Assume that it will be necessary to install a temporary plug upstream of GV-2W to maintain isolation of the West Wet Well.
c. Construct reinforced concrete baffle beams in the West Wet Well. See Drawing S-102.
d. Perform any identified concrete repairs in the West Wet Well as directed by the Engineer.
e. Deenergize Pump A-1. Install a temporary plug in the existing piping to remain upstream of GV-A1. Demolish existing Pump A-1 and all associated suction and discharge piping up to KGV-24 and including suction GV-A1 and discharge cone valve CONV-A1.

35. Phase E7 (Drawing E-109): Install new Pump P-5 and demolish Pump A-2.

a. Complete this work in coordination with work under Phase G14.
b. Install new Pump P-5.
c. Install new feeder between the Pump P-5 motor starter and P5/P6 MV switch.
d. Perform permanent termination of the P-5 motor starter to the P5/P6 MV switch.
e. Remove LOTOs from the P5/P6 MV switch.
f. Start-up, test, and commission new Pump P-5.
g. Shutdown Pumps P-2, P-4, and A-2.
h. Apply LOTO at the P2/P4 MV switch.
i. Demolish Pump A-2 and its associated motor starter, including all conduit, wiring, and ancillary equipment.
j. Remove electrical and mechanical interlocks that prevented operation of three motors on the P2/P4 MV switch.
k. Remove LOTOs from the P2/P4 MV switch.
l. Return Pumps P-2 and P-4 to normal operation.

36. Phase G14 (Drawing G-114): Install Pump P-5 and demolish Pump A-2.

a. Install new Pump P-5 and all associated structural supports and ancillary equipment including motor/drive, shaft, electrical systems, and controls. Install all associated suction and discharge piping up to KGV-24, new gate valve GV-5, new cone valve CONV-5, and all associated supports, electrical systems, and controls. Successfully pressure test the new piping between GV-5 and KGV-24.

1) The estimated total available pumping capacity exceeds 150 MGD.

b. Upon completion of a successful pressure test, temporarily shutdown the West Wet Well to remove the plug on the new Pump P-5 suction line and then return the West Wet Well to service. Open GV-5 and KGV-24, and start-up, test, and commission new Pump P-5.

1) The estimated total available pumping capacity exceeds 150 MGD provided that Pump A-2 is still in service and can be operated while GV-2W is closed. If Pump A-2 is already taken out of service, then the temporary shutdown of the West Wet Well must be performed during dry weather

conditions, defined in Part 1.6, since the total available pumping capacity is estimated to be approximately 112 MGD with only Pumps P-1, P-2, and P-3 in service.

c. Deenergize Pump A-2.
d. During dry weather conditions, defined in Part 1.6, close valves KGV-18, KGV-22, GV-2W, and GV-2E to facilitate demolition of Pump A-2. Install plugs in the piping upstream of GV-2W and GV-2E if needed.

    1) The estimated total available pumping capacity is approximately 112 MGD assuming Pumps P-4, P-5, and P-6 are in service.
    2) Drain the force main between KGV-18, KGV-22, GV-2E, and GV-2W.
    3) Demolish existing Pump A-2 and all associated suction and discharge piping including discharge gate valve GV-B2, discharge cone valve CONV-A2, and the tee on the discharge header. The Pump A-2 suction elbow is to be abandoned.
    4) Complete construction of the new 48-inch lower header to reflect final conditions depicted on Drawing M-102.
    5) Open valves KGV-18 and KGV-22.
    6) The estimated total available pumping capacity exceeds 150 MGD.

37. Phase G15 (Drawing G-115): Commission the complete influent pumping system.

    a. Install and test new elbows, tee, ancillary components, and accessories interconnecting GV-2W and GV-2E. See Drawing M-101.
    b. If plugs were installed upstream of GV-2W and GV-2E, incrementally shutdown the respective wet wells and remove the plugs during dry weather conditions, defined in Part 1.6.
    c. Open valves GV-2W and GV-2E.
    d. Complete any remaining modifications for the surge relief, air release, instrumentation, electrical, hydraulic, or other systems needed for the influent pumping system's commissioning.
    e. All six new Pumps P-1, P-2, P-3, P-4, P-5, and P-6 and their systems are now installed and individually commissioned.
    f. Commission the complete influent pumping system and perform process control system testing pursuant to Section 01 91 13 'General Commissioning Requirements' and Section 40 61 21.20 'Process Control System Testing'.
    g. Demobilize the screened influent bypass pumping system and perform restoration of disturbed areas.

38. Rehabilitate the East and West Force Mains with Spray-In-Place Pipe Lining (SIPPL). See Drawings MD-113, MD-114, MD-115, M-107, and M-108 as well as Specification Section 33 01 30.70 'Spray-in-Place Polymeric Pipe Lining'.

    a. The work in this step is to be performed during dry weather conditions, defined in Part 1.6, since one of the two influent pumping system force mains will be out of service.

        1) Although this sequence is presented linearly, anticipate that this work will need to be performed over non-continuous periods to accommodate dry weather timing restrictions.

2) It is assumed that new fittings will be removed temporarily as needed for internal access to either force main. When SIPPL construction activities for either force main cannot be completed within a single dry weather period, temporarily install the new fittings so that the force main can be returned to service. Permanent installation of the new fittings will not be deemed complete until their removal is no longer required for SIPPL construction.

b. Portions of this work may be performed in coordination with work under other earlier phases with approval of the Owner, OCO, and Engineer.
c. Provide temporary supports for piping systems and valves as needed.
d. Temporarily relocate existing piping and other systems as necessary for SIPPL operations and the replacement of insulated 48-inch fittings. Any interruptions to existing systems must comply with constraints identified above in Part 1.7.
e. Valves proposed for isolation of the force mains might not seat watertight. Seal open ends of the piping to prevent leakage and reduce risk of flooding the work area.
f. Incrementally perform SIPPL of the East Force Main:

1) For SIPPL between KGV-12 and the new 90-bend:

a) Close and LOTO valve KGV-12, valve KGV-22, and the two valves on the East Force Main upstream of the grit tanks.
b) Drain the isolated segment of the East Force Main.
c) Demolish the existing 48-inch 90-bend at the change of tunnel direction.
d) Prepare to install the new 48-inch 90-bend so that service can be promptly restored when needed.
e) Temporarily disassemble the new 48-inch piping downstream of KGV-12 as needed for working access.
f) Clean and prepare the substrate for the force main. Exercise caution to minimize risk of accidental damage to the force main. Anticipate significant accumulation of deposits throughout. Properly dispose of wastewater and solids.
g) Perform pre-rehabilitation internal inspection. Promptly notify the Construction Manager if any defects are observed. Submit pre-rehabilitation video and report to the Construction Manager.
h) After the Engineer's review and acceptance of the pre-rehabilitation internal inspection, perform SIPPL of the existing East Force Main in the segment between KGV-12 and the 90-bend.
i) After providing adequate time for curing, perform post-rehabilitation inspection and collect samples for testing as needed. Submit post-rehabilitation video and report to the Construction Manager.

2) For SIPPL between the new 90-bend and the valves immediately upstream of the grit tanks, repeat the procedure used for the previous segment's SIPPL except with demolition of two fittings near the grit tanks for access to that end of the force main. Be prepared to promptly install the new fittings to restore service when needed. See Drawings MD-113 and M-117.
3) Permanently install the new 90-bend and fittings with insulation system seamlessly tied into existing insulation on adjacent piping. Selectively replace insulation system on existing adjacent piping as needed.

g. Incrementally perform SIPPL of the West Force Main with the same procedure used for the East Force Main except that valve KGV-13 is used for isolating the upstream end of the piping instead of KGV-12 and KGV-22.

39. Commence closeout procedures, complete final cleaning, and demobilize the construction workforce. See Section 01 77 00 ‘Closeout Procedures’.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013513.24

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SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Preparing and implementing a Health and Safety (H&S) Plan to establish in detail the protocols necessary for protecting workers from potential hazards during the work specified in the Contract Documents.

B. Related Requirements:

1. Section 011000 "Summary" for a description of work.

1.3 DEFINITIONS

A. CIH is a certified industrial hygienist.

B. SSHO is the site safety & health officer. The Contractor shall provide a responsible individual, competent through experience and training, to be able to identify hazards associated with the Contractor’s Work and has overall responsibility for the safety and health performance of contractor’s activities, including lower tier subcontractors. The person shall be present on-site during all contractor activities and shall ensure that the requirements of the Project Specific Safety and Health Plan are fully implemented. This person shall also:

1. Attend pre-work conferences and site safety and health orientations and briefings. The Contractor is expected to supplement the site orientation with information related to the Contractor's scope of work.
2. Document weekly tool box safety meetings for the Contractor’s employee’s onsite.
3. Submit weekly safety and health inspection reports of the construction site as it relates to the Contractor's scope of work. Record hazards identified, and corrective actions taken. The weekly inspection report shall be provided to the Site Manager.
4. Report all job-related accidents/illness related to the Contractor’s employees and lower tier subcontractors as soon as practical to the Site Manager and perform site accident and incident investigations associated with the Contractor's scope of work and fully cooperate with any other accident or incident investigations which may be required.
5. Maintain safety and health statistical information and provide monthly reports to the Site Manager. Reports shall include, employee hours worked, the number of first aid cases, the number of medical treatment cases, the number of restricted and lost workday cases as defined by the US Occupational Health and Safety Administration. These reports shall

include statistical information related to all of the Contractor's activities and the activities of lower tier subcontractors.

6. Provide Site Manager with the immediate notification of any regulatory inspection and a copy of all resulting citations or notice of deficiencies.

1.4 ACTION SUBMITTALS

A. Qualifications of the CIH and the SSHO.

B. Prior to commencing work at the jobsite, Contractors must file with the Site Manager all required documents, such as: A copy of the ***Contractor's Project Specific Safety and Health Plan*** and copies of employee training certificates, insurance certificates, construction permits, blasting permits, crane certifications and operator licenses, Steam Boiler Certifications, Elevator Certifications and any approved "OSHA Variances," or other approvals as required to safely and legally perform the Contractor's Scope of Work. The ***Contractor's Project Specific Safety and Health Plan*** shall as a minimum include the following:

1. Letter of corporate commitment to Safety and Health signed by CEO or President of the contractor's organization.
2. Brief description of the contractor's scope of work.
3. Project safety and health organization, responsibilities and accountability procedures.
4. Project safety and health goals and objectives.
5. Project hazard communication and safety training. (This section shall include a minimum requirement for a site hazard communication program and weekly safety meetings.)
6. Activity hazard analyses covering activities within the contractor's scope of work describing the steps of each principle activity, the hazards associated with each activity and procedures to be used to eliminate or control the hazards.
7. Personal protective equipment. (Note: Minimum site PPE requirements shall include hard hats, safety glasses with side shields and sturdy work boots.)
8. Specialized medical surveillance and/or air monitoring procedures, if required.
9. Safe work procedures. These may be incorporated by reference to the Contractor's Corporate Safety and Health Program.
10. Safety inspections and audits.
11. Project emergency response and preparedness procedures including provisions for providing first aid and notification of emergency services.
12. The Contractor (and any of its subcontractors), must submit, a Hazardous Waste Management Plan that addresses the handling, labeling, transpiration and disposal of hazardous waste. The Contractor shall be held solely responsible for compliance with the provisions of all applicable regulations associated with hazardous waste generated as a consequence of the Contractor's activities.
13. Owner's site safety training.
14. Owner's lockout/tagout procedures.
15. Procedures for onboarding and providing safety training new project personnel throughout the project.

1.5 INFORMATIONAL SUBMITTALS

A. Listed below are general conditions related to Safety and Health which the Contractor is required to comply with.

1. Should a specific interpretation be required concerning special and/or unusual safety, fire protection, or environmental concerns not covered by, the National Fire Protection Association Codes, and current OSHA/EPA or other local regulations the contractor shall contact the Site Manager's Safety and Health Representative or Corporate Safety and Health Office for guidance.
2. The practices, procedures, and requirements set forth in this Appendix shall apply equally to all Contractors, and it is mandatory that each Contractor inform and enforce the provisions of this Appendix in all contracts with its Subcontractors.
3. The Site Manager shall have the right to direct the removal from the jobsite any Contractor or Contractor personnel for violation of safety, health, fire protection, or environmental rules and regulations.
4. Fighting or horseplay is strictly prohibited and shall be considered grounds for removal from the project.
5. The illegal use, possession, purchase, sale or diversion of a drug or controlled substance is prohibited. The use or possession of alcoholic beverages at the jobsite is prohibited.
6. The Site Manager shall have the right to direct the removal from the jobsite any defective tools and equipment, the use of which may create a hazardous situation.
7. The Site Manager reserves the right to delete, modify, or supplement these procedures at any time without prior notice, but in such event, will notify all contractors affected by such change in procedures.
8. The Site Manager reserves the right to evaluate the Contractor's, and any of its subcontractor's, overall safety performance, compliance with these procedures, and any established supplements, at intervals the Site Manager deems appropriate.
9. Prior to starting work in any jobsite area, each Contractor must first obtain permission and instructions from the Site Manager, or designee

1.6 TRAINING

A. Certify that all Contractor personnel assigned for the purpose of performing or supervising work in accordance with the provisions of the H&S plan have received appropriate safety training in accordance with 29 CFR 1926.65. Training shall consist of a minimum of 40 hours of health and safety training and 8 hours refresher training annually. In addition, Contractor's supervisory personnel shall have a minimum of 8 hours additional specialized training for managing hazardous waste operations.

B. Additionally, the Contractor shall be responsible for, and shall guarantee that, only personnel successfully completing the required training are permitted to enter designated areas of the site where worker protection is required.

C. All personnel newly assigned to the project, including subcontractor employees, shall complete a project-specific site safety orientation before performing any work on site. The Contractor shall maintain records of all orientations and training provided and shall ensure that newly assigned personnel are informed of current site hazards, emergency procedures, applicable health and safety requirements, and task-specific controls

D. All personnel assigned to the project must also complete the Owner’s site safety training. Incorporate Owner Site Safety training into

1.7 MEDICAL SURVEILLANCE

A. Certify that the services of an occupational physician will be provided and utilized to provide the minimum medical examinations and surveillance specified herein for all workers performing or supervising work in accordance with the provisions of the H&S plan.

B. The entire medical surveillance program shall meet the requirements of OSHA standard 29 CFR 1926.65(f) including the provision requiring the Contractor to obtain a physician's written medical opinion based on site specific information furnished by the Contractor.

C. Maintain all medical surveillance records in accordance with 29 CFR 1926.65 and make these records available to the Engineer or other regulatory agencies as required.

1.8 DESCRIPTION OF REQUIREMENTS

A. This Section describes the minimum health and safety requirements for this project. Develop a detailed H&S Plan using this Section as a basis and delineating additional details and requirements as deemed necessary. The H&S plan shall establish in detail the protocols necessary for protecting workers from potential hazards encountered during demolition activities.

B. Utilize the services of a certified industrial hygienist (CIH) by the American Board of Industrial Hygienists (ABIH) to develop and implement the H&S plan, including any on-site air monitoring program, conducting initial site-specific training and provide continued support for all health and safety activities as needed, including the upgrading or downgrading of the level of personnel protection.

C. In addition, a Site Safety and Health Officer (SSHO) shall assist and represent the CIH in the continued implementation and enforcement of the H&S Plan. The SSHO shall be assigned to the site on a full-time basis during performance of activities covered by the H&S plan and shall be either the Contractor's employee or a subcontractor who reports to the Contractor and the CIH in matters pertaining to site safety and health.

D. The H&S Plan shall include but not necessarily be limited to, the following components as required by OSHA 29 CFR 1926.65(b)4 and 1926.65(p)(l)(2):

1. Site Description and Evaluation.
2. Names of key personnel and alternate responsible for site safety and health (responsibilities and chain of command).
3. Safety and health hazard assessment and risk analysis for each site task and operator (Accident Prevention Plan).
4. Education and Training.
5. Personnel Protective Equipment.
6. Medical Surveillance.
7. Air Monitoring (Environmental).
8. Standard Operating Procedures, Engineering Controls and Work Practices.
9. Site Control Measures (Work Zones, Communications and Security).
10. Personnel Hygiene and Decontamination.
11. Equipment Decontamination.
12. Logs, Reports and Record Keeping.

13. Heat/Cold Stress Monitoring.
14. Pre-emergency planning.
15. Personnel roles, lines of authority, training and communication.
16. Emergency recognition and prevention.
17. Safe distances and places of refuge.
18. Site security and control.
19. Evacuation routes and procedures.
20. Decontamination.
21. Emergency Medical treatment and first aid.
22. Emergency alerting and response procedures.
23. Critique of response and follow-up.
24. Personnel Protection Equipment and emergency equipment.

1.9 REGULATORY REQUIREMENTS

A. The Contractor is responsible for awareness, knowledge and full compliance with all applicable rules, regulations, laws and practices applicable to the Contractor's Scope of Work, including lower tier subcontractors, prescribed by the site owner, and any other government or agency governing the safety and health of employees, other site personnel, the general public and protection of the environment. Within the United States and its Territories these include, but are not limited to regulations promulgated by the following:

1. Occupational Safety and Health Administration (OSHA)
2. Environmental Protection Agency (EPA)
3. Department of Transportation (DOT)
4. Department of Energy, Nuclear Regulatory Commission (NRC)
5. Mine Safety and Health Administration (MSHA)

B. Additional rules required by the Site Manager include:

1. Each Contractor has the responsibility for instructing its employees in safe practices for the operation of tools and equipment and for the maintenance of safe conditions.
2. Contractors shall furnish for their employees' personal safety equipment such as, ANSI Z89.1 approved hard hats, ANSI Z87.1 approved eye protection with fixed side shields, ear protection, foot protection, NIOSH approved respiratory protection, fall protection and other equipment as required for safe performance of their particular work assignment. All personnel on the job site shall be required at a minimum to wear hard hats, safety glasses with side shields and proper and sturdy footwear.
3. Danger tags and locks shall be utilized to prevent personal injury and equipment damage in accordance with project electrical and mechanical tagging procedures.
4. Scaffolding and other structures utilized for elevated work platforms shall have the required decking, handrails, mid-rails, toe boards, proper access, and nets or screens.
5. Catwalks shall conform to a two-plank width minimum and, if elevated, shall have handrails and toe boards.
6. Areas in which "overhead" work is to be performed shall be blocked, decked, barricaded, netted, posted, or evacuated as instructed by project supervision.
7. Pits, trenches, and other excavations shall be shored/shielded or sloped to the proper angle of repose, barricaded, and provided with proper access.

8. When not in use, blades of bulldozers and buckets of front-end loaders shall be lowered to the ground. Also, beds of dump trucks shall be lowered when traveling or not in use. Project parking and traffic regulations shall be complied with.
9. Crane booms shall be lowered at the end of single shifts or secured against movement by attaching the hoist line to a fixed structure.
10. Specific air sampling shall be performed to determine the presence of toxic materials or dusts, flammable atmosphere and adequate oxygen content, in accordance with project procedures. Respirators, safety harnesses, lifelines, standby personnel, and permits shall be used when appropriate.
11. Personnel involved in activities which require the use of an Air Purifying Respirator (APR) shall not have facial hair which interferes with the respirator's face seal.
12. The Contractor shall provide to the Site Manager a copy of MSDSs for all hazardous materials prior to their use at the site.
13. Back-up alarms shall be provided on all construction vehicles and equipment and shall alarm continuously while the vehicle or equipment is in reverse motion. For equipment not equipped with a back-up alarm, a spotter shall be used.
14. All portable generators shall have frames externally grounded or other means to ensure there is no potential for circuit to frame conductivity.
15. All electrical services used in conjunction with field activities shall be equipped with Ground Fault Circuit Interrupters (GFCI).
16. Compliance with the following fire prevention measures is mandatory:

    a. Smoking is permitted only in specific areas as designated in project rules and procedures.
    b. Open fires are prohibited. Temporary gas-fired heaters shall not be used in enclosed areas. Only UL and NFPA approved petroleum and/or electrically fired heating devices will be authorized for use.
    c. Hot work permits shall be required for all flame and spark producing work tasks.
    d. Debris, scrap, and refuse shall be segregated and controlled in metal containers and removed at appropriate intervals. Any potential fire hazard shall be controlled.
    e. Each Contractor is responsible for maintaining and cleaning their work area. All walkways shall be kept clean and free of obstructions. Broken/spilled, scrap or other waste materials shall be placed in appropriate containers or waste areas as soon as practical after they are generated.
    f. Flammable liquids shall be kept in UL approved safety containers and properly labeled as to contents.
    g. Flammable and combustible materials shall be stored in designated locations that meet Federal, State and local regulations.
    h. All equipment such as cranes, trucks, bulldozers, graders, loaders and backhoes shall be equipped with proper fire extinguishers.
    i. The use of heavy equipment with internal combustion engines is prohibited within enclosed areas.

17. Only the number of persons provided with proper seats shall ride in a vehicle. No one shall ride on running boards, stand on moving equipment or ride on a vehicle other than in a proper seated position.
18. The swing radius of all heavy equipment such as cranes, back hoes, etc. shall be clearly barricaded.
19. The contractor shall provide 100% fall protection for fall exposures greater than 6 ft in accordance with project procedures.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Full-size physical assemblies that are constructed either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify

selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as as indicated in-place portion of permanent construction, consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.

    a. Include each system, assembly, component, and part of the exterior wall and roof to be constructed for the Project. Colors of components shall be those selected by the Engineer for use in the Project.

3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.
4. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term “testing laboratory” shall have the same meaning as the term “testing agency.”

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer or Construction Manager.

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1.4 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel and Delegated-Designer.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner’s quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.

2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include Work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.

7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Design Professional Qualifications: A professional engineer/registered architect who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Design/engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329**,** and with additional qualifications specified in

individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect, demonstrate, repair and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods. Contractor responsibilities include the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. Build laboratory mockups at testing facility, using personnel, products, and methods of construction indicated for the completed Work.
6. When testing is complete, remove test specimens and test assemblies,mockups, and laboratory mockups; do not reuse products on Project.
7. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Engineer or Construction Manager.
3. Notify Engineer and Construction Manager seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee same tasks during construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Engineer's and Construction Manager's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Engineer's preliminary review, to the satisfaction of the Engineer, before completion of final mockup.
8. Approval of mockups by the Engineer does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

1. Coordinate construction of the mockup to allow observation of air barrier installation, flashings, air barrier integration with fenestration systems, and other portions of the building air/moisture barrier and drainage assemblies, prior to installation of veneer, cladding elements, and other components that will obscure the Work.

M. Room Mockups: Construct room mockups according to approved Shop Drawings, incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Engineer to evaluate quality of the Work. Comply with requirements in "Mockups" Paragraph.

N. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Payment for these services will be made from testing and inspection allowances specified in Section 012100 “Allowances,” as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Engineer, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor’s Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payments.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Engineer, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Engineer, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's and Construction Manager's and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.

25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; http://ec.europa.eu/growth/single-market/ce-marking/
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csagroup.com.
65. CSA - CSA International; www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).

70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org .
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. ICBO - International Conference of Building Officials; (See ICC).
101. ICC - International Code Council; www.iccsafe.org.
102. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
103. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
104. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
105. IEC - International Electrotechnical Commission; www.iec.ch.
106. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
107. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
108. IESNA - Illuminating Engineering Society of North America; (See IES).
109. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
110. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
111. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
112. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
113. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.

114. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
115. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
116. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
117. ISO - International Organization for Standardization; www.iso.org.
118. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
119. ITU - International Telecommunication Union; www.itu.int/home.
120. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
121. LMA - Laminating Materials Association; (See CPA).
122. LPI - Lightning Protection Institute; www.lightning.org.
123. MBMA - Metal Building Manufacturers Association; www.mbma.com.
124. MCA - Metal Construction Association; www.metalconstruction.org.
125. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
126. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
127. MHIA - Material Handling Industry of America; www.mhia.org.
128. MIA - Marble Institute of America; www.marble-institute.com.
129. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
130. MPI - Master Painters Institute; www.paintinfo.com.
131. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
132. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
133. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
134. NADCA - National Air Duct Cleaners Association; www.nadca.com.
135. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
136. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
137. NBI - New Buildings Institute; www.newbuildings.org.
138. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
139. NCMA - National Concrete Masonry Association; www.ncma.org.
140. NEBB - National Environmental Balancing Bureau; www.nebb.org.
141. NECA - National Electrical Contractors Association; www.necanet.org.
142. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
143. NEMA - National Electrical Manufacturers Association; www.nema.org.
144. NETA - InterNational Electrical Testing Association; www.netaworld.org.
145. NFHS - National Federation of State High School Associations; www.nfhs.org.
146. NFPA - National Fire Protection Association; www.nfpa.org.
147. NFPA - NFPA International; (See NFPA).
148. NFRC - National Fenestration Rating Council; www.nfrc.org.
149. NHLA - National Hardwood Lumber Association; www.nhla.com.
150. NLGA - National Lumber Grades Authority; www.nlga.org.
151. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
152. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
153. NRCA - National Roofing Contractors Association; www.nrca.net.
154. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
155. NSF - NSF International; www.nsf.org.
156. NSPE - National Society of Professional Engineers; www.nspe.org.
157. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
158. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
159. NWFA - National Wood Flooring Association; www.nwfa.org.

160. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
161. PDI - Plumbing & Drainage Institute; www.pdionline.org.
162. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
163. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
164. RFCI - Resilient Floor Covering Institute; www.rfci.com.
165. RIS - Redwood Inspection Service; www.redwoodinspection.com.
166. SAE - SAE International; www.sae.org.
167. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
168. SDI - Steel Deck Institute; www.sdi.org.
169. SDI - Steel Door Institute; www.steeldoor.org.
170. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
171. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
172. SIA - Security Industry Association; www.siaonline.org.
173. SJI - Steel Joist Institute; www.steeljoist.org.
174. SMA - Screen Manufacturers Association; www.smainfo.org.
175. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
176. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
177. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
178. SPIB - Southern Pine Inspection Bureau; www.spib.org.
179. SPRI - Single Ply Roofing Industry; www.spri.org.
180. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
181. SSINA - Specialty Steel Industry of North America; www.ssina.com.
182. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
183. STI - Steel Tank Institute; www.steeltank.com.
184. SWI - Steel Window Institute; www.steelwindows.com.
185. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
186. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
187. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
188. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
189. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
190. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
191. TMS - The Masonry Society; www.masonrysociety.org.
192. TPI - Truss Plate Institute; www.tpinst.org.
193. TPI - Turfgrass Producers International; www.turfgrasssod.org.
194. TRI - Tile Roofing Institute; www.tileroofing.org.
195. UL - Underwriters Laboratories Inc.; http://www.ul.com.
196. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
197. USAV - USA Volleyball; www.usavolleyball.org.
198. USGBC - U.S. Green Building Council; www.usgbc.org.
199. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
200. WA - Wallcoverings Association; www.wallcoverings.org
201. WASTEC - Waste Equipment Technology Association; www.wastec.org.
202. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
203. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
204. WDMA - Window & Door Manufacturers Association; www.wdma.com.

205. WI - Woodwork Institute; www.wicnet.org.
206. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
207. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.

2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 013513.24 “Special Procedure for MOPO and Construction Sequence”.
2. Section 015000 “Temporary Bypass Pumping Systems”.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Engineer, Construction Manager, Owner, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations. Cedar Creek WPCP has a limited power capacity for the temporary electrical service as noted in these specifications. Should the Contractor require additional power beyond what the plant can provide in their temporary service, the Contractor shall provide temporary generators for the additional power requirements to complete the work of this contract, Contractor shall coordinate with the Engineer, CM, and owner for all work and to obtain the temporary electrical service. The Contractor shall submit the required load letter upon Notice of Award of the Contract by the County to move the project forward.

E. Water and Sewer Service from Existing System: Potable water from Owner's existing water system is available for use with metering. Provide connections and extensions of services and metering as required for construction operations.

F. Sewer, Water, and Electric Power Service: Use charges are specified in Section 011200 "Multiple Contract Summary."

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1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, temporary fencing, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:

1. Methods used to meet the goals and requirements of the Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.

5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
6. Indicate locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

H. Bypass Pumping Plan: Submit site drawing and narrative indicating bypass measures for maintenance of plant operations in accordance with Section 015728.

I. Influent Channel Isolation and Dewatering Drawings: Submit drawings, calculations, and narrative indicating bulkhead plan to isolate piping.

J. Temporary Bulkhead Drawings: Submit drawings, calculations, and narrative indicating bulkhead plan to isolate piping.

K. Mechanical Pipe Plug Drawings: Submit drawings, calculations, and narrative indicating bulkhead plan to isolate piping.

L. Stop Log Procedure: Submit drawings and narrative indicating plan to install, use, and remove stop logs.

M. Inflatable Pipe Plug Procedure: Submit drawings and narrative indicating plan to install, use, and remove pipe plugs. Include the following:

1. Locations and sizing of pipe plugs to be utilized in the project, including maximum allowable backpressure, as well as required backpressure at each location. See Section 2.3 for performance requirements.
2. Expected duration of plug installation and maximum pressure that plug can withstand
3. Extraneous equipment including but not limited to:

    a. Air compressor capable of reaching required PSI
    b. Pressure monitoring and alarm system to ensure plugs stay at required PSI

1.5 QUALITY ASSURANCE

A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.

B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

D. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its

use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top rails.

B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete bases for supporting posts.

C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Engineer from manufacturer's standard colors.

D. Wood Enclosure Fence: Plywood, 6 feet high, framed with four 2-by-4-inch-rails, with preservative-treated wood posts spaced not more than 8 feet apart.

E. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

F. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36-by-60-inches.

G. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Field Offices: Owner will provide conditioned interior space for field offices for duration of Project.

C. Construction Manager’s/Engineer’s/Owner’s Field Office: Of sufficient size, but minimum 12-feet by 50-feet, to accommodate needs of Owner, Engineer, and Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections for duration of project. Keep office clean and orderly. Furnish and equip offices as follows:

1. Field office trailer shall have at least one office, one conference room, one bathroom, one closet, and two exterior doors.

2. Bathroom shall include toilet, sink and faucet, and faucet, medicine cabinet, and exhaust fan.
3. Conference room shall include built-in plan table.
4. Engineer's field office shall be weather-tight construction with floor, walls, and ceiling completely insulated. Each room shall have at least one operating window. Each window shall have a venetian blind and full insect screen. Furnish two sets of keys for each exterior door. Provide fully insulated skirting on all sides of the field office trailer. Provide steps, platforms, handrails, and boot scrapers for each exterior door.
5. Field office trailer shall be Mobile Mini, ModSpace, Williams Scotsman, or equal. Converted storage or box containers will not be acceptable.
6. Furnishings:

    a. Provide the following furnishings for the Engineer's temporary field office for the duration of the project. All furnishings shall be new – or in very good condition – subject to approval of the Engineer.

        1) 60-inch by 30-inch desks with file drawer and 5 drawers, all lockable.
        2) Upholstered swivel type chair with arms for each desk.
        3) One 30-inch by 84-inch conference table.
        4) Eight armless side chairs (stacking type).
        5) Two 54-inch by 30-inch folding tables.
        6) Six file cabinet, 4 drawer, legal size, Hon No. HN-315C, or equal.
        7) Four wastebaskets.
        8) One rolling plan storage rack, 10-stick capacity.
        9) One lockable storage cabinet, 72-inch high, 36-inch wide, and 18-inch deep.
        10) Two steel bookcase units, 4 shelves high, Hon No. HN-S48 ABC, or equal.
        11) 24 painted steel coat hangers.
        12) One electric bottled water dispenser (5 gallon minimum) with hot and cold outlets and refrigerator unit. Adequate water bottles shall be provided (and paid for by the Contractor) until Final Completion.
        13) One wall-mounted first aid kit, McMaster-Carr 9501T1 or equal.
        14) Two smoke detectors, with batteries.
        15) Two dry erase boards, aluminum frame, 36-inch by 60-inch, markers and eraser, Quartet Model No. TS-S 535 or equal.
        16) One 1000-watt minimum 1.4-cu.ft. microwave oven.
        17) One 6-cf refrigerator.
        18) Commercial duty cross-cut shredder with basket, designed for 3 to 5 users, Fellowes Powershred SB-125i, or equal.
        19) One first aid kit, OSHA (1910.151.b) and ANSI (Z308.1-2003) compliant, suitable for ten people.

7. Equipment:

    a. Contractor shall provide the following equipment for each temporary field office for the duration of the project. All equipment shall be new.

        1) A multifunction Photocopier, printer, and scanner.

    b. With 50-sheet auto-feeder, capable of copying and printing
    c. Letter-sized, legal-sized, and 11-inch by 17-inch documents.

d. Contractor to provide paper and ink cartridges, as required, for the duration of the project.

1) Four 8-outlet surge protectors with six-foot cord and minimum 1800-joule energy rating or greater; as manufactured by Belkin, or equal.
2) One 12-cup coffeemaker with timer, by Krups, or equal.

8. Services:

a. Provide the following services for the duration of the project. Services shall include all costs for installation, use, maintenance, and removal of all products, services and equipment billed by each provider for each service specified herein.
b. Field office shall have complete and fully functional electrical, plumbing, and HVAC systems. Provide at least two smoke detectors hard-wired into the electrical system. Perform all scheduled and unscheduled maintenance for all systems and as directed by the Engineer.
c. Electrical System: Provide connection to temporary electric service. Comply with the electrical requirements of the furnished office trailer. Provide main circuit panel, sufficient GFCI outlets and lighting in each room, exterior lights at each exterior door, and proper grounding of entire electrical system.
d. Plumbing system: Connect to existing potable water supply. Provide hot water heater and hot and cold water to each fixture. Connect waste pipes to existing sanitary system or a waste holding tank. Heat trace and insulate exterior piping to prevent freezing. Where potable water service is not available, Contractor shall provide bottle water service with water chiller/dispenser.
e. HVAC System: Provide central heating and air conditioning system with programmable thermostat. System shall be capable of maintaining an interior temperature of 70 degrees F when the exterior temperature is 0 degrees F and an interior temperature of 75 degrees F when exterior temperature is 100 degrees F.
f. Bottled water service: Provide bottled water service complete with dispenser with hot- and cold-water taps and regular bottle and cup replenishment as directed by the Engineer.
g. Janitorial service: Provide janitorial services (at least weekly) that include dusting, sweeping, vacuuming, mopping, disinfection, and trash removal.
h. Sanitary service: Provide regular pumping of waste holding tank, if applicable, as needed.
i. Internet Access:

1) Provide high-speed internet access for the duration of the project.
2) Minimum Download Speed: 2 Gbps.
3) Minimum Upload Speed: 50 Mbps.
4) Provide password protected, high-speed WiFi router within the trailer.

j. Pay all costs for installation, maintenance, and removal of the telephone and internet service and instruments, including cellular phone service. The monthly cost of all calls made and received by the Engineer, including toll and long-distance calls, shall be paid for by the Contractor for the duration of the project.

9. Supplies: Provide the following supplies for the duration of the project: copy paper, toner, toilet paper, paper towels, soap, light bulbs, and other consumables as required by the Engineer.

D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

E. Temporary Electrical Service

1. Temporary electrical service shall be coordinated with the owner.
2. Cedar Creek WPCP has a limited temporary power capacity for the temporary electrical service as noted in these specifications. Should the Contractor require additional power beyond what the plant can provide in their temporary service, the Contractor shall provide temporary generators for the additional power requirements to complete the work of this contract, Contractor shall coordinate with the Engineer, CM, and owner for all work and to obtain the temporary electrical service. The Contractor shall submit the required load letter upon Notice of Award of the Contract by the County to move the project forward.

F. Temporary Heat and HVAC

1. Provide temporary heat as may be necessary for thawing out and heating the ground or materials and for proper execution, protection and drying-out of the Work.
2. Provide all temporary heat for new structures until the permanent heat is operational and accepted by the Engineer Owner.
3. Provide all temporary heat for existing facilities when the heating system is removed from service and until the new permanent system is operational and accepted by the Engineer/Owner.
4. Provide all temporary ventilation in new structures when the existing ventilation system is taken out of service and until the new permanent ventilation system is operational and accepted by the Engineer/Owner.
5. Provide all temporary ventilation in existing structures when the existing ventilation system is taken out of service and until the new permanent system is operational and accepted by the Engineer/Owner.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

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PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where shown on the Drawings or where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work. Engineer’s trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use within 30 days of the Notice to Proceed and prior to Commencement of Work at the site. Do not remove until approved by Engineer or are replaced by authorized use of completed permanent facilities.

3.3 ENGINEER'S OFFICE

A. Engineer's trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed and prior to commencement of Work at the site. All systems, furnishings, equipment, and services specified herein shall be furnished, installed, and completely operational for the field office to be considered established.

1. Provide weekly office cleaning services for the duration of the project.
2. Provide weekly supplies including, but not limited to restroom supplies (toilet tissue paper, paper towel, and soap), as well as light bulbs, air conditioner filters, etc.
3. Provide monthly office supplies for printers and fax machines, etc.
4. Supply all fuel for heating and pay all utility bills.

B. Install field office plumb and level.

C. Trailer shall be removed, and the site shall be cleaned up and restored before Final Completion of the project.

3.4 CONTRACTOR'S FIELD OFFICE

A. Provide a temporary field office(s) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present at all times while the Work is in

progress. Instructions received at the Contractors field office from the Engineer shall be considered delivered to the Contractor.

B. Locate field office(s) in accordance with approved shop drawings and as directed by the Owner.

C. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by the Engineer or Owner.

3.5 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service, if approved by Owner.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

C. Water Service: If approved, connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Provide all air, steam and water, including temporary piping and appurtenances required for cleaning and testing pipelines and equipment. Remove temporary piping and appurtenances upon approval of equipment being tested.

G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.

a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.

b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

H. Temporary Light and Power: Provide by Contractor, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.

I. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

J. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

K. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

L. Comply with National Electrical Code for installation of temporary electric power and lighting. Remove temporary wiring at job completion, repair penetrations, and restore finishes.

M. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Engineer and Owner.

3.6 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas.
3. Recondition base after temporary use, including removing contaminated material, regrading, proof-rolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

F. Storage and Staging: Use designated areas of Project site for storage and staging needs.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulation.

H. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings. Signs shall be constructed of A-A Ext – APA grade plywood, 1-in thick. Posts and braces shall be of pressure treated lumber.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

I. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

J. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

K. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

L. Temporary Elevator Use: Use of elevators is not permitted.

M. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

N. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

O. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

P. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.7 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide, install and maintain signage directing occupants to temporary egress.

K. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
2. Paint and maintain appearance of walkway for duration of the Work.

L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

M. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Construct dustproof partitions with two layers of 6 mil polyethylene sheet on each side. Cover floor with two layers of 6 mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

    a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

O. Weather protection shall comply with M.G.L. Chapter 149 Section 44G.

3.8 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Engineer.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.9 VEHICLE ACCESS AND PARKING

A. Provide temporary access roads, parking areas, traffic control devices, and staging areas as required by the work and as approved by the Engineer.

B. Clear snow and ice from all drives, walks and stairs to maintain safe vehicle and pedestrian access to the site and facilities as directed by the Engineer.

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3.10 WASTE MANAGEMENT

A. Provide covered dumpster, minimum 4 cubic yards, dedicated to field office waste. Provide separate covered dumpster of adequate size for construction debris. Empty dumpsters on a regular basis and as directed by the Engineer. Dumpsters shall not exceed their capacities at any time.

3.11 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Final Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. Just prior to Final Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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SECTION 015728 - TEMPORARY BYPASS PUMPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnishing all labor, materials, equipment, and incidentals required and installing, field testing, and maintaining temporary bypass pumping systems for the purpose of diverting flow around work areas or supplementing flow as required for installation for the new influent pumping system.

B. Bypass systems must be of sufficient capacity to handle peak flows indicated herein.

C. Provide the necessary labor and supervision to set up the pumping and bypassing system. The Owner’s contract operator will operate the bypass pumping system.

D. Provide diesel fuel for operation of the bypass pumping systems.

E. Assume that each of the influent supplemental bypass pumps will need to be intermittently operated during periods when the Influent Pumping Station has total capacity less than 150 MGD.

F. Assume that primary service pump(s) will need to be operated continuously when the plant drain bypass system is active. Standby pumps will only be operated for routine exercising and when primary service pump(s) are taken out of service.

G. Provide all materials and labor as necessary to maintain flow conveyance under all weather conditions.

1. Interruption of flows will not be permitted.
2. Overflows from bypass operations will not be permitted to enter into any streams or bodies of water.

H. Contractor is solely responsible for any legal actions taken by the state regulatory agencies if such overflows occur during construction.

I. Bypass pumping equipment shall include pumps, conduits, engines, and related equipment necessary to divert the flow or sewage around the section in which work is to be performed.

1. Maintain at the same location and in operable condition, duplicate equipment to be used in case there is equipment failure.
2. In this event, promptly repair or replace the failed equipment to the satisfaction of Construction Manager.

J. Do not exceed 85 dBA at a distance of 5 feet from any part of the system. Do not exceed 69 dBA at a distance of 30 feet.

1. Engine driven equipment for bypass pumping equipment to have “critical grade mufflers.”
2. Provide equipment with sound attenuation enclosure integral to the pump.
3. These conditions are subject to any other additional stipulations that may be required by local sound ordinances.

K. The design, installation and operation of temporary bypass pumping systems is the Contractor's responsibility.

1. Provide the services of a professional bypass company who can demonstrate to Owner, Construction Manager and Engineer that the company specializes in the design and operation of temporary bypass pumping systems.
2. The bypass system must meet the requirements of all codes and regulatory agencies having jurisdiction.

L. Maintain temporary bypass pumping systems so that they are completely functional throughout the required period of service.

1. Maintain continuous operation of existing facilities throughout construction.

M. Discharge of sewage to the ground, creeks, and/or storm sewers shall be prohibited. Any violation shall be corrected immediately. If the OWNER is required to alleviate any prohibited discharges, the CONTRACTOR shall be charged the OWNER's cost times two. All costs shall be deducted from the Contract Amount.

N. Following the required period of service, remove temporary bypass pumping systems from site.

O. Provide all maintenance including manufacturer recommended preventive maintenance and on-call repair services.

1. Provide repair services and/or replacement equipment 24 hours per day, seven days per week within 4 hours of being called.

P. Provide and store enough diesel fuel on site to continually operate the primary pumps for at least 3 consecutive days. Contractor to provide all necessary diesel fuel required for operation.

Q. Provide a refueling service to maintain continuous 24-hours per day, seven days per week pumping system operation. Contractor to provided all necessary diesel fuel required for operation. Owner’s contract operator will operate the system.

R. Contractor shall handle all system maintenance.

S. Related Requirements:

1. Section 013513.24 “Special Procedure for MOPO and Construction Sequence”.
2. Section 015000 “Temporary Facilities and Controls.”

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1.3 DEFINITIONS

A. Bypass Pumping System:

1. The bypass pumping system consists of all equipment, pipe, valves, plugs, power supplies and other appurtenances required to divert sewer flow from sewer or sewer pumping stations.
2. The bypass pumping system to be comprised of pumping setups in addition to all bypass pipe necessary to complete the work.

B. Bypass Pipe:

1. The bypass pipe consists of the pipe, valves and other appurtenances including, but not limited to, air relief valves and dewatering connections.
2. The bypass pipe includes both the suction and discharge pipe for each bypass setup.

C. Firm Pumping Capacity: The capacity of the Primary Pump Setup with the largest pump out of service.

D. Average Daily Flow: The average of the daily influent flow volume for a continuous 12 month period.

E. Primary Pump Setup: The primary pump setup to be capable of pumping the Peak Flow, be connected to the bypass pipe, have an isolation valve, have a check valve, and be complete with power supplies.

F. Backup Pump Setup: The backup pump(s) is located at each Primary Pump Setup.

1. At setups where one Primary Pump conveys the Firm Pumping Capacity, the Backup Pump shall be identical to the Primary Pump.
2. When two or more pumps operate in parallel to convey the Firm Pumping Capacity, size the Backup Pump(s) to convey the Firm Pumping Capacity with the largest Primary Pump out-of-service.
3. Backup Pumps to be operational, be connected to the bypass pipe, have an isolation valve, have a check valve with visual indication of operation (e.g., external swing arm), and be complete with power supplies.

G. Standby Pump:

1. Locate the Standby Pump within 30 minutes of the project site and ready for installation at any setup in the event that a Primary Pump or Backup pump is out of service requiring repairs.
2. The Standby Pump to have the capacity of the largest pump at each setup.
3. The Standby Pump to be readily capable to be connected to the bypass pipe at each setup (i.e., given the nature of its potential emergency need, it should not require field fabrication/assembly of pipe to be connected to the header).

H. Discharge Connection: The discharge connection is where the pumped flow exits the bypass pipe and is introduced into a gravity sewer or force main.

I. Peak Flow or Peak Wet Weather Flow:

1. The peak flow that may occur in a sewer inclusive of wet weather flow produced by groundwater infiltration, precipitation and snow melt.
2. This value shall also include peak infiltration and inflow.
3. Peak flow may also mean the peak capacity necessary to drain a tank within a certain timeframe.

J. Operational Test:

1. The period of specified duration that the installed system is tested to verify operational integrity of a system prior to placing the system in service.
2. Operational testing requires that representatives of the equipment manufacturer be on site for timely identification and resolution of system issues.

K. Low Flow Period: The time of day when the wastewater system flow rate reaches the diurnal minimum.

1.4 SUBMITTALS

A. Submit the following:

1. Detailed description of each proposed temporary bypass pumping system, including pumps, pump drives, piping, hoses, valves, fittings, controls, wiring and any other related accessories required to provide a complete operating system in conformance with the requirements of this Section.
2. Calculations of static lift, pipe size selection, friction losses, flow velocity, total dynamic head, and pump selection.
3. Pump performance curves and head capacity curves showing pump operating range and capacity to meet all required flows.
4. Detailed plans and sections showing the proposed pumping system layout including dimensions and elevations. Include the following:

    a. Sewer plugging plan, including type, location, and manufacturer of plugs with emergency release procedures.
    b. Thrust and restraint block sizes and locations, if necessary.
    c. Temporary pipe supports, anchorage, cover material and other accessories as required to stabilize the piping system.
    d. Staging area and access requirements for all pumps.
    e. Number, size, material, location, and method of installation of suction piping.
    f. Number, size, material, location, and method of installation of discharge piping.
    g. Pump size, capacity, number of units, diesel engine specifications, fuel tank capacity, fuel consumption requirements, method of refueling, and location of all pumping equipment.
    h. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted).
    i. Standby power generator size and location.
    j. Proposed method of freeze protection.
    k. Proposed method of noise control for each pump.
    l. Temporary pipe supports, anchorage, cover material and other accessories as required to stabilize the piping system.
    m. Installation schedule and maintenance schedule.

n. List of personnel responsible for 24-hour on-site pump services and phone numbers.
o. A minimum of five reference installations of projects with similar size in wastewater pumping applications. Include contact names and phone numbers.
p. List of recommended spare parts to be stored on-site for emergency maintenance.

5. Information on vendor's service staff capabilities and replacement parts inventory to show that vendor has sufficient resources to provide emergency service and replacement equipment and/or parts to the work site prior to backup, surcharge, or overflow from the upstream system network.
6. Description of system operation and controls. Include a list of all alarm conditions and procedures for correcting problems including equipment replacement prior to backup, surcharge, or overflow from the upstream system network.
7. Description and schedule for the proposed procedures for start-up and testing of the facilities to demonstrate compliance with specified automatic operation and maintenance of a constant discharge pressure.
8. Plan of Operations for inclement weather including wet weather events and snowstorms, demonstrating the ability to maintain pumping system operations throughout inclement weather events.
9. Submittals for temporary bypass pumping systems shall be prepared and stamped by a professional engineer registered in the State of New York.
10. Detailed plan for 24-hour alarm monitoring.
11. Information on the pump controller to illustrate how each pump’s capacity will vary with varying flow rate.
12. Proposed method of noise control for each pump and generator, if provided.
13. Installation schedule and maintenance schedule.
14. Provide information on the vendor's service staff capabilities and replacement parts inventory to show that the vendor has sufficient resources to provide emergency service and replacement equipment and/or parts to the site within one hour of a service call.
15. A description and schedule for the proposed procedures for start-up and testing of the facilities to demonstrate compliance with specified automatic operation and maintenance of a constant discharge pressure.
16. A plan of operations for inclement weather including snowstorms and high flow events. The plan shall demonstrate the ability to maintain pumping system operations throughout inclement weather events.
17. A description and schedule for the proposed procedures for dismantling the system, and restoring normal operations at the facility.
18. Provide evidence that Contractor is insured in the event of flooding resulting in the damage or loss of bypass pump and equipment.
19. Provide evidence that the bypass pipe material and thickness can withstand all normal operating and surge pressures with a safety factor of 2.0.
20. Denote any conditions that will cause pumps to lose suction lift (prime) and describe procedures to rectify.
21. Show that the emergency switchover from primary to backup pumping will be automatic should Primary Pumps fail.
22. Show suction and discharge piping is protected from possible damage from construction activities.

1.5 DELEGATED DESIGN SUBMITTALS

A. Sign and seal Shop Drawings with design calculations and assumptions confirming performance requirements.

1. Include with Shop Drawings.
2. Professional Engineer Registration: State of New York

1.6 QUALITY ASSURANCE

A. Demonstrate experience to the Engineer or employ the services of a vendor who can demonstrate five years of recent and continuous specialization in the design, installation, operation, and removal of temporary bypass pumping systems in wastewater applications of similar size and complexity within the past three years.

B. Furnish the complete system from a single vendor who is capable of providing service staff, repair parts, and replacement of deficient system component within four hours of a service call, twenty-four hours per day, seven days per week.

C. Meet the requirements of all codes and regulatory agencies having jurisdiction. The Contractor is responsible for damage and any environmental fines/penalties due to backups or overflows onto streets, yards, and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways, including any subsequent remediation measures required or made necessary by such backups or overflows.

1.7 MANUFACTURER'S SERVICES

A. Provide the services of the manufacturer's representative for physical checkout field testing and operation and maintenance instruction for a minimum of one person day per pumping system. See requirements in Part 3.

B. Provide the services of the manufacturer's representative or designated alternative, who will be on site during all bypass pumping operations. Provide list of these designated personnel with telephone numbers prior to the start of bypass pumping.

PART 2 - PRODUCTS

2.1 INFLUENT PUMP BYPASS SYSTEM DESCRIPTION

A. Comply with design parameters specified herein.

1. Design and install temporary bypass pumping systems. The Owner’s contract operator will operate bypass pumping systems.
2. The Owner’s contract operator will provide on-site monitoring of bypass pumping while in operation.
3. Be capable of providing repair services and/or replacement equipment 24 hours per day, seven days per week.

B. Pumping System Control Panels: NEMA 4. Include flow indication, a flow totalizer, indicator lamps showing which pumps are operating, selector switch for auto or manual start and stop for each pump and visual and audible alarms for indication of operation failure and alarm conditions.

C. Bypass plant influent wet wells from Influent Screen Building channels to Grit Building with submersible pumps.

1. Refer to 013513.24 “Special Procedure for MOPO and Construction Sequence” for information on the existing plant operations and constraints during construction.
2. Refer to 015000 “Temporary Facilities and Controls” for requirements related to temporary electrical service, if needed.

D. Provide stop logs, temporary bulkheads, and/or plugs in the screening channels to isolate flow from the influent wet wells, if needed.

1. Portable compressor used for inflation of pipe plugs shall be classified as explosion proof if located within the influent screen building .

E. Provide a high level float system for the bypass pumping operation connected to an auto-dialer, which will provide notification to appropriate personnel in the event of an emergency situation.

1. Coordinate with owner on the setup of the auto-dialer system.

F. Maintain vehicle and pedestrian access on the plant roads and sidewalks at all times. Where pipes cross vehicular travel lanes, provide temporary road ramps to protect pipes while maintaining vehicle access.

G. Emergency egress and emergency response vehicle access routes must be maintained at all times. Coordinate and obtain approval from the Authority Having Jurisdiction for any proposed impediments to either.

H. Discharge Plant Drain bypass flow into distribution box.

1. Remove grating and secure/support piping as necessary.
2. Provide temporary railing/safety barrier around opening.
3. Provide seal as necessary to limit odors.
4. Connections shall be approved by the owner.

2.2 PLANT DRAIN BYPASS SYSTEM DESCRIPTION

A. Comply with design parameters specified herein.

1. Design and install temporary bypass pumping systems. The Owner’s contract operator will operate the bypass pumping systems.
2. The Owner will provide on-site monitoring of bypass pumping while in operation.
3. Be capable of providing repair services and/or replacement equipment 24 hours per day, seven days per week.

B. Pumping System Control Panels: NEMA 4. Include flow indication, a flow totalizer, indicator lamps showing which pumps are operating, selector switch for auto or manual start and stop for each pump and visual and audible alarms for indication of operation failure and alarm conditions.

C. Bypass plant drain flow from MH 3 to Grit Building with submersible pumps

1. Remove manhole frame and cover, chimney and cone section to accommodate installation of pumps.
2. Refer to 013513.24 “Special Procedure for MOPO and Construction Sequence” for information on the existing plant operations and constraints during construction. Refer to 015000 “Temporary Facilities and Controls” for requirements related to temporary electrical service, if needed.

D. Provide inflatable plugs at inlet and outlet of MH 2.

1. Portable compressor used for inflation of pipe plugs shall be classified as explosion proof if located within the building.

E. Provide a high level float system for the bypass pumping operation connected to an auto-dialer, which will provide notification to appropriate personnel in the event of an emergency situation.

1. Coordinate with owner on the setup of the auto-dialer system.

F. Discharge plant drain bypass flow into distribution box.

1. Remove grating and secure/support piping as necessary.
2. Provide temporary railing/safety barrier around opening.
3. Provide seal as necessary to limit odors.
4. Connections shall be approved by the owner.

2.3 GENERAL PUMPING EQUIPMENT

A. Furnish pumping units and accessories from a single vendor. For each temporary bypass pumping system, include pumps, drives, piping, piping headers, valves, flow meter, controls and appurtenances as required for a complete system.

B. Design and build pumps, drives, and controls for 24-hour continuous service at all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain. Design and construct parts to have the strength, stability, and stiffness to meet specified requirements. Provide methods for inspection, repairs, and adjustment.

C. Furnish necessary foundation bolts, nuts, and washers.

D. Furnish each piece of equipment with a nameplate (with embossed data) securely mounted to body of the equipment.

1. Nameplate for Pumps: Include, as minimum, the manufacturer's name and model number, serial number, rated flow capacity, head, speed, and other pertinent data.

2. Nameplates for Drives: Include, as minimum, manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles, and power and service factors.

E. Provide sound attenuation and comply with applicable noise ordinances for equipment.

F. Suitable for outdoor operation under adverse weather conditions. Provide protection from freezing as required to maintain system operation.

G. Pump Manufacturers:

1. Flygt, Godwin Pumps of America, Bridgeport NJ.
2. United Rentals
3. Thompson Pump and Manufacturing Co., Port Orange FL.
4. Or equal.

2.4 FLOW ISOLATION PLAN

A. Provide Flow Isolation Plan(s) for temporary flow isolation as required.

B. Temporary Flow Isolation:

1. Provide bulkhead(s) or other means of flow isolation to isolate the area(s) of work from receiving process flow and to divert flow as necessary for installation of the bypass pumping system(s) within the Influent Screen Building and/or the East and West Wet Wells, in accordance with Section 013513.24 “Special Procedures for Maintenance of Plant Operation and Sequence of Construction” and as shown on the Contract Drawings.
2. Provide Diving Services if necessary for installation and removal of bulkheads or other flow isolation devices.
3. Contractor is required to provide full flow capability at any given time as required by Section 013513.24 “Special Procedures for Maintenance of Plant Operation and Sequence of Construction”, If partial isolation is implemented by means of a cofferdam, bulkhead, or other infrastructure, such infrastructure shall be capable of being removed, opened, or modified at the direction of the Owner for anticipated high flow events. Any opening, such as a built-in sluice gate, shall be capable of allowing the flow requirements to be met.

C. Contractor may install submersible pumps, complete, in the Influent screening channels or the East and West Wet Wells; suggested sequence is presented in Section 013513.24 “Special Procedures for Maintenance of Plant Operation and Sequence of Construction” and shown on the Contract Drawings. Requirements for installation within this specification applies to complete installations within each wet well.

D. Interim Electrical System:

1. Provide an Electrical System to power the pumps as installed and associated equipment.

E. Interim Pump Controls:

1. Provide necessary level controls and measurement devices for the pumping system.

2. Provide Local Control Panels (LCPs) for each pump.

   a. Panels shall include: indicating lights, selector switches, control hardware, emergency Stop mushroom pushbuttons, and Unistrut®-style supports and anchorages.

F. Any other associated materials, equipment and apparatus including spare parts that are necessary for the successful operation and maintenance of the submersible or self priming pumps.

2.5 CONDITIONS OF OPERATION

A. Pumps for Each Site: Identical in every respect with all parts interchangeable.

B. Pump Design: For the conditions of service specified herein, with a rising head capacity curve for stable pump operation from the minimum head operating point to the shut-off head.

1. Service: Temporary Bypass Pumping.
2. Number of Pumps: As required for short-term temporary bypass of incoming drains and sewers at various manholes as needed during shutdown and rehabilitation of the influent pump station wet wells.
3. Liquid: Raw Wastewater, process drains, or stormwater.
4. Design capacity total peak (gpm): As required by the Application.
5. Drive: Diesel or electric.

C. Bypass operations during reduced pump capacity periods or wet well shutdowns lining or completing system connections should be attempted during dry weather conditions. Monitor the weather forecast prior to and during bypass operations. Be prepared to follow contractors submitted plan of operations for inclement weather events.

D. Dry weather flow rates have been approximated based on the Owner's records. The flows are estimated for the various locations that may require bypass flow during construction in the table below but not guaranteed. Contractor to coordinate with the Engineer once a timeline and bypass layout is established.

1. INFLUENT PUMP STATION BYPASS FLOWS
   Minimum of 30 MGD

2. PLANT DRAIN BYPASS FLOWS
   Maximum Daily Flows only:

Average	4.7 MGD
90th Percentile	7.5MGD
95th Percentile	8.9 MGD
98th Percentile	10.5 MGD
Maximum	14.2 MGD

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2.6 PUMPING SYSTEM COMPONENTS

A. General: Centrifugal, submersible or end suction, fully automatic, self-priming units that do not require the use of foot-valves, vacuum pumps, diaphragm pumps, or isolation valves or float apparatus in the priming system. Capable of running dry, with no damage for extended periods of time.

B. Pump Seals: High pressure, mechanical self-adjusting type with solid carbide faces capable of withstanding suction pressures to 100 psi.

1. Mechanical Seal: Cooled and lubricated in an oil bath reservoir, requiring no maintenance or adjustment. Keep oil bath reservoir from coming in contact with pumped water.
2. Pump Seal Metal Parts: Stainless steel.
3. Elastomers: Viton.

C. Pump Drive: Diesel engine or electric motor.

1. For Diesel engine drives:

a. Diesel Engine: Water cooled.
b. Pump and Diesel Engine: Skid mounted with integral fuel tank and skid lifting bracket.
c. Total Storage Quantity of fuel Allowable at Site: Not more than the sum of the individual fuel tank capacities furnished with each pump's diesel engine drive.
d. Provide a refueling service to maintain continuous 24-hours per day, 7 days per week pumping system operation.

2. For electrical motor driven pumps: Assume power costs.
3. If electrically-driven pumps are used, backup pumps shall be diesel-driven. All pumps shall be variable speed.

D. Pump System Controls:

1. Automatic start/stop controls for the pumping system to automatically maintain system flow at each location.
2. Contained in a local control panel with provision to manually operate each pump. Provide indication of pump operation and indicate total flow being pumped.

E. Provide required suction and discharge pipe and fittings, discharge manifold pipe and fittings, shutoff valves, check valves, flow meter, pressure regulating valves, insulation, freeze protection, and required accessories.

1. Pipe and Fittings: Steel with flanged or quick connect coupling connections, or high-density polyethylene pipe with fused joints.
2. Joints: 100 percent restrained.
3. Suction Piping: Rated for 25-inch Hg vacuum.
4. Discharge Piping, Fittings, Connections, Valves, and Piping Accessories: Rated for a minimum working pressure of 150 psi.

F. PIPE

1. Provide required suction and discharge pipe and fittings, discharge manifold pipe and fittings, shutoff valves, check valves, flow meter, pressure regulating valves, insulation, freeze protection, and all required accessories.
2. Pipe and fittings shall be steel with flanged or quick connect coupling connections, or high-density polyethylene (HDPE) pipe with fused joints.
3. Joints must be 100 percent restrained.
4. Suction piping shall be rated for 25-inch Hg vacuum.
5. Discharge piping, fittings, connections, valves, and other discharge piping accessories shall be rated for a minimum working pressure of 80 psi.
6. Minimum DR21 rating.
7. Layflat hose and quick-connect pipe are not permitted.
8. The bypass pump setup for the 54” East Trunk sewer shall be provided with at least two HDPE force-mains, each rated for no more than 50 percent of the firm capacity.

G. CHECK VALVES

1. Check valves shall be swing-arm type for external, visual inspection.

H. ISOLATION VALVES

1. Either gate or plug type valves shall be used to isolate each pump and header, as necessary.

I. TEMPORARY PLUGS

1. Provide temporary plugs, as required, for successful operation of the temporary pumping systems.
2. Plugs shall be designed for the specific purpose of providing temporary plugging of active pipes.
3. Plugs shall be firmly attached to a stationary object at ground level by a cable in order to prevent loss of plugs in pipelines.
4. Sewer plugs shall be capable of accommodating the maximum allowable surcharge heads within the sewer system that may be experienced during construction.
5. Plugs shall be readily removed from the system during emergency shutdowns.
6. Sewer plugs shall be pneumatic.

J. FLOW METERS

1. Provide magnetic flow meter on each system as follows:
2. EQ Basin Drainage bypass pump setup.
3. Flow meter shall be provided with digital display such that Owner can observe pumped rate.

K. ALARM MONITORING SYSTEM

1. Contractor shall coordinate with Owner for the bypass pump set up including suction water levels and bypass system alarms.
2. Bypass pumping system's monitoring system shall be capable of providing the following alarms:

    a. Lag Pump 1 On.
    b. Lag Pump 2 On.
    c. Lead Pump Fail.
    d. Lag Pump 1 Fail.
    e. Lag Pump 2 Fail.
    f. High Water.
    g. Overflow.

L. Provide to the Owner a list of Contractor's personnel to be notified when an alarm is signaled.

1. The list must include names and corresponding cellular phone numbers and cellular phone service providers.
2. All cellular phones on the list must be capable of receiving text messages.

M. When alarms are activated, the system shall also notify the Owner. The Owner will provide names and phone numbers of Owner's staff to be notified.

Ensure the bypass pumping telemetry system is operational during all times when the bypass pumps are operational. Ensure all bypassing equipment is continuously monitored and shall immediately respond to any alarms.

PART 3 - EXECUTION

3.1 INSTALLATION AND PHYSICAL CHECKOUT

A. Install in accordance with the bypass pumping system supplier's recommendations and approved Shop Drawing submittals.

B. Use critically silenced packs on each diesel-driven pump sets. Reduce the sound of the diesel-driven engine to 69 dBA at a distance of 30 feet.

C. Install pumping units on a firm level surface.

D. Furnish the services of the bypass pump system supplier's representative for a minimum of one day per temporary bypass system to assist equipment installation and physical checkout.

3.2 FIELD TESTING

A. Provide field testing in accordance with the approved Shop Drawing submittal. Demonstrate conformance with system requirements.

B. Field testing be conducted by the pump system supplier's representative in the presence of the Engineer. Furnish the services of the bypass pump system supplier's representative for a minimum of one day per temporary bypass system to conduct required testing.

1. Demonstrate a minimum of 24 hours of continuous operation. During the 24 hours of continuous operation, demonstrate system’s ability to automatically start and stop pumps in response to changing flow conditions.

C. Remove and replace any system component that fails to perform in accordance with specified requirements.

3.3 SYSTEM OPERATION

A. Perform required maintenance on the equipment to maintain the system integrity and capacity as specified.

B. Provide maintenance including manufacturer-recommended preventive maintenance and on-call repair services.

C. Provide full-time on-site monitoring of bypass pumping while in operation. Provide repair services and/or replacement equipment 24 hours per day, seven days per week.

D. Provide clean-up and disposal of contaminated material and reporting for product spills.

3.4 EQUIPMENT REMOVAL

A. At the completion of the period of service, disconnect temporary piping and remove system components from Site. Restore the work site to its original condition.

END OF SECTION 015728

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 “Summary” for Contractor requirements related to Owner-furnished products.
2. Section 012100 "Allowances" for products selected under an allowance.
3. Section 012300 "Alternates" for products selected under an alternate.
4. Section 012500 "Substitution Procedures" for requests for substitutions.
5. Section 014200 "References" for applicable industry standards for products specified.
6. Section 017700 “Closeout Procedures” for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project by contractor, pre-purchased by the Owner, or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycle contract materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in PART 2 “Comparable Products” Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model

number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in PART 2 "Comparable Products" Article.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Resolution of Compatibility Disputes between Multiple Contractors:

a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification Sections in Divisions 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, including Owner pre-purchased products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
5. Inspect Owner pre-purchased products on delivery to determine compliance with Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection for wind.

5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.
9. Comply with product manufacturer’s requirements for maintenance and exercise of products during storage.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Engineer through Construction Manager in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product that complies with requirements.

    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with

requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer that complies with requirements.

a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

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2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.

B. Engineer’s Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 “Submittal Procedures.”

1. Form of Approval of Submittal: As specified in Section 013300 “Submittal Procedures.”
2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Coordination of Owner-installed products.
7. Progress cleaning.
8. Starting and adjusting.
9. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products and limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

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1.4 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to submitting cutting and patching plan, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Engineer and Construction Manager of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

a. Contractor's superintendent.
b. Trade supervisor responsible for cutting operations.
c. Trade supervisor(s) responsible for patching of each type of substrate.
d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

B. Layout Conference: Conduct conference at Project site.

1. Prior to establishing layout of new and existing perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Engineer and Construction Manager of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:

a. Contractor's superintendent.
b. Professional surveyor responsible for performing Project surveying and layout.
c. Professional surveyor responsible for performing site survey serving as basis for Project design.

2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
3. Review requirements for including layouts on Shop Drawings and other submittals.
4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certified Surveys: Submit two copies signed by land surveyor.

C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

D. Cutting and Patching Plan: Submit plan describing procedures at least Insert number days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.6 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.7 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: Refer to Section 014000 “Quality Requirements.”

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements, whose structural function is not known, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.

f. Mechanical systems piping and ducts.
g. Control systems.
h. Communication systems.
i. Fire-detection and -alarm systems.
j. Conveying systems.
k. Electrical wiring systems.
l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

a. Water, moisture, or vapor barriers.
b. Membranes and flashings.
c. Exterior curtain-wall construction.
d. Sprayed fire-resistive material.
e. Equipment supports.
f. Piping, ductwork, vessels, and equipment.
g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraphs, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer and Construction Manager promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Engineer and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and

duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer and Construction Manager.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer and Construction Manager before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items onsite and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

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3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

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3.9 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Repair Work previously completed and subsequently damaged during construction period Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 024119 “Selective Demolition”
2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
3. Section 044313.13 "Anchored Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
4. Section 044313.16 "Adhered Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
5. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor. However, the Owner reserves the right to identify any of their existing equipment assets for salvage prior to demolition and disposal.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

C. Project specific construction sequencing dictates that existing pumps are removed from service incrementally. Retain parts from existing pumps as they are removed from service to allow for maintenance and/or emergency repair of pumps that remain in service. Retain and store all pump parts that are removed from service until substantial completion or until otherwise approved by the Owner and Engineer. The Owner will retain ownership of all existing pumps until the end of the project.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

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1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, and waste disposal plan. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Use. Include estimated quantities and assumptions for estimates.

C. Waste Disposal: Identify facility name, location and contact information for locations where waste will be disposed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.

B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

C. Salvaged Items for Sale and Donation: Not permitted on Project site.

D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

G. Plumbing Fixtures: Separate by type and size.

H. Lighting Fixtures: Separate lamps by type and protect from breakage.

I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged, remove waste materials and legally dispose of at designated spoil areas on Owner’s property.

C. Burning: Do not burn waste materials.

END OF SECTION 017419

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 012900 “Payment Procedures” for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Engineer’s use prior to Engineer’s inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

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1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's “punch list”), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Construction Manager's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for

Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Engineer and Construction Manager.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. MS Excel Electronic File. Engineer, through Construction Manager, will return annotated file.
    b. PDF Electronic File. Engineer, through Construction Manager, will return annotated file.
    c. Web-Based Project Management Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).
    d. Three Paper Copies. Engineer, through Construction Manager, will return two copies.

1.10 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit by email to Engineer.

E. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining: clean according to manufacturer’s recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

    1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.

q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 “Execution” before requesting inspection for determination of Substantial Completion.

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
3. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operation and maintenance submittals is acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Engineer. Enable reviewer comments on draft submittals.
2. Submit three paper copies. Engineer, through Construction Manager, will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Engineer will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-

reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Engineer.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.

4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.

3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and

flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
2. Section 012900 “Payment Procedures” for maintaining and exhibiting project record documents as a prerequisite for progress payments.
3. Section 017300 "Execution" for final property survey.
4. Section 017700 "Closeout Procedures" for general closeout procedures.
5. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
3) Submit Record Digital Data Files and one set(s) of plots.
4) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Work Change Directive.

k. Changes made following Engineer's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
2. Format: DWG, Version AutoCAD 2023, Microsoft Windows operating system.
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Engineer through Construction Manager for resolution.
6. Engineer will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

a. See Section 013100 "Project Management and Coordination" for requirements related to use of Engineer's digital data files.
b. Engineer will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Engineer and Construction Manager.
e. Name of Contractor.

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1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit Record Specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

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1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's and Construction Manager's reference during normal working hours. As a prerequisite for monthly progress payments, exhibit the updated record documents for review by Owner and Engineer for accuracy and completeness.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

B. Allowances: Furnish demonstration and training instruction time under the demonstration and training allowance as specified in Section 012100 "Allowances."

C. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up. See requirements in Section 012200 "Unit Prices."

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

    a. Name of Project.
    b. Name and address of videographer.
    c. Name of Engineer.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

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1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.

d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

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1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Engineer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.

1. Submit video recordings on CD-ROM or thumb drive or by uploading to web-based Project software site.
2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:

a. Name of Contractor/Installer.
b. Business address.
c. Business phone number.
d. Point of contact.
e. Email address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

a. Produce segments to present a single significant piece of equipment per segment.
b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 018819 - TIGHTNESS TESTING PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Tightness testing of cast-in-place reinforced concrete liquid retaining structures.

B. Related Requirements:

1. Section 033100 "Structural Concrete" for concrete related construction.
2. Section 031500 "Concrete Accessories" for joints in concrete structures.
3. Section 033600 "Grout" for grout related construction.
4. Section 400559.23 Stainless Steel Slide Gates” for water-controlling gates.
5. Section 400551 “Common Requirements for Process Valves” for valves and valve actuators.

C. References:

1. ACI-350.1 – Tightness Testing of Environmental Engineering Concrete Containment Structures

1.3 PRETESTING MEETINGS

A. Pretesting Conference: .

1. Discuss:

a. Testing methods to be used.
b. Measurement of precipitation and evaporation.
c. Pre-testing preparations.
d. Water filling and disposal operations, including coordination with Owner.
e. Cleanup activities.
f. Emergency actions, in case they are required.
g. Procedures necessary to obtain a specified special warranty.

2. Attendees:

a. Owner.

b. Construction Manager.
c. Contractor.
d. Engineer.

1.4 INFORMATIONAL SUBMITTALS

A. Submit in accordance with Section 013300:

1. Action Plan: Submit a detailed plan and schedule for each structure, which shows method of filling, testing and disposal of water.
2. Repair Procedures: Submit for acceptance the proposed repair methods, materials, and modifications needed, if structure does not meet tightness testing.
3. Test Reports: Submit a completed Tightness Test Report, Figure A, appended at the end of this Section of each test for each structure.

1.5 FIELD CONDITIONS

A. Coordinate timing and procedures for obtaining water for testing, structure testing, and water disposal with the Engineer and Owner a minimum of 30 days in advance of actual testing.

B. Water Source:

1. Provide water for testing independent from Owner's water source.
2. Use plant process water for testing. Obtain water at a time, flow rate, and location approved by Owner.
3. Use water for testing from Owner's plant water system. Obtain water at a time, flow rate, and location approved by Owner.
4. Provide labor, materials, equipment, incidentals, and power required to convey water to the structure.

C. Water Disposal:

1. Dispose of test water in an approved manner. Do not dispose by discharging onto the ground surface of public or private land.
2. Coordinate disposal of test water by reintroduction into the Plant process at a time, flow rate, and location with Owner.
3. Provide labor, materials, equipment, incidentals, and power required to convey water from the structure.

D. Environmental Conditions: Do not schedule test measurements for a period when the weather forecast indicates a substantial change in weather patterns that would affect testing. Do not schedule test measurements when weather forecast indicates water surface would be frozen before test is completed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

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3.1 GENERAL

A. Perform tightness testing of cast-in-place reinforced concrete liquid retaining structures conforming to ACI 350.1 and as specified herein.

B. Perform tightness tests prior to waterproofing and dampproofing and prior to placing backfill around structures in order to permit observation and detection of leakage points.

C. Individually test each cell of multi-cell tanks.

D. Multi-cell tanks may be tested as a single unit where indicated.

3.2 PREPARATION

A. Remove soil, mud, debris and all other contaminants from structures prior to initiating tightness tests. Flush floor and sumps with water to provide a clean surface that is ready for testing.

B. Prior to testing, temporarily seal or bulkhead inlet and outlet pipes not required to be operational for testing procedures.

C. Prior to testing, install blind flange on Pump P-3 suction piping.

3.3 EXAMINATION

A. Examine structures to be tested for potential leakage paths including cracks, voids, honeycombs, and unsealed joints. Repair such paths to prevent leakage prior to testing.

B. Proceed with testing only after unsatisfactory conditions have been corrected.

3.4 TESTING PROCEDURES

A. Testing Conditions:

1. Do not begin filling of reinforced concrete structure until concrete elements of the structure have attained specified design strength, but not less than 14 days after placement of all concrete elements.
2. Do not begin filling of reinforced concrete structure until all concrete repairs, including, but not limited to, crack and spall repairs identified after inspection of the tank, are completed and fully cured in accordance with repair product manufacturer's recommendations, but not less than 14 days after completion of repairs.
3. Fill reinforced concrete structure not exceeding a rate of 4 feet per 1 hour.
4. To minimize water absorption by concrete during testing, fill reinforced concrete structure to maximum operating water surface level and maintain water at that level for at least 3 days, prior to beginning tightness tests. Observe the exterior surfaces of the structure in both the early mornings and late afternoons during 3 days prior to tightness testing. Note any water observed on the structure exterior surfaces.
5. Test only a single structure at a time. Concurrent testing of contiguous or adjacent structures will not be allowed.

B. Testing Procedures:

1. Test Duration / Test Period: At least the time required to lower the water surface 3/8 inch (9.5 mm), assuming a loss of water at the maximum allowable rate, but not longer than 5 days.
2. Measure water surface elevations at 24-hour intervals. The vertical distance to the water surface shall be measured to within 1/16 inchfrom a fixed point on the structure above the water surface. Measure water surface elevations at the same four locations, 90 degrees apart. Record water temperature 18 inches below water surface when taking the first and last sets of measurements.

    a. Use methods to determine amount of precipitation or evaporation as approved by the Engineer.

3. Compute percentage of water volume loss based on measured change in water surface elevation, area of the horizontal water surface, initial water volume, and correction for precipitation or evaporation where applicable.
4. Restart test when test measurements become unreliable due to unusual precipitation or other external factors.

C. Test New Pipe Penetration into the East and West Wet Wells, above the recommended wet well liquid operating levels by a minimum of 1-FT above the crown of the pipe(s), including but not limited to:

1. Three (3) 24 inch Plant Drains Pipes
2. Two (2) 10 inch Surge Relief Pipes
3. Two (2) 4 inch Air Release Drain Pipes

D. Reports: Prepare and submit as referenced in this Section.

3.5 ACCEPTANCE

A. Estimates of gate, valve and door leakage will not be allowed as adjustments to the measured structure leakage.

B. Following conditions are considered as not meeting the criteria for acceptance, regardless of actual loss of water volume from the structure:

1. Groundwater seeping or flowing into the structure through floors, walls, or wall-floor joints.
2. Structures which exhibit seeping or flowing water from joints, cracks, voids, honeycombs, or from beneath the foundation.
3. Damp spots on concrete surfaces.
4. Moisture can be deposited on a dry hand-held against the exterior surface of the structure.

C. Tightness of concrete tanks and structures will be considered acceptable when the conditions of conditions included in paragraph above are not present and when loss of water volume does not exceed 0.05 percent of the starting volume per day.

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3.6 REPAIRS AND RETESTING

A. Structures failing the tightness test and not exhibiting visible leakage may be retested after an additional stabilization period of 7 days. Structures failing this second test shall be repaired prior to further testing.

B. Retest repaired structures until the structure meets all requirements.

3.7 SCHEDULE

A. Test following structures for tightness:

1. Tank types include:

a. Influent Pump Station East Wet Well.
b. Influent Pump Station West Wet Well.
c. Influent Screen Building Channels.

2. Miscellaneous structures include:

a. Wet Well.
b. Influent Screen Building Channels.

3. Structures subject to requirements of Article 3.5 Paragraph A only include:

a. New East Wet Well Suction Pipe Connection to New Pump P-3

END OF SECTION 018819

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FIGURE A
TIGHTNESS TEST REPORT

PROJECT _____ SUBMITTED BY _____

STRUCTURE * _____ TEST DATES _____

Allowable loss of water volume _____ percent in 24 hours

Measured loss of water volume _____ percent in 24 hours

TEST READINGS

Water Temperature at Start _____ [_____] degrees FWater Temperature at End _____ [_____] degrees F

Operating Water Surface Level _____

			Water Surface Elevation				
Entry	Date**	Time	Location 1	Location 2	Location 3	Location 4	Initials**
0							
1							
2							
3							
4							
5							
Change in level (difference between entry 5 and entry 0)							
Average change in level (sum of change in level / 4)							
Correction for precipitation/evaporation							
Corrected change in level = CL =							
Measured percent water loss in 24 hrs. = $\frac{(CL) \times (\text{surface area}) \times (100)}{(\text{initial water volume}) (\text{number of test days})}$							

Notes and Field Observations ** _____

_____

_____

_____

_____

* Attach a sketch showing a plan of structure and measurement locations.

** Place date and initials at the beginning of each entry.

END OF TIGHTNESS TEST REPORT FORM

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SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Owner's Project Requirements and Basis-of-Design Document are included by reference for information only.

1.2 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section 011000 "Summary" for Commissioning Authority responsibilities.
2. Section 011200 "Multiple Contract Summary" for Commissioning Authority responsibilities.
3. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
4. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
5. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.
6. Section 019119.43 "Exterior Enclosure Commissioning" for technical commissioning requirements for exterior closure.
7. Section 210800 "Commissioning of Fire Suppression" for technical commissioning requirements for fire suppression.
8. Section 220800 "Commissioning of Plumbing" for technical commissioning requirements for plumbing.
9. Section 230800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
10. Section 260800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.

11. Section 270800 "Commissioning of Communications" for technical commissioning requirements for communications systems.
12. Section 280800 "Commissioning of Electronic Safety and Security" for technical commissioning requirements for electronic safety and security systems.

1.3 ALLOWANCES

A. Labor and management costs for the performance of commissioning process.

B. The following are excluded from the commissioning allowance:

1. Equipment and systems installation, startup, and field quality-control testing indicated in the Contract Documents.
2. Test equipment, instrumentation, and tools (including, but not limited to, proprietary test equipment, instrumentation, and tools) required to perform tests.
3. Work to correct commissioning issues.
4. Work to repeat tests when equipment and systems fail acceptance criteria.

1.4 UNIT PRICES

A. Commissioning allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual labor hours are computed at the end of commissioning process. See Section 012100 "Allowances" for commissioning allowance.

B. The following are excluded from the computation for the adjustment of the commissioning allowance for technician labor hours:

1. Work to correct commissioning issues.
2. Work to repeat tests when equipment and systems fail acceptance criteria.

1.5 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

B. Basis-of-Design Document: A document prepared by Engineer that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Commissioning Authority: An entity engaged by Owner, and identified in Section 011000 "Summary," to evaluate Commissioning-Process Work.

D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation of commissioning requirements.

E. Commissioning: A quality-focused process for verifying and documenting that the facility and its systems and assemblies are planned, designed, installed, and tested to comply with Owner's

Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of the commissioning process is defined in Section 011000 "Summary."

F. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.

1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:

a. Completion of tests and acceptance of test results.
b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
c. Comply with requirements in Section 017900 "Demonstration and Training."
d. Completion and acceptance of submittals and reports.

G. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Engineer or Commissioning Authority.

H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Engineer-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

1.6 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Commissioning Authority, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning process.
2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
3. Engineer, plus employees and consultants that Engineer may deem appropriate for a particular portion of the commissioning process.

1.7 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the Construction Schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for the Construction Schedule general requirements for commissioning process. Provide detailed schedule activities for maintenance of plant operations (MOPO) with accompanying narratives, figures, and identification of responsible parties.
3. Contractor personnel and subcontractors participating in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Commissioning Coordinator Letter of Authority:

1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:

a. Make inspections required for commissioning process.
b. Coordinate, schedule, and manage commissioning process of Contractor, subcontractors, and suppliers.
c. Obtain documentation required for commissioning process from Contractor, subcontractors, and suppliers.
d. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.

F. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.

1. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

G. List test instrumentation, equipment, and monitoring devices. Include the following information:

1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
2. Brief description of intended use.
3. Calibration record showing the following:

a. Calibration agency, including name and contact information.
b. Last date of calibration.
c. Range of values for which calibration is valid.
d. Certification of accuracy.
e. Certification for calibration equipment traceable to NIST.
f. Due date of the next calibration.

H. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

I. Construction Checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

1.8 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:

a. Pre-startup reports.
b. Approved test procedures.
c. Test data forms, completed and signed.

d. Progress reports.
e. Commissioning issue report log.
f. Commissioning issue reports showing resolution of issues.
g. Correspondence or other documents related to resolution of issues.
h. Other reports required by commissioning process.
i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction-Phase Commissioning Process Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.9 QUALITY ASSURANCE

A. Commissioning Coordinator Qualifications:

1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.
2. Certification of commissioning-process expertise. The following certifications are acceptable. Owner reserves the right to accept or reject certifications as evidence of qualification.

a. Certified Commissioning Authority, by AABC Commissioning Group (ACG).
b. Commissioning-Process Management Professional, by American Society of Heating, Refrigerating and Air-Conditioning Engineers.
c. Certified Commissioning Professional, by Building Commissioning Association.
d. Accredited Commissioning-Process Authority Professional, by University of Wisconsin.
e. Accredited Commissioning-Process Manager, by University of Wisconsin.
f. Accredited Green Commissioning-Process Provider, by University of Wisconsin.

B. Calibration Agency Qualifications: Certified by The American Association for Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.

B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:

1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
2. Calibrated and certified.

    a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
    b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.

3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.

1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Bind report in three-ring binders.
2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
3. Record report on compact disk.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:

    a. Test specification.

b. Pre-startup reports.
c. Approved test procedures.
d. Test data forms, completed and signed.
e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

A. Construction checklists cannot modify or conflict with the Contract Documents.

B. Create construction checklists based on actual systems and equipment to be included in Project.

C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.

1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
2. Included optional features.
3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
4. Installation Checks:

a. Location according to Drawings and approved Shop Drawings.
b. Configuration.
c. Compliance with manufacturers' written installation instructions.
d. Attachment to structure.
e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
f. Utility connections are of the correct characteristics, as applicable.
g. Correct labeling and identification.
h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.

E. Performance Tests:

1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.

F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify deferred construction checklists by number and title.
2. Provide a target schedule for completion of deferred construction checklists.
3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning process with the Construction Schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.
2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:

1. Coordinate with subcontractors on their commissioning responsibilities and activities.
2. Obtain, assemble, and submit commissioning documentation.
3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."
4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
5. Review and comment on preliminary test procedures and data forms.
6. Report inconsistencies and issues in system operations.
7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 017900 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
14. Assemble and submit commissioning report.

3.5 COMMISSIONING TESTING

A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.

C. Construction Checklists:

1. Complete construction checklists as Work is completed.
2. Distribute construction checklists to installing contractors before they start work.
3. Installers:

   a. Verify installation using approved construction checklists as Work proceeds.
   b. Complete and sign construction checklists weekly for work performed during the preceding week.

4. Provide Commissioning Authority access to construction checklists.

D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

F. Test Procedures and Test Data Forms:

1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
3. Completed test data forms are the official records of the test results.
4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
5. Review preliminary test procedures and test data forms, and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:

   a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
   b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.

6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.

    a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.

7. False load test requirements are specified in related sections.

    a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Engineer's written approval.

I. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for

deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:

a. Identify deferred tests by number and title.
b. Provide a target schedule for completion of deferred tests.

2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Engineer and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Engineer, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:

a. Identify delayed tests by test number and title.
b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.

2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Engineer and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Engineer, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:

a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
b. Submit commissioning compliance issue report form within 24 hours of the test.
c. Determine the cause of the failure.
d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.

5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.

a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.

6. Diagnose and correct failed test demonstrations as follows:

a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
c. Record the results of each step of the diagnostic procedure.
d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
e. Determine and record corrective measures.
f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.

7. Retest:

a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
b. For each repeated test demonstration, submit a new test data form, marked "Retest."

8. Do not correct commissioning compliance issues during test demonstrations.

a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.6 COMMISSIONING MEETINGS

A. Schedule and conduct commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."

3.7 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

1. Construction Checklists:

a. Material checks.
b. Installation checks.
c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
d. Performance Tests:

1) Static tests, as appropriate.
2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
3) Equipment and assembly performance tests.
4) System performance tests.
5) Intersystem performance tests.

2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.

C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Engineer if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.8 SCHEDULING

A. Commence commissioning process as early in the construction period as possible.

B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 013200 "Construction Progress Documentation."

1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
2. Schedule the start date and duration for the following commissioning activities:

    a. Submittals.
    b. Preliminary operation and maintenance manual submittals.
    c. Installation checks.
    d. Startup, where required.
    e. Performance tests.
    f. Performance test demonstrations.
    g. Commissioning tests.
    h. Commissioning test demonstrations.

3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:

1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

1. Coordinate Owner's witness participation via Engineer.
2. Notify Engineer of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.9 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:

a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.

2. Test data reports include the following:

a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
c. Signatures of individuals performing and witnessing tests.
d. Data trend logs accumulated overnight from the previous day of testing.

3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:

a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
b. Action distribution list.
c. Report date.
d. Test number and description.
e. Equipment identification and location.
f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.

j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:

a. Completed data forms.
b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
c. Activities scheduled but not conducted per schedule.
d. Commissioning compliance issue report log.
e. Schedule changes for remaining Commissioning-Process Work, if any.

5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.

a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
b. Attach to the data form printed trend log data collected during the test or test demonstration.
c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.

6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

3.10 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Engineer a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning process.

B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction-phase commissioning process completion.

C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Engineer's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.

D. When construction-phase commissioning process or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 019113

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove Hazardous Materials: Isolate and remove hazardous materials from existing construction and properly dispose as required by existing regulations.

C. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.

D. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

E. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

F. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor. However, the Owner reserves the right to identify any of their existing equipment assets for salvage prior to demolition and disposal.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

C. Project specific construction sequencing dictates that existing pumps are removed from service incrementally. Retain parts from existing pumps as they are removed from service to allow for maintenance and/or emergency repair of pumps that remain in service. Retain and store all pump parts that are removed from service until substantial completion or until otherwise approved by the Owner and Engineer. The Owner will retain ownership of all existing pumps until the end of the project.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review and finalize items to be removed and salvaged by the Owner.
5. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
6. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Engineering Survey: Submit engineering survey of condition of building.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition

operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building in and around the selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials may be present in piping, buildings materials, and structures to be selectively demolished.

1. Hazardous material remediation is specified in Division 2 of the Contract Specifications.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

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1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs and video.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

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3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and

finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 PIPED UTILITY DEMOLITION

A. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed:

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished and then break up and remove.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075216 “Styrene-

Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.9 SELECTIVE DEMOLITION SCHEDULE

A. Refer to Section 013513.24 "Special Procedure or MOPO and Construction Sequence".

B. Remove and Salvage:

1. Existing encapsulating couplings located on 48" force main headers.
2. Existing centrifugal pumps A-1 through A-7.

    a. Retain and store existing pumps as they are removed from service until the end of the project to support use of spare parts for maintenance and emergency repair of existing pumps that remain in service. Dispose of pumps at the end of the project.

3. 48" force main fittings.
4. Pump Motor Starters
5. Load Break Switches

END OF SECTION 024119

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SECTION 028200 - ASBESTOS REMOVAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

A. This asbestos abatement Project will consist of the removal and disposal of asbestos containing materials associated with the Influent Pumping System Improvements Project located at the Cedar Creek Water Pollution Control Plant, 3340 Merrick Road, Wantagh, NY 11783, as indicated in the table below.

Work Area	Location	Description of Asbestos Material	Approximate Quantity Of ACM	ICR 56 Procedure
1a-c	Elevation -28.00 and -35.75	Assumed Gasket Material	200.0 SF	56-11.8
2	Elevation -28.00	Assumed Vibration Dampening Cloth on Exhaust Units	8.0 SF	56-11.3
3	Elevation -28.00	Cementitious Pipe Insulation Fitting/Elbow	50.0 LF	56-7.11
4	Elevation -6.50	Cementitious Pipe Insulation Fitting/Elbow	10.0 LF	56-11.3
5	Elevation 15.50	Cementitious Pipe Insulation Fitting/Elbow	10.0 LF	56-11.3
6	Elevation 15.50 – Electrical Cabinets	Assumed Backer Board/Transite Panel	500.0 SF	56-7.11
		Total:	708.0 SF / 70.0 LF	

B. The work shall include but not be limited to the abatement work tabulated in the H-100 series drawings.

C. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.

D. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply.

E. Working hours shall be as required and approved by the Owner. Asbestos abatement activities including, but not limited to, work area preparation, gross removal activities, cleaning activities, waste removal, etc. may need to be performed during ‘off-hours’ (including nights and weekends). In addition, multiple mobilizations may be required to perform the work identified in this project. The Contractor shall coordinate and schedule all Work with the facility and Owner’s representative.

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1.3 SPECIAL JOB CONDITIONS

A. Any special job conditions, including variances obtained by the Owner, are described below.

1. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.
2. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply.
3. Working hours shall be as required and approved by the Owner. Asbestos abatement activities including, but not limited to, work area preparation, gross removal activities, cleaning activities, waste removal, etc. may need to be performed during 'off-hours' (including nights and weekends). The Contractor shall coordinate and schedule all Work with the facility and Owner's representative.
4. Temporary water lines and electrical supply cables shall be extended to the work area at ceiling height. Disconnection to facility water and electrical systems shall be coordinated in advance with the appropriate site representatives to ensure that areas outside the abatement are not negatively impacted.
5. Water and electric source locations shall be coordinated with the owner/owners representative.
6. Placement of decontamination units shall not obstruct egress in corridors or block exits or interfere with building fire safety system components without the contractor providing mitigating measures approved by the owner.
7. All ACM materials shall be removed completely down to the substrate, to a surface that is free and clear of all residues and made suitable for replacement materials.
8. Contractor to confirm windows are operable to be utilized for Negative Air Unit Exhaust. If the windows are unable to be opened, the contractor shall coordinate with the facility / owner’s representative for removal of window assembly to allow for installation of exhaust manifold. For work areas in the basement/sub-basement a Site specific Variance (SSV) for interior exhaust may be required.
9. Work area 1 consists of assumed valve/flange gasket material. All pipe coatings have tested positive for lead based paint. The remediation of LBP shall be performed for any mechanical or tourch cutting/cut lines that must be performed before the intact abatement of the gaskets.

1.4 PERMITS AND COMPLIANCE

A. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local laws, rules, and regulations pertaining to Work practices, protection of Workers, authorized visitors to the site, persons, and property adjacent to the Work.

B. Perform asbestos related Work in accordance with New York State Industrial Code Rule 56 (herein referred to as Code Rule 56), 40 CFR 61, and 29 CFR 1926. Where more stringent requirements are specified, adhere to the more stringent requirements.

C. The Contractor must maintain current licenses, permits and certifications pursuant to New York State Department of Labor and Department of Environmental Conservation for all Work related

to this Project, including the removal, handling, transport, and disposal of asbestos containing materials.

D. The Contractor must have and submit proof upon request that any persons employed by the Contractor to engage in or supervise Work on any asbestos Project have a valid NYS asbestos handling certificate pursuant to Code Rule 56.

E. The Contractor shall be responsible for obtaining all Variances as may be required for the Project or as requested by the Owner. Approval of the Owner is required prior to submission of a Variance application to any regulatory agency. Failure to obtain Owner approval may result in Owner not permitting variance to be used on the project.

F. The Contractor shall be responsible for compliance with The New York State Uniform Fire Prevention and Building Code, or its successor during all Work at the site.

G. Failure to adhere to the Project Documents shall constitute a breach of the Contract and the Owner shall have the right to and may terminate the Contract provided, however, the failure of the Owner to so terminate shall not relieve the Contractor from future compliance.

1.5 SUBMITTALS

A. Pre-Work Submittals: Within 7 days prior to the pre-construction conference, the Contractor shall submit 3 copies of the documents listed below for review and approval prior to the commencement of asbestos abatement activities:

1. Contractor license issued by New York State Department of Labor.
2. A list of Projects performed within the past two (2) years including the dollar value of all Projects. Provide Project references to include Owner, consultant, and air monitoring firm's name, contact persons, address, and phone number.
   Progress Schedule:

   a. Show the complete sequence of abatement activities and the sequencing of Work within each building or building section.
   b. Show the dates for the beginning and completion of each major element of Work including substantial completion dates for each Work Area, building, or phase.

3. Project Notifications: As required by Federal and State regulatory agencies together with proof of transmittal (i.e. certified mail return receipt).
4. Building Occupant Notification: As required by regulatory agencies.
5. Abatement Work Plan: Provide plans that clearly indicate the following:

   a. All Work Areas/containments numbered sequentially.
   b. Locations and types of all decontamination enclosures.
   c. Entrances and exits to the Work Areas/containments'. Type of abatement activity/technique for each Work Area/containment.
   d. Number and location of negative air units and exhaust. Also provide calculations for determining number of negative air pressure units.
   e. Location of water and electrical connections to building services.
   f. Waste transport routes through the building to the waste storage container.

6. Disposal Site/Landfill Permit from applicable regulatory agency.
7. NYS Department of Environmental Conservation Waste Transporter Permit.

B. On-Site Submittals: Refer to Part 3.01.C & D for all submittals, documentation, and postings required to be maintained on-site during abatement activities.

C. Project Close-out Submittals: Within 30 days of the completion of each abatement phase, the Contractor shall submit one copy of the documents listed below to the environmental consultant for review and approval prior to Contractor's final payment. Once the close-out submittal is approved, the Contractor shall provide three sets of the approved close-out documents (double-sided and bound) to.

1. All waste disposal manifests and disposal logs (Original waste manifests shall be sent to.
2. OSHA compliance air monitoring records conducted during the Work.
3. Daily progress log, including the entry/exit log.
4. Disposal Site/Landfill Permit from applicable regulatory agency.
5. Project notifications, amended notifications, Variances.

1.6 PRE-CONSTRUCTION CONFERENCE

A. Prior to start of preparatory Work under this Contract, the Contractor shall attend a pre-construction conference attended by Owner, Facility Personnel, and Environmental Consultant.

B. Agenda for this conference shall include but not necessarily be limited to:

1. Contractor's scope of Work, Work plan, and schedule to include number of workers and shifts.
2. Contractor's safety and health precautions including protective clothing and equipment and decontamination procedures.
3. Environmental Consultant's duties, functions, and authority.
4. Contractor's Work procedures including:

    a. Methods of job site preparation and removal methods.
    b. Respiratory protection.
    c. Disposal procedures.
    d. Cleanup procedures.
    e. Fire exits and emergency procedures.

5. Contractor's required pre-work and on-site submittals, documentation, and postings.
6. Contractor's plan for twenty-four (24) hour Project security both for prevention of theft and for barring entry of unauthorized personnel into Work Areas.
7. Temporary utilities.
8. Handling of furniture and other moveable objects.
9. Storage of removed asbestos containing materials.
10. Waste disposal requirements and procedures, including use of the Owner supplied waste manifest.

C. In conjunction with the conference the Contractor shall accompany the Owner and Environmental Consultant on a pre-construction walk-through documenting existing condition

of finishes and furnishings, reviewing overall Work plan, location of fire exits, fire protection equipment, water supply and temporary electric tie-in.

1.7 APPLICABLE STANDARDS AND REGULATIONS

A. The Contractor shall comply with the following codes and standards, except where more stringent requirements are shown or specified:

B. Federal Regulations:

1. 29 CFR 1910.1001, "Asbestos" (OSHA)
2. 29 CFR 1910.1200, "Hazard Communication" (OSHA)
3. 29 CFR 1910.134, "Respiratory Protection" (OSHA)
4. 29 CFR 1910.145, "Specification for Accident Prevention Signs and Tags" (OSHA)
5. 29 CFR 1926, "Construction Industry" (OSHA)
6. 29 CFR 1926.1101, "Asbestos, Tremolite, Anthophyllite, and Actinolite" (OSHA)
7. 29 CFR 1926.500 "Guardrails, Handrails and Covers" (OSHA)
8. 40 CFR 61, Subpart A, "General Provisions" (EPA)
9. 40 CFR 61, Subpart M, "National Emission Standard for Asbestos" (EPA)
10. 49 CFR 171-172, Transportation Standards (DOT)

C. New York State Regulations:

1. 12 NYCRR, Part 56, "Asbestos", Industrial Code Rule 56 (DOL)
2. 6 NYCRR, Parts 360, 364, Disposal and Transportation (DEC)
3. 10 NYCRR, Part 73, "Asbestos Safety Program Requirements" (DOH)
4. “New York State Uniform Fire Prevention and Building Code”

D. Standards and Guidance Documents:

1. American National Standard Institute (ANSI) Z88.2-80, Practices for Respiratory Protection
2. ANSI Z9.2-79, Fundamentals Governing the Design and Operation of Local Exhaust Systems
3. EPA 560/585-024, Guidance for Controlling Asbestos Containing Materials in Buildings (Purple Book)
4. EPA 530-SW-85-007, Asbestos Waste Management Guidance
5. ASTM Standard E1368 “Standard Practice for Visual Inspection of Asbestos Abatement Projects”

1.8 NOTICES

A. The Contractor shall provide notification of intent to commence asbestos abatement activities as indicated below.

1. At least ten (10) Working days prior to beginning abatement activities, send written notification to:

U.S. Environmental Protection Agency

National Emissions Standards for Hazardous Air Pollutants (NESHAPS) Coordinator
26 Federal Plaza
New York, NY 10007

2. At least ten (10) days prior to beginning abatement activities send written notification to:

New York State Department of Labor
Division of Safety and Health, Asbestos Control Program.
State Office Campus
Building 12 - Room 161B
Albany, NY 12240

B. The Contractor is required to send notifications to regulatory agencies via electronic, mail, or package delivery service that will provide proof of delivery and receipt.

C. The Contractor shall be responsible for maintaining current project filings with regulatory agencies for the duration of the project.

D. The Contractor shall post and/or provide Building Occupant Notification at least 10 days prior to beginning abatement activities as required by Code Rule 56.

1.9 PROJECT MONITORING AND AIR SAMPLING

A. The Owner shall engage the services of an Environmental Consultant (the Consultant) who shall serve as the Owner's Representative in regard to the performance of the asbestos abatement Project and provide direction as required throughout the entire abatement Project period. The consultant and all subconsultants shall not have any contractual relationship with the Contractor for the duration of the asbestos project.

B. The Contractor is required to ensure cooperation of its personnel with the Consultant for the air sampling and Project monitoring functions described in this section. The Contractor shall comply with all direction given by the Consultant during the course of the Project.

C. The Consultant shall provide the following administrative services:

1. Review and approve or disapprove all submittals, shop drawings, schedules, and samples.
2. Assure that all notifications to governmental agencies by the Contractor are submitted in a timely manner and are correct in content.

D. The Consultant shall staff the Project with a trained and certified person(s) to act on the Owner's behalf at the job site. This individual shall be designated as the Abatement Project Monitor (APM).

1. The APM shall be on-site at all times the Contractor is on-site. The Contractor shall not be permitted to conduct any Work unless the APM is on-site (except for inspection of barriers and negative air system during non-working days).
2. The APM shall have the authority to direct the actions of the Contractor verbally and in writing to ensure compliance with the Project documents and all regulations. The APM shall have the authority to Stop Work when gross Work practice deficiencies or unsafe

practices are observed, or when ambient fiber concentrations outside the removal area exceed .01 f/cc or background level.

a. Such Stop Work order shall be effective immediately and remain in effect until corrective measures have been taken and the situation has been corrected.
b. Standby time and air sample collection and analysis required to resolve the situation shall be at the Contractor's expense.

3. The APM shall provide the following services:

a. Inspection of the Contractor's Work, practices, and procedures, including temporary protection requirements, for compliance with all regulations and Project specifications.
b. Provide abatement Project air sampling as required by applicable regulations (NYS, AHERA) and the Owner. Sampling will include, but not be limited to background, work area preparation, asbestos handling, final cleaning, and clearance air sampling.
c. Verify daily that all Workers used in the performance of the Project are certified by the appropriate regulatory agency.
d. Monitor the progress of the Contractor's Work, and report any deviations from the schedule to the Owner.
e. Monitor, verify, and document all waste load-out operations including placement of generator and location labels on each waste container, as required by federal regulations.
f. Verify that the Contractor is performing personal air monitoring daily, and that results are being returned and posted at the site as required.
g. The APM shall maintain a log on site that documents all project related and Consultant and Contractor actions, activities, and occurrences.
h. Verify landfill to be used for waste disposal with waste transporter(driver) and Contractor prior to waste trailer/dumpster leaving site. Confirm the waste transporter firm and landfill are listed on the regulatory notifications for the project and the waste transport vehicle license number is listed on the current NYS DEC Waste Transporter permit.

4. The following minimum inspections shall be conducted by the APM, accompanied by the Contractor’s supervisor. Additional inspections shall be conducted as required by Project conditions and/or the Owner’s direction. Progression from one phase of Work to the next by the Contractor is only permitted with the written approval of the APM.

a. Pre-Construction Inspection: The purpose of this inspection is to verify the existing conditions of the Work Areas and to document these conditions.
b. Pre-Commencement Inspection: The purpose of this inspection is to verify the integrity of each containment system prior to disturbance of any asbestos containing material. This inspection shall take place only after the Work Area is fully prepped for removal.
c. Work Inspections: The purpose of this inspection is to monitor the Work practices and procedures employed on the Project and to monitor the continued integrity of the containment system. Inspections within the removal areas shall be conducted by the APM during all preparation, removal, and cleaning activities at least twice every Work shift. Additional inspections shall be conducted as warranted.

d. Pre-Encapsulation Inspection: The purpose of this inspection is to ensure the complete removal of Asbestos Containing Material (ACM), from all surfaces in the Work Area prior to encapsulation.
e. Visual Clearance Inspection: The purpose of this inspection is to verify that: all materials in the scope of work have been properly removed; no visible asbestos debris/residue remains; no pools of liquid or condensation remains; and all required cleanings are complete. This inspection shall be conducted before final air clearance testing.
f. Post-Clearance Inspection: The purpose of this inspection is to ensure the complete removal of ACM, including debris, from the Work Area after satisfactory final clearance sampling and removal of all isolation and critical barriers and equipment from the Work Area.
g. Punch List Inspection: The purpose of this inspection is to verify the Contractor's certification that all Work has been completed as contracted and the existing condition of the area prior to its release to the Owner.

E. The Consultant shall provide abatement Project air sampling and analysis as required by applicable regulations (New York State and/or AHERA). Sampling will include but is not limited to, background, work area preparation, asbestos handling, and final cleaning and clearance air sampling.

1. Unless otherwise required by applicable regulations, the Consultant shall have samples analyzed by Phase Contrast Microscopy (PCM). Results shall be available within 24 hours of completion of sampling.
2. Samples shall be collected as required by applicable regulations (New York State and/or AHERA) and these specifications. If Transmission Electron Microscopy (TEM) clearance air sampling is utilized by the owner, the clearance criteria and sampling protocols must be in compliance with AHERA. If PCM air sample analysis results exceed the satisfactory clearance criteria, then TEM analysis of the entire set of clearance air samples may be used, provided that a standard NIOSH/ELAP accepted laboratory analysis method is utilized that shall report each air sample result in fibers per cubic centimeter.
3. If the air sampling during any phase of the abatement project reveals airborne fiber levels at or above .01 fibers/cc or the established background level, whichever is greater, outside the regulated Work Area, Work shall stop immediately and corrective measures required by Code Rule 56 shall be initiated. Notify all employers and occupants in adjacent areas. The Contractor shall bear the burden of any and all costs incurred by this delay.
4. The Environmental Consultant shall submit copies of all elevated air sampling results collected during abatement and all final air clearance results to the Commissioner of Labor, as required by regulation.

1.10 CONTRACTOR AIR SAMPLING

A. In addition to the requirements of OSHA 1926.1101, the Contractor shall be required to perform personal air monitoring every Work shift in each Work Area during which abatement activities occur in order to determine that appropriate respiratory protection is being worn and utilized.

B. The Contractor shall conduct air sampling that is representative of both the 8-hour time weighted average and 30-minute short-term exposures to indicate compliance with the permissible exposure and excursion limits.

C. The Contractor's laboratory analysis of air samples shall be conducted by an NYS DOH ELAP approved laboratory. The consultant shall not collect or analyze the Contractor’s air samples.

D. Results of personnel air sample analyses shall be available, verbally, within twenty-four (24) hours of sampling and shall be posted upon receipt. Written laboratory reports shall be delivered and posted at the Work site within five (5) days. Failure to comply with these requirements may result in all work being stopped until compliance is achieved.

1.11 PROJECT SUPERVISOR

A. The Contractor shall designate a full-time Project Supervisor who shall meet the following qualifications:

1. The Project Supervisor shall hold New York State certification as an Asbestos Supervisor.
2. The Project Supervisor shall meet the requirements of a "Competent Person" as defined by OSHA 1926.1101 and shall have a minimum of one year experience as a supervisor.
3. The Project Supervisor must be able to speak, read, and write English fluently, as well as communicate in the primary language of the Workers.

B. If the Project Supervisor is not on-site at any time whatsoever, all Work shall be stopped. The Project Supervisor shall remain on-site until the Project is complete. The Contractor may not remove the Project Supervisor from the Project without the written consent of the Owner and the Environmental Consultant; however the Project Supervisor shall be removed from the Project if so requested by the Owner.

C. The Project Supervisor shall maintain the bound Daily Project Log and the entry/exit logs as required by New York State Department of Labor.

D. The Project Supervisor shall be responsible for the performance of the Work and shall represent the Contractor in all respects at the Project site. The Supervisor shall be the primary point of contact for the Asbestos Project Monitor.

1.12 MEDICAL REQUIREMENTS

A. Before exposure to airborne asbestos fibers, provide Workers with a comprehensive medical examination as required by 29 CFR 1910.1001, and 29 CFR 1926.1101.

1. This examination is not required if adequate records show the employee has been examined as required by 29 CFR 1910.1001, and 29 CFR 1926.1101 within the past year.
2. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving potential disturbance of asbestos fibers.

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1.13 TRAINING

A. As required by applicable regulations, prior to assignment to asbestos Work instruct each employee with regard to the hazards of asbestos, safety and health precautions, and the use and requirements of protective clothing and equipment.

B. Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134, and 29 CFR 1926.1101. Provide respirator training and fit testing.

1.14 RESPIRATORY PROTECTION

A. Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH).

B. Respirators shall be individually fit-tested to personnel under the direction of an Industrial Hygienist on a yearly basis. Fit-tested respirators shall be permanently marked to identify the individual fitted, and use shall be limited to that individual.

C. Where fiber levels permit, and in compliance with regulatory requirements, Powered Air Purifying Respirators (PAPR) are the minimum allowable respiratory protection permitted to be utilized during gross removal operations of OSHA Class I or OSHA Class II friable ACM.

D. No respirators shall be issued to personnel without such personnel participating in a respirator training program.

E. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and shall conform to the OSHA requirements in 29 CFR 1910.134 and 29 CFR 1926.1101.

F. A storage area for respirators shall be provided by the Contractor in the clean room side of the personnel decontamination enclosure where they will be kept in a clean environment.

G. The Contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the work day.

H. Filters used with negative pressure air purifying respirators shall not be used any longer than one eight (8) hour work day. Any loose respirator filters found within the regulated area, must be disposed of as asbestos waste.

I. Any authorized visitor, Worker, or supervisor found in the Work Area not wearing the required respiratory protection shall be removed from the Project site and not be permitted to return.

J. The Contractor shall have at least two (2) Powered Air Purifying Respirators stored on site designated for authorized visitors use. Appropriate respirator filters for authorized visitors shall be made available by the Contractor.

1.15 DELIVERY AND STORAGE

A. Deliver all materials to the job site in original packages with containers bearing manufacturer's name and label.

B. Store all materials at the job site in a suitable and designated area.

1. Store materials subject to deterioration or damage away from wet or damp surfaces and under cover.
2. Protect materials from unintended contamination and theft.
3. Storage areas shall be kept clean and organized.

C. Remove damaged or deteriorated materials from the job site. Materials contaminated with asbestos shall be disposed of as asbestos debris as herein specified. This includes unused Contractor supplies located in the regulated work area.

1.16 TEMPORARY UTILITIES

A. Shut down and lock out all electrical power to the asbestos Work Areas, including lighting circuits. Any electrical power passing through the Work Areas that can't be shut down due to health and safety reasons, shall be protected as per the requirements of Industrial Code Rule 56.

B. Provide temporary 120-240 volt, single phase, three wire, 100 amp electric service with Ground Fault Circuit Interrupters (GFCI) for all electric requirements within the asbestos Work Area.

1. Where available, obtain from Owner's existing system. Otherwise provide power from other sources (i.e. generator).
2. Provide temporary wiring and "weatherproof" receptacles in sufficient quantity and location to serve all HEPA equipment and tools.
3. Provide wiring and receptacles as required by the Environmental Consultant for project monitoring and air sampling equipment (pumps, fans, leaf blowers, etc.).
4. All power to the Work Area shall be brought in from outside the area through GFCI's at the source.

C. Provide temporary lighting with "weatherproof" fixtures for all Work Areas including decontamination chambers.

1. The entire Work Area shall be kept illuminated at all times.
2. Provide lighting as required by the Environmental Consultant for the purposes of performing required inspections.

D. All temporary devices and wiring used in the Work Area shall be capable of decontamination procedures including HEPA vacuuming and wet-wiping.

E. Utilize domestic water service, if available, from Owner's existing system. Provide hot water heaters with sufficient capacity to meet Project demands.

PART 2 - PRODUCTS

2.1 PROTECTIVE CLOTHING

A. Provide personnel utilized during the Project with disposable protective whole body clothing, head coverings, gloves and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber for comfort, but shall not

be used alone. Make sleeves secure at the wrists and make foot coverings secure at the ankles by the use of tape, or provide disposable coverings with elastic wrists or tops.

B. Provide sufficient quantities of protective clothing to assure a minimum of four (4) complete disposable outfits per day for each individual performing abatement Work.

C. Eye protection and hard hats shall be provided and made available for all personnel entering any Work Area.

D. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the Work Area.

2.2 SIGNS AND LABELS

A. Provide warning signs and barrier tapes at all approaches to asbestos Work Areas. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the area.

1. Provide danger signs in vertical format conforming to 29 CFR 1926.1101, minimum 20" x 14" displaying the following legend.

DANGER
ASBESTOS CANCER AND LUNG DISEASE
HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA

2. Provide 3" wide yellow barrier tape printed with black lettered, "DANGER ASBESTOS REMOVAL". Locate barrier tape across all corridors, entrances and access routes to asbestos Work Area. Install tape 3' to 4' AFF.

B. Provide asbestos danger labels affixed to all asbestos materials, scrap, waste, debris and other products contaminated with asbestos.

1. Provide asbestos danger labels of sufficient size to be clearly legible, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

2. Provide the following asbestos labels, of sufficient size to be clearly legible, for display on waste containers (bags or drums) which will be used to transport asbestos contaminated material in accordance with United States Department of Transportation 49 CFR Parts 171 and 172: (Note: Include “RQ” for friable asbestos waste only.)

RQ, NA2212, (WASTE) ASBESTOS, 9, PGIII

3. Generator identification information shall be affixed to each waste container or any packaging used to containerize asbestos waste indicating the following printed in indelible ink:

   Generator Name
   Facility Name
   Facility Address
   Date

2.3 DAILY PROJECT LOG & WORK AREA ENTRY/EXIT LOG

A. Provide a bound Daily Project Log. The log shall contain on title page the Project name; name, address and phone number of Owner; name, address and phone number of Environmental Consultant; name, address and phone number of Abatement Contractor; emergency numbers including, but not limited to local Fire/Rescue department and all other New York State Department of Labor requirements.

B. All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted.

C. All persons entering and exiting the Work Area shall sign the entry/exit log and include name, certification number, and time.

D. The Project Supervisor shall document all Work performed daily and note all inspections required by Code Rule 56, i.e. testing and inspection of barriers and enclosures.

2.4 SCAFFOLDING AND LADDERS

A. Provide all scaffolding and/or staging as necessary to accomplish the Work of this Contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. The type, erection and use of all scaffolding and ladders shall comply with all applicable OSHA construction industry standards.

B. Provide scaffolding and ladders as required by the Environmental Consultant for the purposes of performing required inspections.

2.5 SURFACTANT (AMENDED WATER)

A. Wet all asbestos-containing materials prior to removal with surfactant mixed and applied in /accordance with manufacturer's printed instructions.

2.6 ENCAPSULANT

A. Encapsulant shall be tinted or pigmented so that application when dry is readily discernible.

B. The encapsulant solvent or vehicle shall not contain a volatile hydrocarbon.

2.7 WASTE DISPOSAL BAGS, DRUMS, AND CONTAINERS

A. Provide 6 mil polyethylene disposal bags printed with asbestos caution labels. Bags shall also be imprinted with U.S. Department of Transportation required markings.

B. Provide 30 or 55 gallon capacity fiber, plastic, or metal drums capable of being sealed air and water tight if asbestos waste has the potential to damage or puncture disposal bags. Affix asbestos caution labels on lids and at one-third points around drum circumference to assure ready identification.

C. Containers and bags must be labeled accordance with 40 CFR Part 61 NESHAPS and Code Rule 56. When the bags/containers are moved to the holding area, lockable trailer, or lockable hardtop dumpster from the waste decontamination system washroom, each bag/container must also be appropriately labeled with the date moved in waterproof markings.

D. Labeled ACM waste containers or bags shall not be used for non-ACM waste or trash. Any material placed in labeled containers or bags, whether turned inside out or not shall be handled and disposed of as ACM waste.

2.8 HEPA VACUUM EQUIPMENT

A. All vacuuming performed under this contract shall be performed with High Efficiency Particulate Air (HEPA) filter equipped industrial vacuums conforming to ANSI Z9.2.

2.9 POWER TOOLS

A. Any power tools used to drill, cut into, or otherwise disturb asbestos material shall be manufacturer equipped with HEPA filtered local exhaust ventilation.

2.10 FIRE RETARDANT PLASTIC SHEETING

A. All polyethylene (plastic) sheeting used on the Project (including but not limited to sheeting used for critical and isolation barriers, fixed objects, walls, floors, ceilings, waste container) shall be at least 6 mil fire retardant sheeting.

B. Decontamination enclosure systems shall utilize at least 6 mil opaque fire retardant plastic sheeting. At least 2 layers of 6 mil reinforced fire retardant plastic sheeting shall be used for the flooring.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Should visible emissions or water leaks be observed outside the Work Area, immediately stop Work and institute emergency procedures per Code Rule 56. Should there be elevated fiber levels outside the Work Area, immediately stop Work, institute emergency procedures per Code Rule 56, and notify all employers and occupants in adjacent areas. All costs incurred in

decontaminating such non-Work Areas and the contents thereof shall be borne by the Contractor, at no additional cost to the Owner.

B. Valid NYS DOL Asbestos Handler certification cards shall be on site prior to admittance of any Contractor's employees to the asbestos Work Area.

C. The following submittals, documentation, and postings shall be maintained on-site by the Contractor during abatement activities at a location approved by the Abatement Project Monitor:

1. Valid Contractor handling license issued by New York State Department of Labor.
2. NYS DOL Asbestos Handler certification cards for each person employed in the removal, handling, or disturbance of asbestos.
3. Daily OSHA personal air monitoring results.
4. NYS Department of Health ELAP certification for the laboratory that will be analyzing the OSHA personnel air samples.
5. NYS Department of Environmental Conservation Waste Transporter Permit.
6. Project documents (specifications and drawings.)
7. Notifications, Variances, Approved Work Plan. Ensure that the most up-to-date notifications and Variances are on-site.
8. Applicable regulations.
9. Material Safety Data Sheets of supplies/chemicals used on the Project.
10. Disposal Site/Landfill Permit from applicable regulatory agency.
11. List of emergency telephone numbers.
12. Magnahelic manometer semi-annual calibration certification.
13. Waste Disposal Log.
14. Daily Project Log.
15. Entry/Exit Logs.

D. The following documentation shall be maintained on-site by the Abatement Project Monitor during abatement activities:

1. Valid Contractor handling license issued by New York State Department of Labor.
2. Air Sample Log.
3. Air sample results.
4. Project Monitor Daily Log
5. Asbestos Survey Report.
6. A copy of ASTM Standard E1368 "Standard Practice for Visual Inspection of Asbestos Abatement Projects."
7. Calibration chart for rotometer(s) used on-site.

E. The Work Area must be vacated by building occupants prior to decontamination enclosure construction and Work Area preparation.

F. All demolition necessary to access asbestos containing materials for removal must be conducted within negative pressure enclosures by licensed asbestos handlers. Demolition debris may be disposed of as construction and demolition debris provided the Abatement Project Monitor determines that it is not contaminated with asbestos and there has been no disturbance of ACM within the enclosure. If the demolition debris is determined to be contaminated or ACM has been disturbed, it must be disposed of as asbestos waste.

3.2 PERSONNEL DECONTAMINATION ENCLOSURE

A. Provide personnel decontamination enclosure contiguous to the Work Area or as per Variance. The decontamination enclosure shall be attached to the Work Area and not located within it unless isolation barriers are installed. If the decontamination chamber is accessible to the public it shall be fully framed, sheathed, and lockable to prevent unauthorized entry.

B. Access to the Work Area will be from the clean room through an air-lock to the shower and through an air lock to the equipment room. Each airlock shall be a minimum of three feet from door to door. Additional air locks shall be provided as required by Code Rule 56 for remote decontamination enclosures.

C. The decontamination enclosure ceiling and walls shall be covered with one layer of opaque 6 mil fire retardant plastic sheeting. Two layers of reinforced fire retardant plastic sheeting shall be used to cover the floor.

D. The entrance to the clean room shall have a lockable door with adequate small openings for Work Area make-up air. Provide suitable lockers for storage of Worker's street clothes. Storage for respirators along with replacement filters and disposable towels shall also be provided.

E. Provide a temporary shower with individual hot and cold water supplies and faucets. Provide a sufficient supply of soap and shampoo. There shall be one shower for every six Workers. The shower room shall be constructed in such a way so that travel through the shower chamber shall be through the shower. The shower shall not be able to be bypassed.

F. Shower water shall be drained, collected and filtered through a system with at least a 5.0 micron particle size collection capability containing a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system. The filtered waste water shall then be discharged in accordance with applicable codes and the contaminated filters disposed of as asbestos waste.

G. The equipment room shall be used for the storage of tools and equipment. A walk-off pan filled with water shall be located in the Work Area outside the equipment room for Workers to clean foot coverings when leaving the Work Area. A labeled 6 mil plastic ACM waste bag for collection of contaminated clothing shall be located in this room.

H. The personal decontamination enclosure shall be cleaned and disinfected minimally at the end of each Work shift and as otherwise directed by the Asbestos Project Monitor.

3.3 WASTE DECONTAMINATION ENCLOSURE

A. Provide a waste decontamination enclosure contiguous to the Work area. The decontamination enclosure shall be attached to the Work Area and not located within it unless isolation barriers are installed. If the decontamination chamber is accessible to the public it shall be fully framed, sheathed, and lockable to prevent unauthorized entry.

B. The waste decontamination enclosure system shall consist of a holding area, air lock and washroom. The airlock shall be a minimum of three feet from door to door. The entrance to the holding area shall have a lockable door.

C. The decontamination enclosure ceiling and walls shall be covered with one layer of opaque 6 mil fire retardant plastic sheeting on walls and ceiling. Two layers of reinforced fire retardant plastic sheeting shall be used to cover the floor.

D. Where there is only one egress from the Work Area, the holding area of the waste decontamination enclosure system may branch off from the personnel decontamination enclosure equipment room, which then serves as the waste wash room.

E. The waste wash room water shall be drained, collected, and filtered through a system with at least a 5.0 micron particle size collection capability containing a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system. The filtered waste water shall then be discharged in accordance with applicable codes and the contaminated filters disposed of as asbestos waste.

F. In small asbestos Projects where only one egress from the Work Area exists, the shower room may be used as a waste washroom. In this instance, the clean room shall not be used for waste storage, but shall be used for waste transfer to carts, which shall immediately be removed from this enclosure.

3.4 WORK AREA ENTRY AND EXIT PROCEDURES

A. Access to and from the asbestos Work Area is permitted only through the personnel decontamination enclosure unless otherwise stipulated in a Site Specific Variance.

B. Workers shall sign the entry/exit log upon every entry and exit.

C. The following procedures shall be followed when entering the Work Area:

1. Before entering the Work Area, Workers shall proceed to the clean room, remove all street clothes, and don protective clothing, equipment, and respirators.
2. Workers shall proceed from the clean room through the shower room and the equipment room and into the Work Area.

D. The following procedures shall be followed when exiting the Work Area:

1. Before leaving the Work Area, gross asbestos contamination will be removed by brushing, wet cleaning and/or HEPA vacuuming, followed by use of the walk-off pan.
2. In the equipment room, Workers shall remove disposable clothing, but not respirators, and shall place clothing in plastic disposal bags for disposal as contaminated debris prior to entering the shower room. Reusable equipment shall be removed and stored in the equipment room (e,g, work boots).
3. Workers shall shower thoroughly while wearing respirators, then wash respirator with soap and water prior to removal.
4. Upon exiting the shower, Workers shall enter the clean room and don new disposable clothing if the Work shift is to continue or street clothes to exit area. Under no circumstances shall Workers enter public non-Work Areas in disposable protective clothing.

E. If remote decontamination enclosures are permitted by Code Rule 56 or a Site Specific Variance, workers shall wear two disposable suits for all phases of Work. Workers exiting the

work area shall HEPA vacuum the outer suit, enter the airlock, remove the outer suit and then place it back into the Work Area. A clean second suit shall be donned before exiting the airlock and proceeding to the decontamination enclosure or another work area via the designated pathway required by Code Rule 56.

3.5 WORK AREA PREPARATION

A. Asbestos danger signs shall be posted at all approaches to the asbestos Work Area. Post all emergency exits as emergency exits only on the Work Area side, post with asbestos caution signs on the non-Work Area side. Provide all non-Work Area stairs and corridors accessible to the asbestos Work Area with warning tapes at the base of stairs and beginning of corridors. Warning tapes shall be in addition to caution signs.

B. Shut down and lock out the building heating, ventilating, and air conditioning systems. Electrical systems and circuits shall also be shut down unless permitted to remain active per Code Rule 56 and appropriately protected and labeled. Existing lighting sources shall not be utilized. Provide temporary electric power and lighting as specified herein.

C. All non-ACM surfaces and objects within the Work Area shall be pre-cleaned using HEPA vacuuming and/or wet-wiping methods. Dry sweeping and any other methods that raise dust shall be prohibited. ACM shall not be disturbed during pre-cleaning.

D. Movable objects within the Work Area shall be HEPA vacuumed and/or wet-wiped and removed from the Work Area.

E. All non-movable equipment in the Work Area shall be completely covered with 2 layers of fire retardant plastic sheeting, at least 6 mil in thickness, and secured in place with duct tape and/or spray adhesive. Active Fire Protection System components in the Work Area shall not be covered with fire retardant plastic sheeting or any other obstruction.

F. Provide enclosure of the asbestos Work Area necessary to isolate it from unsealed areas of the building in accordance with the approved asbestos Work plan and as specified herein.

G. Provide critical barriers by sealing off all openings including but not limited to operable windows and skylights, doorways, diffusers, grills, electrical outlets and boxes, doors, floor drains, and any other penetrations to surfaces in the Work Area enclosure, using 2 layers of at least 6 mil fire retardant plastic sheeting.

H. Provide isolation barriers by installing temporary framing and sheathing at openings larger than 32 square feet forming the limits of the asbestos Work Area. Sheathing thickness must be a minimum of 3/8 inch and all sheathing shall be caulked and the Work Area side sealed with two layers of 6 mil fire retardant plastic sheeting. Isolation barriers in stairwells and at work area egress locations shall not be covered with sheathing, only two layers of 6 mil fire retardant plastic sheeting.

I. Isolation barriers shall be installed at all elevator openings in the Work Area. Elevators running through the regulated abatement work area shall be shut down or isolated as per Code Rule 56. Elevator controls shall be modified so that elevators bypass the Work Area

J. Provide two independent layers of 6 mil fire retardant plastic sheeting over all floor, wall, and ceiling surfaces. Isolation barriers shall also be covered with two independent layers (for a total of four layers). Sheeting shall be secured with duct tape. All joints in fire retardant plastic sheeting shall overlap 12" minimum. Carpeting left in place shall be covered with 3/8 inch plywood sheathing prior to plasticizing.

K. Unless otherwise specified for removal, the Contractor shall either protect all fiberglass insulation on piping, ductwork, tanks, etc. in the Work Area using two layers of six mil fire retardant plastic sheeting or remove the insulation as asbestos containing waste. If the Contractor elects to remove the fiberglass insulation as asbestos-contaminated, he/she shall be responsible for reinsulation if reinsulation of removed insulations is part of the Contract or Project.

L. Frame out emergency exits from Work Area. Provide double layer 6 mil fire retardant plastic sheeting and tape seal opening. Post as emergency exits only and tape utility knife to the Work Area side of each exit. Within the Work Area, mark the locations and directions of emergency exits throughout the Work Area using exit signs and/or duct tape.

M. Remove all items attached to or in contact with ACM only after the Work Area enclosure is in place. HEPA vacuum and wet wipe with amended water all items prior to their removal from the Work Area and before the start of asbestos removal operations.

N. Suspended ceiling tiles shall only be removed after Work Area preparation is complete. If possible, non-contaminated ceiling tiles shall be HEPA vacuumed and removed from the Work Area before asbestos removals begin. Contaminated ceiling tiles shall be disposed of as asbestos waste.

3.6 NEGATIVE AIR PRESSURE FILTRATION SYSTEM

A. Provide a portable asbestos filtration system that develops a minimum pressure differential of negative 0.02 in. of water column within all full enclosure areas relative to adjacent unsealed areas and that provides a minimum of 4 air changes per hour in the Work Area during abatement and 6 air changes for non-friable flooring and/or mastic removal.

B. Such filtration systems must be made operational after critical and isolation barriers are installed but before wall, floor, and ceilings are plasticized and shall be operated 24 hours per day during the entire Project until the final cleanup is completed and satisfactory results of the final air samples are received from the laboratory.

C. The system shall include a series of pre-filters and filters to provide High Efficiency Particulate Air (HEPA) filtration of particles down to 0.3 microns at 100% efficiency and below 0.3 microns at 99.9% efficiency. Provide sufficient replacement filters to replace pre-filters every 2 hours, secondary pre-filters every 24 hours, and primary HEPA filters every 600 hours (25 continuous days) of operation. HEPA filter sides shall be marked with installation date during all new HEPA filter installations on project.

D. A minimum of one additional filtration unit of at least the same capacity as the primary unit(s) shall be installed and fully functional to be used during primary unit (s) filter changing and in case of primary failure.

E. At no time will the unit exhaust indoors, within 15 feet of a receptor, including but not limited to windows and doors, or adversely affect the air intake of the building. Exhaust ducting shall not exceed 25' in length, except as allowed by Industrial Code Rule 56. Provide construction fencing at ground level exhaust termination locations per Code Rule 56.

F. Upon electric power failure or shut-down of any filtration unit, all abatement activities shall stop immediately and only resume after power is restored and all filtration units are fully operating. For shut-downs longer than one hour, all openings into the Work Area, including the decontamination enclosures, shall be sealed.

G. For all OSHA Class I removal Work Areas, the Contractor shall provide a manometer to verify negative air pressure. Manometers shall be read twice daily and recorded within the Daily Project Log.

H. There shall be at least a 4 hour settling period after the Work Area is fully prepared and the negative filtration units have been started to ensure integrity of the barriers.

I. Once installed and operational, the Contractor's Supervisor shall conduct daily inspections of the Work Area to insure the airtight integrity of the enclosure and operation of the negative air system. Findings shall be recorded within the Daily Project Log. Inspections shall also be conducted on days when no abatement activities are in progress per Code Rule 56 (i.e. weekends).

3.7 REMOVAL OF ASBESTOS CONTAINING MATERIALS

A. Asbestos-containing materials shall be removed in accordance with the Contract Documents and the approved Asbestos Work Plan. Only one type of ACM shall be abated at a time within a Work Area. Where there are multiple types of ACM requiring abatement, Code Rule 56 procedures for sequential abatement shall be followed.

B. Sufficiently wet asbestos materials with a low pressure, airless fine spray of surfactant to ensure full penetration prior to material removal. Re-wet material that does not display evidence of saturation.

C. One Worker shall continuously apply amended water while ACM is being removed.

D. Perform cutting, drilling, abrading, or any penetration or disturbance of asbestos containing material in a manner to minimize the dispersal of asbestos fibers into the air. Use equipment and methods specifically designed to limit generation of airborne asbestos particles. All power operated tools used shall be provided with manufacturer HEPA equipped filtered local exhaust ventilation, as required by regulation.

E. Upon removal of ACM from the substrate, the newly exposed surfaces shall be HEPA vacuumed and/or wet cleaned. Surfaces must be thoroughly cleaned using necessary methods and any required solvents to completely remove any adhesive, mastic, etc.

F. All removed material shall be placed into 6 mil plastic disposal bags or other suitable container upon detachment from the substrate. Cleanup of accumulations of loose debris or waste shall be performed whenever there is enough accumulation to fill a single bag or container and minimally at the end of each work shift.

G. Large components shall be wrapped in two layers of 6 mil fire retardant plastic sheeting. Sharp components likely to tear disposal bags shall be placed in fiber drums or boxes and then wrapped with sheeting.

H. Power or pressure washers are not permitted for asbestos removal or clean-up procedures unless approved in a Site Specific Variance and allowed by owner.

I. All open ends of pipe and duct insulation not scheduled for removal shall be encapsulated using lag cloth.

J. All construction and demolition debris determined by the Environmental Consultant to be contaminated with asbestos shall be handled and disposed of as asbestos waste.

K. The use of metal shovels, metal dust pans, etc. are not permitted inside the work area.

3.8 EQUIPMENT AND WASTE CONTAINER DECONTAMINATION AND REMOVAL PROCEDURES

A. External surfaces of contaminated containers and equipment shall be cleaned by wet cleaning and/or HEPA vacuuming in the Work Area before moving such items into the waste decontamination enclosure system airlock by persons assigned to this duty. The persons in the Work Area shall not enter the airlock. No gross removal operations are permitted when waste transfer is in progress.

B. The containers and equipment shall be removed from the airlock by persons stationed in the washroom during waste removal operations. The external surfaces of containers and equipment shall be cleaned a second time by wet cleaning.

C. The cleaned containers of asbestos material and equipment are to be dried of any excessive pooled or beaded liquid, placed in uncontaminated 6 mil plastic bags or sheeting, as the item's physical characteristics demand, and sealed airtight.

D. The clean recontainerized items shall be moved into the airlock that leads to the holding area. Workers in the washroom shall not enter this airlock.

E. Containers and equipment shall be moved from the airlock and into the holding area by persons dressed in clean personal protective equipment, who have entered from the holding area.

F. The cleaned containers of asbestos material and equipment shall be placed in water tight carts with doors or tops that shall be closed and secured. These carts shall be held in the holding until transfer to the waste container. The carts shall be wet cleaned and/or HEPA vacuumed at least once each day.

G. The exit from the decontamination enclosure system shall be secured to prevent unauthorized entry.

H. Where the waste removal enclosure is part of the personnel decontamination enclosure, waste removal shall not occur during shift changes or when otherwise occupied. Precautions shall be taken to prevent short circuiting and cycling of air outward through the shower and clean room.

3.9 WORK AREA DECONTAMINATION, CLEANING, AND CLEARANCE PROCEDURES

A. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed unless modified by a Site Specific Variance.

B. First Cleaning:

1. All bagged asbestos waste and unnecessary equipment shall be decontaminated and removed from the Work Area.
2. All surfaces in the Work Area shall be wet cleaned, except active fire protection system components that may be damaged by water. A wet-purpose shop vacuum may be used to pick up excess liquid, and may either be decontaminated prior to removal from the Work Area or disposed of as asbestos waste.
3. The Abatement Project Monitor (APM) shall conduct a visual inspection of the Work Area for cleanliness and completion of abatement.
4. The Contractor shall then apply a thin coat of encapsulant to all surfaces in the Work Area that were not the subject of removal. In no event shall encapsulant be applied to any surface that was the subject of removal prior to obtaining satisfactory air monitoring results. Encapsulants shall be pigmented or tinted to provide an indication for completeness of coverage. The APM shall determine adequacy of coverage.
5. After the encapsulant has been applied and the required waiting/settling / drying time has elapsed, the first layer of fire retardant plastic sheeting shall then be removed and bagged as asbestos waste.

C. Second Cleaning

1. All surfaces in the Work Area shall be HEPA vacuumed and then wet cleaned. Wet cleaning of active fire protection system components is not necessary if damage may occur.
2. The APM shall conduct a second visual inspection of the Work Area for cleanliness.
3. After the required waiting/settling/drying time has elapsed, the second layer of fire retardant plastic sheeting shall be removed and bagged as asbestos waste.

D. Third Cleaning

1. All surfaces in the Work Area shall be HEPA vacuumed and then wet cleaned. Wet cleaning of active fire protection system components is not necessary if damage may occur.
2. After the required waiting/settling/drying time has elapsed, the APM shall conduct a third visual inspection of the Work Area for completeness of abatement and cleanliness. The APM shall document the results of the visual inspection in the Project Monitor Log and Contractor’s Daily Project Log.
3. After satisfactory APM visual inspection, aggressive final clearance air sampling shall then be conducted by the Environmental Consultant provided no visible asbestos debris/residue; pools of liquid, or condensation remains. NOTE: TEM samples should be used vs. PCM if demolition or other dust-generating evolutions are taking place in adjacent areas, as evident from excessive loading.
4. Upon receipt of satisfactory final clearance air sampling results, the negative air pressure equipment can then be shut down, and the isolation and critical barriers removed and bagged as asbestos waste. Following this and satisfactory inspections by the project

supervisor and the APM for cleanliness, the decontamination enclosures shall be removed.

E. As a result of any visual inspection by the APM or should air sampling results indicate high fiber levels, the Contractor will re-clean the affected areas at no additional expense to the Owner.

3.10 TENT ENCLOSURES

A. Tent enclosures may only be used where specifically permitted by Code Rule 56 or a Site Specific Variance issued by the NYS Department of Labor.

B. The Contractor shall restrict access to the immediate area where tent removal procedures are taking place using barrier tape and/or construction barriers. Caution signs shall be posted.

C. Remote personnel decontamination enclosures shall be constructed. Configuration shall be as required by Project size and a washroom with attached airlock shall be constructed contiguous to the tent enclosure for small and large size tent enclosure work areas. For tent enclosures with gross abatement of friable materials, a contiguous decontamination system shall be constructed, maintained and utilized, except for minor size tent enclosure work areas where an adjacent decontamination room or area is permitted by Code Rule 56.

D. The Work Area shall be precleaned. All objects and equipment that will remain in the restricted area during abatement shall be sealed with two layers of six mil polyethylene and tape.

E. The tent shall be a single use barrier constructed with a rigid frame and at least two layers of six mil polyethylene unless one layer of six mil polyethylene is otherwise permitted by Code Rule 56. Tents with twenty (20) square feet or less of floor space or no gross removal of friable ACM shall be constructed of one (1) layer of six mil polyethylene and shall include walls, ceilings and a floor (except portions of walls, floors and ceilings that are the removal surface) with double folded seams. All seams shall be sealed airtight using duct tape and/or spray adhesive.

F. The tent shall be constructed with at least one airlock for worker/waste egress.

G. A manometer shall be used for all OSHA Class I abatement.

H. Negative air shall be maintained at four (4) air changes per hour for non-friable and glovebag abatement tent enclosure work areas. Eight (8) air changes shall be maintained for friable gross removal tent enclosure work areas. In a Minor size abatement tent enclosure work area a HEPA vacuum may be used to maintain the required air changes.

I. OSHA compliance air monitoring is required per section 1.09.

J. ACM removal shall follow procedures defined in section 3.07.

K. Waste material shall be placed in properly labeled 6 mil plastic bags or other appropriate containers. The outside of the bags or containers shall be wet wiped and/or HEPA vacuumed in the washroom and shall then be placed in a second bag/container before being transferred to the waste storage container. All transportation of waste bags and containers outside the Work Area

shall be in watertight carts. These carts shall be held in the holding area until transfer to the waste container. The carts shall be wet cleaned and/or HEPA vacuumed at least once each day.

L. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed.

1. All bagged asbestos waste and unnecessary equipment shall be decontaminated and removed from the Work Area.
2. All surfaces in the Work Area shall be wet cleaned. A wet-purpose shop vacuum may be used to pick up excess liquid, and shall be decontaminated prior to removal from the Work Area.
3. The Contractor shall then apply a thin coat of encapsulant to all non-removal surfaces covered with plastic in the Work Area. In no event shall encapsulant be applied to any surface that was the subject of removal prior to obtaining satisfactory air monitoring results. Encapsulants shall be pigmented or tinted to provide an indication for completeness of coverage. The APM shall determine adequacy of coverage.
4. After the waiting/settling/drying time requirements have elapsed, the Asbestos Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completion of abatement. The APM shall document the results of the visual inspection in the Project Monitor Log and Contractor's Daily Project Log.
5. After satisfactory APM visual inspection, aggressive final clearance air sampling shall then be conducted by the Environmental Consultant.
6. Upon receipt of satisfactory final clearance air sampling results, the tent shall be collapsed into itself, placed in suitable disposal bags, and tranferred through the washroom to the waste decontamination enclosure. Isolation and critical barriers shall then be removed and bagged as asbestos waste followed by satisfactory visual inspections by the project supervisor and the APM for cleanliness.

3.11 GLOVEBAG REMOVAL

A. Glovebag removals may only be used as specifically permitted by Code Rule 56 or a Site Specific Variance issued by the NYS Department of Labor. Glovebags may only be used on pipe or duct insulation.

B. In addition to conformance with applicable regulations and variances, glovebag removals are only permitted to be conducted within tent enclosures complying with these specifications.

C. The Contractor shall restrict access to the immediate area where tent/glovebag removal procedures are taking place using barrier tape and/or construction barriers. Caution signs shall be posted.

D. Remote personnel decontamination enclosures shall be constructed. Configuration shall be as required by Project size and a washroom with attached airlock shall be constructed contiguous to the tent enclosure.

E. Glovebag removals shall utilize commercially available glovebags of at least six mil thickness. Use shall be in accordance with the manufacturer's instructions and the following minimum requirements:

1. The sides of the glovebag shall be cut to fit the size pipe being removed. Tools shall be inserted into the attached tool pocket.
2. The glovebag shall be placed around the pipe and the open edges shall be folded and sealed with staples and duct tape. The glovebag shall also be sealed at the pipe to form a tight seal.
3. Openings shall be made in the glovebag for the wetting tube and HEPA vacuum hose. The opening shall be sealed to form a tight seal.
4. All glovebags shall be smoke tested by the Asbestos Project Monitor under negative pressure using the HEPA vacuum before removal operations commence. Glovebags that do not pass the smoke test shall be resealed and then retested.
5. After first wetting the materials to be removed, removal may commence. ACM shall be continuously wetted. After removal of the ACM, the piping shall be scrubbed or brushed so that no visible ACM remains. Open ends of pipe insulation shall be encapsulated.
6. After the piping is cleaned, the inside of the glovebag shall be washed down and the wetting tube removed. Using the HEPA vacuum, the glovebag shall be collapsed and then twisted and sealed with tape with the ACM at the bottom of the bag.
7. A disposal bag shall be placed around the glovebag that is then detached from the pipe. The disposal bag is then sealed and transferred through the washroom to the waste storage container.

F. After glovebag removals are complete, tent decontamination procedures shall be followed.

3.12 RESTORATION OF UTILITIES, FIRESTOPPING, AND FINISHES

A. After final clearance, remove locks and restore electrical and HVAC systems. All temporary power shall be disconnected, power lockouts removed and power restored. All temporary plumbing shall be removed.

B. Finishes damaged by asbestos abatement activities including, but not limited to, plaster/paint damage due to duct tape, staples, and spray adhesives, and floor tile lifted due to wet or humid conditions, shall be restored prior to final payment.

1. Finishes unable to be restored shall be replaced under this Contract at the Contractor’s expense.
2. All foam and expandable foam products and materials used to seal Work Area openings shall be completely removed upon completion of abatement activities.

C. All penetrations (including, but not limited to, pipes, ducts, etc.) through fire rated construction shall be firestopped using materials and systems tested in accordance with ASTM E814 on Projects where reinsulation is part of the required work.

3.13 DISPOSAL OF ASBESTOS WASTE

A. Transportation And Disposal Site

1. The Contractor's Hauler and Disposal Site shall be approved by the Owner. All waste generated during the asbestos project shall be disposed of as RACM asbestos waste.
2. The Contractor shall give twenty-four (24) hour notification prior to removing any waste from the site. Waste shall be removed from the site only during normal working hours

unless otherwise specified. No waste may be taken from the site unless the Contractor and Environmental Consultant are present and the Environmental Consultant authorizes the release of the waste as described herein.

3. All waste generated as part of the asbestos project shall be removed from the site within ten (10) calendar days after successful completion of all asbestos abatement work.
4. Upon arrival at the Project Site, the Hauler must possess and present to the Environmental Consultant a valid New York State Department of Environmental Conservation Part 364 Asbestos Hauler's Permit. The Environmental Consultant may verify the authenticity of the hauler's permit with the proper authority.
5. The Hauler, with the Contractor and the Environmental Consultant, shall inspect all material in the transport container prior to taking possession and signing the Asbestos Waste Manifests.

B. Waste Storage Containers

1. All waste containers shall be fully enclosed and lockable (i.e. enclosed dumpster, trailer, etc.). No open containers will be permitted on-site (i.e. open dumpster with canvas cover, etc.) unless specifically permitted by applicable regulation or a Site Specific Variance. When asbestos contaminated waste must be kept on the work site overnight or longer, it shall be double bagged and stored in accordance with Federal, State, and local laws.
2. The Environmental Consultant shall verify that the waste storage container and/or truck tags (license plates) match that listed on the New York State Department of Environmental Conservation Part 364 permit. Any container not listed on the permit shall be removed from the site immediately.
3. The container shall be plasticized and sealed with two (2) layers of 6 mil polyethylene. Once on site, it shall be kept locked at all times, except during load out. The waste container shall not be used for storage of equipment or contractor supplies.
4. While on-site, the container shall be labeled with EPA Danger signage:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

5. The New York State Department of Environmental Conservation Asbestos Hauler's Permit number shall be stenciled on both sides and back of the container.
6. The container is not permitted to be loaded unless it is properly plasticized, has the appropriate danger signage affixed, and has the permit number appropriately stenciled on the container.
7. Waste generated off-site is not permitted to be brought onto the Project site and loaded into the waste container.
8. All asbestos waste removed from the project site shall be transported directly to the disposal site without any addtional waste being added to the container during transport.

C. Hauler's Asbestos Waste Manifest

1. The Hauler's Manifest shall be completed by the Contractor and verified by the Environmental Consultant that all the information and amounts are accurate and the proper signatures are in place.

2. The Manifests shall have the appropriate signatures of the Environmental Consultant, the Contractor, and the Hauler representatives prior to any waste being removed from the site.
3. Copies of the completed Hauler's Manifest shall be retained by the Environmental Consultant and the Contractor and shall remain on site for inspection.
4. Upon arrival at the Disposal Site, the Hauler's Manifest shall be signed by the Disposal Facility operator to certify receipt of ACM covered by the manifest.
5. The Contractor shall forward copies of the Hauler's Manifest to the Environmental Consultant within 14 days of the waste container being removed from the site. Failure to do so may result in payment being withheld from the Contractor.
6. All waste disposal manifests and disposal logs shall be submitted by the Contractor to the Owner with the final close-out documentation.

END OF SECTION 028200

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SECTION 028300 - REMOVAL AND DISPOSAL OF LEAD-CONTAINING PAINT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Description Of Work

1. This specification covers the removal and disposal of lead-based or lead-containing paint associated with the Influent Pumping System Improvements Project located at the Cedar Creek Water Pollution Control Plant, 3340 Merrick Road, Wantagh, NY 11783.

Floor	Room	Component	Color	Substrate	WA Desig-nation	Approximate Quantity	Procedure
-28 Level	Basement Dry Well	Centrifugal Pumps 1	Grey	Metal	**1**	**1.0 SF along Cut lines at Gaskets**	Manual Wet Scraping/ Chemical Stripping
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 2**	**Yellow**	**Metal**		**1.0 SF along Cut lines at Gaskets**	
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 2**	**Grey**	**Metal**			
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 3**	**Yellow**	**Metal**		**1.0 SF along Cut lines at Gaskets**	
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 3**	**Grey**	**Metal**			
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 4**	**Yellow**	**Metal**		**1.0 SF along Cut lines at Gaskets**	
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 4**	**Grey**	**Metal**			
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 5**	**Yellow**	**Metal**		**1.0 SF along Cut lines at Gaskets**	
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 5**	**Grey**	**Metal**			
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 6**	**Yellow**	**Metal**		**1.0 SF along Cut lines at Gaskets**	
-28 Level	**Basement Dry Well**	**Centrifugal Pumps 6**	**Grey**	**Metal**			
-28 Level	Basement Dry Well	Centrifugal Pumps 7	Yellow	Metal		**1.0 SF along Cut lines at Gaskets**	
-28 Level	Basement Dry Well	Centrifugal Pumps 7	Grey	Metal			

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Floor	Room	Component	Color	Substrate	WA Desig-nation	Approximate Quantity	Procedure
-28 Level	Basement Dry Well	Top Big Pipes	Grey	Metal		**5.0 SF along Cut lines at Gaskets**	
-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Grey	Metal		**5.0 SF along Cut lines at Gaskets**	
-28 Level	**Basement Dry Well**	**Elevator Door Frame**	**Brown**	**Metal**	**2**	**50.0 SF**	Manual Wet Scraping/ Chemical Stripping
-28 Level	Basement Dry Well	Door	Brown	Metal		**21.0 SF**	Manual Wet Scraping/ Chemical Stripping
-28 Level	**Basement Dry Well**	**Door Frame**	**Brown**	**Metal**			
-28 Level	Basement Dry Well	Wall	White	Plaster			
-28 Level	Staircase	Walls	Tan	Plaster	**3**	**500.0 SF**	Manual Wet Scraping/ Chemical Stripping
		Closed Stringer	**Tan**	**Metal**			
		Open Stringer	**Tan**	**Metal**			
		Riser	**Tan**	**Metal**			
		Underneath Staircase	**Tan**	**Metal**			
		Riser	Grey	Metal			
-28 Level	Basement Dry Well	Column	White	Concrete			
-28 Level	Basement Dry Well	Wall	White	Brick Mortar			
-14 Level	**Centrifugal Pipe Perimeter**	**Staircase Plat-form Support**	**Brown**	**Metal**	**4a-g**	**60.0 SF**	Manual Wet Scraping/ Chemical Stripping
-14 Level	Centrifugal Pipe Perimeter	Handrail	Grey	Metal			
-6.5 Level	**Staircase-Basement Walkway**	**Walls**	**White**	**Plaster**	**5**	**200.0 SF**	Manual Wet Scraping/ Chemical Stripping
		Door	**Brown**	**Metal**		**21.0 SF**	
		Door Frame	**Brown**	**Metal**			
		Closed Stringer	**Tan**	**Metal**		**200.0 SF**	
		Open Stringer	**Tan**	**Metal**			
		Riser	**Tan**	**Metal**			
		Underneath Staircase	**Tan**	**Metal**			
4.5	**Stairwell-**	**Closed Stringer**	**Tan**	**Metal**	**6**	**500.0 SF**	Manual Wet

Floor	Room	Component	Color	Substrate	WA Desig-nation	Approximate Quantity	Procedure
Level	**Bearing Access Platforms**	**Open Stringer**	**Tan**	**Metal**			Scraping/ Chemical Stripping
		Riser	**Tan**	**Metal**			
		Underneath Staircase	**Tan**	**Metal**			
		Ceiling	Tan	Plaster			
15.5 Level	**Stairwell-Ground Floor Ref**	**Closed Stringer**	**Tan**	**Metal**	**7**	**500.0 SF**	Manual Wet Scraping/ Chemical Stripping
		Open Stringer	**Tan**	**Metal**			
		Riser	**Tan**	**Metal**			
		Underneath Staircase	**Tan**	**Metal**			

2. All layers of coating shall be considered as LBP and removed down to the substrates. Substrates coated with LBP and targeted for demolition may be removed and disposed of solid structure waste following TCLP testing.
3. Substrates coated with LBP and targeted for refurbishment and recoating shall be abated using manual wet scraping or chemical stripping procedures, localized testing of chemical stripping products shall proceed broader use and only after approval by the DPW Environmental Consultant.
4. The abatement contractor shall separate paint chips and contaminated dust/particulate generated by the abatement from other project waste streams including worker personal protective equipment and plastic sheeting. All waste other than lead paint chips and contaminated dust/particulate shall be TCLP tested prior to disposal.
5. Waste generated by the work of this method shall be stored on site in a NYSDEC compliant Hazardous and Waste Storage Area and transported under manifest to the disposal site.
6. The contractor shall prepare a project specific work plan and project specific HASP for the work of this contract.
7. LBP remediation shall be consistent with guidelines from SSPC and work shall comply with the OSHA regulations including the use of decontamination units and hand wash stations.
8. The contractor may propose alternate LBP removal procedures however, use of alternate procedures will require approval by DPW Environmental Consultant; the abatement contractor is responsible with maintaining the physical conditions and integrity of the targeted substrates, and the surrounding structures during abatement work.
9. The Contractor shall request and receive in writing prior to proceeding with any work info from the owner regarding surfaces/materials that require protection.

B. Definitions

1. Action Level: Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period in an occupational/industrial environment.

2. Area Sampling: Sampling of lead concentrations within the lead control area and inside the physical boundaries, which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel. This sampling will be conducted by Westchester County Department of Public Works and Transportation (DPW) third party consultant, if required.
3. Certified Contractor: Certified under 40 CFR 745.226 to inspect, assess or remove lead-based paint, dust or soil. Certification as required to provide notification to the Environmental Protection Agency prior to the commencement of lead-based paint abatement activities in residential dwellings and child occupied facilities.
4. Contaminated Room: Room for removal of contaminated personal protective equipment (PPE).
5. Decontamination Shower Facility: That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal room#, with a shower facility in between.
6. Eight-Hour Time Weighted Average (TWA): Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.
7. EPA Notification: The certified contractor shall notify the Environmental Protection Agency at least 5 business days prior to conducting lead-based paint abatement in residential or child occupied facilities. The notification requirements for updating and canceling projects shall also be completed as required.
8. High Efficiency Particulate Air (HEPA) Filter Equipment: HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron or larger size particles.
9. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps.
10. Lead-Based Paint (LBP): Paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight.
11. Lead-Based Paint Hazard (LBP Hazard): Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, and lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.
12. Lead-Containing Paint (LCP): Lead-based paint or other similar surface coating containing lead or lead compound in excess of 0.06 percent by weight of the total nonvolatile content of the paint.
13. Lead Control Area: An enclosed area or structure, constructed as a temporary containment equipped with HEPA filtered local exhaust, which prevents the spread of lead dust, paint chips, or debris existing as a condition of lead-based paint removal operations. The lead control area is also isolated by physical boundaries to prevent unauthorized entry of personnel.
14. Lead Permissible Exposure Limit (PEL): Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a workday, the PEL shall be determined by the following formula: PEL (micrograms/cubic meter of air) = 400/No. Hours worked per day.
15. Personal Sampling: Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. The sampling, conducted by the Contractor, shall provide information to complete the required exposure assessment to identify the level of exposure a worker would be subject to without respiratory protection. Whenever there has been a change of

equipment, process, control, personnel or a new task has been initiated, the Contractor shall conduct additional personal sampling.

16. Physical Boundary: Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area but inside boundary."
17. Project Supervisor (PS): As used in this section, refers to a person employed by the Contractor who is trained and certified in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. The PS shall be trained and certified to inspect, assess or remove lead based paint, dust or soil.
18. Third Party Consultant: DPW will provide a third party consultant to provide pre-work assessments, project monitoring assessments for the work area and surrounding areas and final clearance assessments.
19. Worker certifications: All workers inspecting, assessing, or removing lead-based paint, dust or soil who are trained and certified to conduct these activities. As per 40 CFR Part 745 and 29 CFR 1926.

C. Submittals: Submit the following:

1. Product Data:

    a. Vacuum and negative air filters (if units are required)
    b. Respirators

2. Test Reports

    a. Compliance Assessment report

3. Certificates

    a. Certifications of PS
    b. Testing laboratory qualifications
    c. Contractor Consultant qualifications, if any required
    d. Respiratory protection program
    e. Hazard communication program
    f. EPA approved hazardous waste treatment or disposal facility for lead disposal
    g. Hazardous waste management plan
    h. Vacuum filters
    i. Employee training certifications
    j. Certification of medical examinations

4. Manufacturer's Instructions

    a. Chemicals and equipment
    b. Materials
    c. Material safety data sheets for all chemicals

5. Lead-Based Paint/Lead-Containing Paint Removal Plan (LBP/LCPRP) including PS approval (signature, date, and certification number):

    a. The job specific plan for the work procedures to be utilized,

b. The job specific plan for worker protection issues regarding personal protective equipment, the work procedures, and exposure assessment procedures,
c. The job specific plan for protecting the work area, ventilation and drainage systems,
d. Collected waste water disposal,
e. Paint debris disposal (hazardous and non-hazardous waste).

6. Containment Design

a. The containment design proposed for use during surface preparation and clean up activities as required to perform the work. The Plan for staging, installing, moving and removing the containment. Include all data, calculations and assumptions used for the design of the containment and ventilation system to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air and baseline lead dust/soil concentrations are not reached or exceeded outside of the lead control area.
b. Methods to be used to verify adequate air flow characteristics and negative pressure within containment.
c. The plan for staging and storing any waste material;
d. The plan for establishing barriers to control access of personnel within the exposure zones.

7. Compliance Plan

a. Establish monitoring programs for the monitoring activities that are the responsibility of the Contractor and include provisions for complying with the results of any monitoring and analysis that is conducted by the Contractor and DPW.
b. Establish procedures for monitoring of airborne exposures surrounding project activities and the establishment of visible barriers to control the access of personnel within the exposure zones. DPW will provide instrument monitoring of airborne exposure and/or wipe sampling within the work area or the surrounding areas by a third party consultant.
c. Provide procedures for the visual assessment of the ground (soil) to determine whether it has been impacted by project activities, if required. Identify the corrective action that will be taken in the event of unacceptable results. In the event visual assessments of the ground show unacceptable results, the Contractor will undertake the necessary clean up of the ground (soil) as appropriate as directed by DPW. Clean up to pre-project levels will be required. The third party consultant will provide final visual, instrument and wipe sampling to clear the work and surrounding areas.
d. Final Clearance Evaluation – Provide written procedures identifying the methods that will be used to conduct final project clean up and the final cleanliness inspections and evaluations that will be undertaken in compliance with the project requirements.

8. Closeout Submittals

a. Completed and signed hazardous waste manifest from treatment or disposal facility
b. Certification of medical examinations, if required

D. Qualifications of Project Supervisor (PS): Submit name, address, telephone number and the EPA certification number of the PS selected to perform responsibilities specified in paragraph entitled "Project Supervisor (PS) Responsibilities." Provide at least two (2) years of previous experience with lead-based paint abatement projects. Submit proper documentation that the PS is trained and certified in accordance with federal, State, and local laws.

E. Contractor Consultant Qualifications: Submit the name, address, telephone number and the EPA certification number of the Contractor Consultant (Contractor) if one is selected to perform the worker protection sampling and any additional sampling the Contractor may decide to take. Submit proper documentation that the Contractor consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA and authorized State (or local) certification and accreditation program. The Contractor consultant shall have at least two (2) years of previous experience with lead-based paint abatement projects.

F. Testing Laboratory: Submit the name, address, and telephone number of the testing laboratory selected to perform the air sampling and disposal testing. The air sampling results shall be utilized for reporting of airborne concentrations of lead for Contractor worker protection issues. This sampling will be separate from the third party consultant sampling that will be conducted by DPW. Use a laboratory accredited under the EPA National Lead Laboratory Accreditation Program (NLLAP) by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis.

G. Lead-Based Paint/Lead-Containing Paint Removal Plan (LBP/LCPRP): Information to also be included in the LBP/LCPRP not indicated in Section 1.1, C 5 & 6 shall include but not be limited to the following items. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of the decontamination facilities. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades and sequencing of lead related work. Include site preparation and cleanup procedures. Include occupational and environmental sampling (if any by the Contractor), frequency and duration of sampling.

H. Occupational And Environmental Sampling Results: Submit occupational and environmental sampling results to the DPW within three working days of collection, signed by the testing laboratory responsible official, the employee that performed the sampling, and the PS.

1. The sampling results shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures in accordance with 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead.
2. Submit worker exposure data conducted during the task based trigger operations of 29 CFR 1926.62.
3. The initial monitoring shall determine the requirements for further monitoring and the need to fully implement the control and protective requirements including the compliance program (LBP/LCP) in accordance with 29 CFR 1926.62.

I. Occupational And Environmental Assessment Data Report:

1. Some LBP/LCP removal work may not require full implementation of the requirements of 29 CFR 1926.62. Based on the experience of the Contractor and/or the use of a specific process or method for performing the work, the Contractor may be able to

provide historic data (previous 12 months) to demonstrate that airborne exposures are controlled below the action level. Such methods or controls shall be fully presented in the LBP/LCPRP. To reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation in an Assessment Data Report.

2. Submit occupational and environmental assessment report to DPW prior to start of work, signed by the testing laboratory responsible official, and the PS.

    a. Submit a report that supports the determination regarding the reduction of the need to fully implement the requirements of 29 CFR 1926.62 and supporting the LBP/LCP. The exposure assessment shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures in accordance with 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.
    b. Submit worker exposure data conducted during the task based trigger operations of 29 CFR 1926.62 with a complete process description in supporting a negative assessment.
    c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the compliance program (LBP/LCPRP) in accordance with 29 CFR 1926.62.

J. Quality Assurance

1. Medical Examinations: Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62, and 29 CFR 1926.103.

    a. Medical Records: Maintain complete and accurate medical records of employees for a period of at least 30 years or for the duration of employment plus 30 years, whichever is longer.
    b. Medical Surveillance: Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62.

2. Project Supervisor (PS) Responsibilities

    a. Certify training as meeting all federal, State, and local requirements.
    b. Review and approve lead-based paint/lead-containing paint removal plan for conformance to the applicable referenced standards.
    c. Continuously inspect lead-based paint removal work for conformance with the approved plan.
    d. Perform air sampling, if required by Contractor.
    e. Ensure work is performed in strict accordance with specifications at all times.
    f. Control work to prevent hazardous exposure to human beings and to the environment at all times.
    g. Certify the conditions of the work as called for elsewhere in this specification.

3. Training: Train each employee performing inspection, assessing, paint removal, disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 40 CFR 745.225, 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations.

    a. Training Certification: Submit a certificate for each employee, signed and dated by the approved training source, stating that the employee has received the required lead training.

4. Respiratory Protection Program

    a. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.
    b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

5. Hazard Communication Program: Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.
6. Hazardous Waste Management: The Hazardous Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations and address:

    a. Identification and classification of hazardous wastes associated with the work.
    b. Estimated quantities of wastes to be generated and disposed of.
    c. Names and qualifications of each Contractor that will be transporting, storing, treating and/or disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of EPA, or State and local hazardous waste permit applications or permits or manifests, as required, and co-ordinate with DPW regarding the use of an existing EPA Identification number or developing separate EPA Identification numbers.
    d. Names, qualifications and training (experience and training) of personnel who will be working on-site with hazardous wastes.
    e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
    f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.
    g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.
    h. Unit cost for hazardous waste disposal according to this plan.

7. Environmental, Safety and Health Compliance: In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 40 CFR Part 745 and 29 CFR 1926.62. Submit matters regarding interpretation of standards to DPW for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.
8. Pre-Construction Conference: Along with the PS, meet with DPW and any facility or consultant representatives to discuss in detail the hazardous waste management plan and

the lead-based paint/lead-containing paint removal plan, including work procedures and precautions for the removal plan.

K. Equipment

1. Respirators: Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.
2. Special Protective Clothing: Furnish personnel who will be exposed to lead-contaminated dust with proper disposable uncontaminated, reusable protective whole body clothing, head covering, gloves, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the PS.
3. Vacuum Filters: UL 586 labeled HEPA filters.
4. Equipment for Owner's Personnel: Furnish DPW with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. The Owner will provide respiratory protection for DPW and their representatives.

L. Removal

1. Title to Materials: Materials resulting from demolition work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of in accordance with all federal, State and local regulations.

1.3 PRODUCT

A. Chemicals: Submit applicable Safety Data Sheets for all chemicals used in paint removal work. Use the least toxic product approved by DPW.

1.4 EXECUTION

A. Protection

1. Notification: Notify DPW 20 days prior to the start of any lead based paint removal work.
2. Notification: Notify the Environmental Protection Agency at least 5 days prior to conducting lead-based paint abatement activities in a residential dwelling or child occupied facility.
3. Lead Control Area Requirements

a. If LBP will be removed by means which will not likely create airborne, lead-containing dust (such as careful wet scraping or chemical stripping), establish a lead control area by situating critical barriers and physical boundaries around the area or structure where LBP/LCP removal operations will be performed.

b. If removal practice will create airborne, lead-containing dust (such as sanding, abrasive blasting, thermal cutting, demolition, or needle gun use), utilize full containment procedures - Contain removal operations by the use of critical barriers and HEPA filtered exhaust or a negative pressure enclosure system with decontamination facilities and with HEPA filtered exhaust if required by the PS, as directed.

4. Protection of Existing Work to Remain: Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.
5. Boundary Requirements: Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.

   a. Physical Boundary: Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.
   b. Warning Signs: Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

6. Furnishings:

   a. The Owner will remove furniture and equipment from the building before lead-based paint removal work begins.
      or
   b. Furniture and equipment will remain in the building. Protect and cover furnishings or remove furnishings from the work area and store in a location approved by DPW.
      or
   c. Existing furniture and equipment are lead contaminated, decontaminate, dispose of as lead contaminated waste.

7. Heating, Ventilating and Air Conditioning (HVAC) Systems: Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area. Provide temporary HVAC system for areas in which HVAC has been shut down outside the lead control area.
8. Decontamination Shower Facility: Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.
9. Eye Wash Station: Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.
10. Mechanical Ventilation System

    a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62.

b. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems, approved by the PS. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.
c. Vent local exhaust outside the building only and away from building ventilation intakes.
d. Use locally exhausted, power actuated, paint removal tools.

11. Personnel Protection: Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

B. Work Procedures: Perform removal and disposal of lead-based paint in accordance with approved lead-based paint/lead-containing paint removal plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with 29 CFR 1926.62, except as specified herein.

1. Personnel Exiting Procedures: Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the workplace wearing any clothing or equipment worn during the work day:

a. Vacuum themselves off.
b. Remove protective clothing in the contaminated change room and place them in an approved impermeable disposal bag.
c. Shower or Wash hands and face at the site, as directed, don appropriate disposable or uncontaminated reusable clothing; move to an appropriate facility; shower.
d. Change to clean clothes prior to leaving the physical boundary designated around the lead control area.

2. Sampling

a. Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air sampling shall be directed or performed by the PS.

1) The PS shall be on the job site directing the air sampling and inspecting the lead-based paint removal work to ensure that the requirements of the contract have been satisfied during the entire lead-based paint removal operation.
2) Collect personal air samples on employees who are anticipated to have the greatest risk of exposure as determined by the PS. In addition, collect air samples on at least 25 percent of the work crew or a minimum of two employees; whichever is greater, during each work shift.
3) Submit results of air samples, signed by the PS, within 24 hours after the air samples are taken. Notify DPW immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the lead control area.

b. Surface and/or soil sampling shall be conducted as required for residential dwellings and child occupied facilities or as may be required for high profile, sensitive work areas, such as administrative buildings, kitchens, barracks, etc., to

determine clearance (i.e., that the work has not contaminated surfaces within and adjacent to the control area) will be performed by a third party consultant provided by DASNY. Notification to DPW will also outline any sampling requirements to be provided for the work.

1) Before any work begins, DPW's third party consultant will collect and analyze baseline soil or wipe samples in accordance with methods defined in federal, State, and local standards inside and outside of the physical boundary to assess the degree of soil and/or dust contamination prior to when lead-based paint removal activities are initiated.
2) After all work is completed, DPW's third party consultant will collect and analyze soil or wipe samples in accordance with methods defined in federal, State, and local standards inside and outside of the physical boundary to assess the degree of soil and/or dust contamination after the lead-based paint removal activities are completed.

c. Area Air Sampling During Paint Removal Work: DPW will conduct area air sampling while lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Area monitoring shall be conducted to ensure unprotected personnel adjacent to the lead control area are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, the Contractor will be advised to stop work, and correct the conditions(s) causing the increased levels. DPW will determine if condition(s) require any further change in work methods. Removal work shall resume only after approval is given by DPW. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.

3. Lead-Based Paint Removal

a. Provide methodology for removing LBP/LCP in the work plan. Remove paint within the areas designated on the drawings in order to completely expose the substrate. Take whatever precautions necessary to minimize damage to the underlying substrate.
b. Avoid flash rusting or deterioration of the substrate. Co-ordinate surface preparations as required by DPW.
c. Provide methodology for LBP/LCP removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris/waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this LBP/LCP removal process in the LBP/LCPRP.
d. Indoor Lead Paint Removal: Perform manual or mechanical or thermal or chemical, as directed, paint removal in lead control areas using enclosures, barriers, or containments and powered locally exhausted paint removal tools. Collect residue and/or debris for disposal in accordance with federal, State, and local requirements.
e. Outdoor Lead Paint Removal: Perform outdoor removal as indicated in federal, State, and local regulations and in the LBP/CPRP. The worksite preparation (barriers or containments) shall be job dependent and presented in the LBP/LCPRP.
f. Sampling After Paint Removal: After the visual inspection, DPW will conduct soil sampling if bare soil is present during external removal operations and collect area

air samples inside and outside the lead control area to determine the airborne levels of lead inside and outside the work area. DPW will collect wipe samples according to the HUD protocol contained in HUD Guidelines to determine the lead content of settled dust and dirt in micrograms per square foot of surface area and parts per million (ppm) or micrograms per gram (µg/g) for soil.

4. Cleanup and Disposal

a. Cleanup: Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the PS. Re-clean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The PS shall then certify in writing that the area has been cleaned of lead contamination before restarting work.

b. Clearance Certification

1) The Contractor shall document in writing and provide analytical documentation to certify that the employee exposure to an airborne concentration of lead were below the required action level, respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to DPW's acknowledgement of the third party sampling results, if required, and upon receipt of the Contractor certification.

2) The DPW third party consultant shall certify surface wipe sample results collected inside and outside the work area are less than 100 micrograms per square foot on uncarpeted floors, less than 500 micrograms per square foot on interior window sills and less than 800 micrograms per square foot on window troughs or not significantly greater than the initial surface loading determined prior to work, as directed.

3) For exterior paint removal work, the DPW third party consultant will provide soil samples taken at the exterior of the work site to be used to determine if soil lead levels had increased at a statistically significant level (significant at the 95 percent confidence limit) from the soil lead levels prior to the work. If soil lead levels do show a statistically significant increase above any applicable Federal or State standard for lead in soil, the soil shall be remediated back to the pre-work level.

c. Testing of Lead-Based Paint Residue and Used Abrasive: The Contractor shall test paint residue and used abrasive in accordance with 40 CFR 261 for hazardous waste.

d. Disposal

1) Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing, which may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261. Dispose of lead-contaminated waste material at an EPA or State approved hazardous waste treatment, storage, or disposal facility off Owner's property.
2) Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55-gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. DPW or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.
3) Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. The Contractor shall provide documentation the transporter is authorized to transport the waste, authorized to deliver the waste to the treatment, storage, or disposal facility and the treatment, storage, or disposal facility is authorized to accept the waste. Comply with land disposal restriction notification requirements as required by 40 CFR 268.
4) All material, whether hazardous or non-hazardous shall be disposed in accordance with laws and provisions and federal, State, or local regulations. Ensure waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

5. Disposal Documentation: Submit written evidence the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and State or local regulatory agencies. Submit one copy of the completed manifest, signed and dated by the initial transporter in accordance with 40 CFR 262.
6. Payment for Hazardous Waste: Payment for disposal of hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials delivered is returned and a copy is furnished to the Owner.

PART 2 - NOT USED

PART 3 - NOT USED

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SECTION 028310 - LCP/LBP DISTURBANCES USING OSHA LEAD SAFE WORK PRACTICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

A. The work covered by this Specification shall consist of furnishing all labor, materials, tools, and equipment necessary to control and mitigate potential lead-based paint (LBP) and lead-containing paint (LCP) material hazards during demolition/renovation activities associated with the Influent Pumping System Improvements Project located at the Cedar Creek Water Pollution Control Plant, 3340 Merrick Road, Wantagh, NY 11783.

B. This Specification shall be used as a guideline for Contractors who complete the demolition/renovation activities pertaining to this Project, as detailed within Section 1.01, B of this Specification. The intent of this Specification is to remain in conformance with Occupational Safety and Health Administration (OSHA) Regulation 29 CFR 1926.62 “Lead Exposure in Construction” and to maintain an airborne concentration of lead-dust below the Action Level. This Specification is written to outline the worst-case scenario regarding lead safe work practices.

C. The following is a detailed listing of identified LBP and/or LCP, above the laboratory and/or device detection limit:

Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
-28 Level	Basement Dry Well	Centrifugal Pumps 1	Grey	Metal	0.2	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 2	Yellow	Metal	3.4	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 2	Grey	Metal	2.1	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 3	Yellow	Metal	1.8	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 3	Grey	Metal	2.4	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 4	Yellow	Metal	3.2	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 4	Grey	Metal	1.1	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 5	Yellow	Metal	1.6	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 5	Grey	Metal	2.2	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 6	Yellow	Metal	1.4	Poor

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Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
-28 Level	Basement Dry Well	Centrifugal Pumps 6	Grey	Metal	1.2	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 7	Yellow	Metal	0.3	Poor
-28 Level	Basement Dry Well	Centrifugal Pumps 7	Grey	Metal	0.2	Poor
-28 Level	Basement Dry Well	Top Big Pipes	Grey	Metal	0.2	Poor
-28 Level	Basement Dry Well	Top Big Pipes	Grey	Metal	0.2	Poor
-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Grey	Metal	0.2	Poor
-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Grey	Metal	0.2	Poor
-28 Level	Basement Dry Well	Concrete Pedestals/Platform Pads	Grey	Metal	0.2	Poor
-28 Level	Basement Dry Well	Pipes Support	Grey	Metal	2.1	Poor
-28 Level	Basement Dry Well	Pipes Support	Grey	Metal	1.7	Poor
-28 Level	Basement Dry Well	Pipes Support	Grey	Metal	2.2	Poor
-28 Level	Basement Dry Well	Centrifugal Pipes	Red	Metal	3.1	Poor
-28 Level	Basement Dry Well	Centrifugal Pipes	Red	Metal	1.1	Poor
-28 Level	Basement Dry Well	Centrifugal Pipes	Red	Metal	2.7	Poor
-28 Level	Basement Dry Well	Centrifugal Pipes	Red	Metal	1.3	Poor
-28 Level	Basement Dry Well	Waste Pipes	Grey	Cast Iron	0.1	Poor
-28 Level	Basement Dry Well	Waste Pipes	Beige	Cast Iron	0.2	Poor
15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Tan	Metal	0.3	Poor
15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Tan	Metal	0.2	Poor
15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Tan	Metal	0.2	Poor
15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Green	Metal	0.2	Poor
15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Green	Metal	0.2	Poor
15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Green	Metal	0.2	Poor
30.5 Level	HVAC Demolition Overall Plan	Wall	Beige	Plaster	0.2	Poor

Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
30.5 Level	HVAC Demolition Overall Plan	HVAC/Duct Coating	Grey	Canvas	0.2	Poor
30.5 Level	HVAC Demolition Overall Plan	HVAC/Duct Coating	Grey	Canvas	0.2	Poor

It should be noted that several components tested did contain minimal lead-concentrations below the EPA threshold level of 1.0 mg/cm^2 or 0.5% by weight for classification as LBP and are considered lead-containing paints or coatings by 29CFR 1926.62. OSHA does not recognize a minimum limit for lead concentration in paint for the purpose of disturbance. Personal Air monitoring of workers performing demolition/cleaning/disturbance of painted surfaces shall be completed to document personnel occupational exposure and reviewed by the Contractor's Competent Person. Items containing any amount of lead concentration are considered lead-containing paints or coatings per 29 CFR 1926.62. See project environmental survey report for lead paint reports. Lead paint summary information is located within the Appendices of this specification.

D. Manual demolition, scraping and sanding of lead-based paint or lead containing paint coated surfaces, power tool cleaning with dust collection systems shall be performed in conjunction with engineering and work practice controls meeting the requirements of 29 CFR 1926.62(e)(1).

E. Components with LBP and LCP shall be removed intact to the extent practicable. A 6-mil polyethylene drop cloth shall be placed around and/or beneath the component, prior to its removal, to catch any paint chips that may become dislodged. Intact components shall be wrapped in a layer of clear 6-mil polyethylene prior to movement to the disposal container. The area around the component removal shall be wet wiped and high-efficiency particulate air (HEPA) filter vacuumed, including the tent enclosure (if applicable). The polyethylene sheeting shall be carefully folded in on itself and placed in a 6-mil disposal bag and sealed closed. All debris shall be properly disposed of in accordance with the respective waste stream Resource Conservation Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP) testing results.

F. Chemical stripping may be used for LBP and LCP removal on surfaces that will be subjected to welding, cutting, torch burning or where it is the only acceptable procedure. No chemical strippers containing methylene chloride shall be used by the Contractor on this project. SDS for stripping and neutralizing chemicals must be reviewed and approved by the Consultant prior to use and a copy shall be posted at the site.

G. The Contractor's use of a subcontractor (must be approved) shall not relieve the Contractor of full responsibility for the work to be performed.

H. If available and approved by the Competent Person, the Contractor may utilize exposure assessment data that is compliant with OSHA and was obtained within the last twelve (12) months from previous jobs conducted under similar conditions, control methods, work practices and environmental conditions to be used in this contract for LCP disturbances only. Other objective data may be used to demonstrate that work activities in this contract will not result in occupational exposures to airborne lead that exceeds the PEL for LCP disturbances only. The assessment shall include comparable lead concentrations (LCP only) in paint/coating materials, work practices, engineering controls and work schedules.

I. The Contractor must provide to his workers the following: Respiratory protection in accordance with the Contractor's Respiratory Protection Program, personal protective clothing, lead-free change areas, hand washing/shower facilities, blood lead level monitoring and training per 29 CFR 1926.62. Respiratory Protection is required for all LBP disturbances.

J. The Contractor shall ensure that any HVAC equipment intakes within and around the control areas are protected by shutting down the units. The Contractor shall alter the size and extent of the isolation barriers as necessary due to weather conditions, functional space use and density of building occupants in the vicinity, as required.

1.3 DEFINITIONS, REGULATIONS & REFERENCE STANDARDS

A. Definitions (excerpted from 29 CFR 1926.62)

1. Action Level: Employee exposure, without regard to the use of respirators, to an airborne lead concentration of 30 micrograms per cubic meter (30 ug/m^3) calculated as an 8-hour time-weighted average (TWA). Exceedance of the Action Level requires blood lead monitoring implementation.
2. Competent Person: One who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has the authorization to take prompt corrective measures to eliminate them. For LBP work, the Competent Person shall also be the on-site Supervisor/Foreman in-charge of the work crew.
3. Exposure Assessment: Each employer who has a workplace or operation covered by 29 CFR 1926.62 shall initially determine if any employee may be exposed to lead at or above the Action Level.
4. Lead: Metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.
5. Lead-Based Paint (LBP): Paint, varnish, shellac or other coatings on surfaces that contain 1.0 milligram per square centimeter (1.0 mg/cm^2) or more lead or 0.5% or more lead by weight. The concentration of 0.5% is equivalent to:

    a. 5,000 parts per million (5,000 ppm) and;
    b. 5,000 milligrams per kilogram (5,000 mg/kg)

6. Lead-Containing Paint (LCP): Paint, varnish, shellac or other coatings on surfaces that contain measurable concentrations less than 1.0 milligrams per square centimeter (1.0 mg/cm^2) lead or less than 0.5% or more lead by weight including equivalents less than 5,000 ppm and 5,000 mg/kg. This does not include paint, varnish, shellac or other coatings on surfaces where the concentration is below the detection limit of the respective laboratory method / device.
7. LBP Inspection: A surface by surface investigation to determine the presence of LBP. A report is then issued that identifies if there is LBP present and where it is located.
8. Lead Risk Assessor: EPA trained and certified to conduct LBP inspections and collect samples for the presence of lead in air, dust and soil for the purposes of abatement clearance testing as well as conduct risk assessments.
9. Permissible Exposure Limit (PEL): The limit above which the employer shall not expose workers to lead. The current PEL for lead is 50 ug/m^3 over an eight-hour time-weighted-average for all employees covered.

B. General Requirements

1. The Contractor is required to perform all work related to this project in strict accordance with all applicable Federal, State and Local regulations.
2. Where these requirements vary, the most stringent shall apply.
3. Specific Requirements

a. American National Standards Institute (ANSI)
ANSI Z9.2-79 – Fundamentals Governing the Design and Operation of Local Exhaust Systems.
b. Z88.2-80 – Practice for Respiratory Protection.
c. Code of Federal Regulations (CFR)
d. 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response.
e. 29 CFR Part 1910.134 – Respiratory Protection.
f. 29 CFR Part 1910.146 – Confined Space Entry Program.
g. 29 CFR Part 1910.1025 – Lead (General Industry Standard).
h. 29 CFR Part 1910.1200 – Hazard Communication.
i. 29 CFR Part 1926.55 – Gases, Vapors, Fumes, Dusts and Mists.
j. 29 CFR Part 1926.57 – Ventilation.
k. 29 CFR Part 1926.62 – Lead (Construction Industry Standard).
l. 40 CFR Part 260 – Hazardous Waste Management Systems: General.
m. 40 CFR Part 261 – Identification and Listing of Hazardous Waste.
n. 40 CFR Part 262 – Generators of Hazardous Wastes.
o. 40 CFR Part 263 – Transporters of Hazardous Waste.
p. 40 CFR Part 264 – Owners and Operators of Hazardous Waste Treatment, Storage & Disposal Facilities.
q. 40 CFR Part 265 – Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage & Disposal Facilities.
r. 40 CFR Part 268 – Land Disposal Restrictions.
s. 40 CFR Part 745 – Lead; Requirements for Lead-Based Paint Activities in Child Occupied Facilities
t. 49 CFR Parts 170-178 – Department of Transportation Regulations.
u. New York Codes of Rules and Regulations (NYCRR)

1) 6 NYCRR Part 360 – Solid Waste Regulations.
2) 6 NYCRR Part 364 – Waste Transporter Permits.
3) 6 NYCRR Part 370-373 – Hazardous Waste Regulations.

v. Steel Structures Painting Council (SSPC)

1) SSPC-Guide 6 – Guide for Containing Debris Generated During Paint Removal Operations.
2) SSPC-Guide 7 – Guide for the Disposal of Lead-Contaminated Surface Preparation Debris.

w. Underwriters Laboratories. Inc. (UL)

1) UL 586 – High Efficiency, Particulate Air Filter Units.

1.4 QUALITY ASSURANCE

A. The Contractor's Competent Person is required to maintain a copy of the following documents on-site.

B. Qualifications:

1. Contractor: Documentation that the Contractor has prior experience on LBP and LCP activity projects similar in nature and extent to ensure the capability to perform the required work procedures in a satisfactory manner.
2. Competent Person: Certification that the Contractor's full-time on-site Competent Person meets the Competent Person requirements of 29 CFR Part 1926.62 and is experienced in administration and supervision of LBP and LCP activity projects, including work practices, protective measures for building and personnel, disposal procedures, etc. The Competent Person shall also be the project Supervisor.
3. Contractor's Testing Laboratory: Documentation that the laboratory performing the OSHA personal sample analysis is an EPA National Lead Laboratory Accreditation Program (NLLAP) accredited laboratory and that it is listed proficient in the NIOSH/EPA Environmental Lead Proficiency Analytical Testing Program (ELPAT), and is a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified laboratory. Certification shall include accreditation for heavy metal analysis, and a Quality Assurance and Quality Control Program. Currently, the American Association for Laboratory Accreditation (ASLA) and the American Industrial Hygiene Association (AIHA) are the EPA recognized laboratory accreditors. Documentation shall include the date of accreditation or reaccreditation.
4. Blood Lead Testing Laboratory: Adequate documentation that the laboratory is certified to perform blood lead analysis for the State where the work site is located.

C. Respiratory Protection Devices

1. Manufacturer's NIOSH certification for respiratory protection devices utilized on the site.

D. Cartridges, Filters, and Vacuum Systems

1. Manufacturer's NIOSH certification of approval of respirator cartridges (organic vapor, acid gas, mist, dust, high efficiency particulate); High Efficiency Particulate Air (HEPA) filtration capabilities for all cartridges, filters, and HEPA vacuum systems.

E. Medical Examination and Records

1. Certification that employees who are involved in LBP and LCP work have received medical examinations and will receive continued medical surveillance, including blood lead level monitoring, as required by 29 CFR Part 1926.62, 29 CFR Part 910.1200, 29 CFR Part 1910.120 and by the state and local regulations pertaining to such work. Records shall be retained, at Contractor expense, in accordance with 29 CFR Part 1910.20.
2. Provide medical surveillance to workers until exposure monitoring reveals that workers are not exposed to airborne lead at or above the Action Level of 30 ug/m^3. This consists of a blood test measuring the level of lead and zinc protoporphyrin by a licensed physician. Further testing and medical exams may be necessary depending on the results of initial blood tests and/or the initial exposure assessment.

F. Training

1. Training certification shall be maintained and posted at the site, prior to the start of work involving LBP and LCP work, for all of the Contractors' workers, supervisors and Competent Person. Training shall meet the requirements of 29 CFR Part 1926.62, 29 CFR Part 1926.59, 29 CFR Part 1910.1200 and 49 CFR 172. Training shall be provided prior to the time of job assignment and as required by the regulations thereafter. The project specific training shall, at a minimum, include the following.

   a. Lead Paint Awareness Training as per 29 CFR 1926.62.
   b. Specific nature of the operation, which could result in exposure to lead.
   c. Purpose, proper selection, fitting, use and limitations of respirators.
   d. Purpose and description of the medical surveillance program and the medical removal protection program, including information concerning the adverse health effects associated with excessive exposure to lead (with particular attention to the adverse reproductive effects on both males and females, hazards to the fetus and additional precautions for employees who are pregnant).
   e. Relevant engineering controls and good work practices.
   f. The contents of any compliance plan in effect.
   g. Instructions to employees that chelating agents should not routinely be used to remove lead from their bodies and should not be used at all except under the direction of a licensed physician.
   h. The employee's right of access to records under 29 CFR part 1910.20.

G. Respiratory Protection Program

1. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least every 12 months thereafter as required by 29 CFR Part1910.134 and 29 CFR Part 1926.62.
2. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR Part 1910.134 and 29 CFR Part 1926.62.
3. All workers are required to don respirator(s) with the appropriate level of protection commensurate with the airborne concentrations of lead in which they are working. The level of protection will be determined by the Contractor, based on objective air monitoring data.

1.5 ON-SITE SUBMITTALS

A. The Contractor's Competent Person is required to maintain a copy of the following documents on-site.

B. Certifications:

C. Prior to the start of work, maintain the on-site, required certifications and licenses listed above in Section 1.03.

D. Equipment List:

E. Maintain a list of equipment items to be used in the work, including brand names, model, capacity, performance characteristics, quantities, and other pertinent information.

F. LBP and LCP Safe Work Practice Compliance Plan:

1. The contractor shall prepare a detailed LBP and LCP Safe Work Practice Compliance Plan that identifies the work procedures, health and safety measures to be used in LBP and LCP work procedures; and that addresses spill prevention, containment, and emergency response procedures. The Plan shall be maintained on-site. The plan shall address the methods to be undertaken during LBP and LCP disturbances to include all requirements of 1926.62(e)(2)(ii) including, but not limited to the following key elements:

    a. LBP and LCP containment methods to control employee exposure to lead at or below the permissible exposure limit.
    b. Training requirements as required by Federal, State, and Local regulations.
    c. Unique problems associated with the LBP and LCP project.
    d. Sketch of location and details of LBP and LCP control areas, decontamination procedures.
    e. Eating, drinking, smoking, and rest room procedures.
    f. Sequencing of LBP and LCP related work.
    g. Personal protective equipment and respiratory protection program, including controls.
    h. Engineering controls, containment structures and safety measures. Refer to 1.07, D of this Section for HEPA filtered negative air unit requirements, as applicable.
    i. Worker exposure assessment procedures.
    j. Work Practice controls.
    k. Housekeeping.
    l. Hygiene facilities and practice.
    m. Medical surveillance, including medical removal procedures.
    n. Sampling, testing and analytical methods for personal air sampling requirements of 29 CFR Part 1926.62. Procedures must include frequency, locations, sampling, and analytical methods to be used.
    o. Contractor to include the segregation and minimization of lead waste streams from construction and demolition waste in their lead-based paint management plan.
    p. Visual clearance log for each control area that is maintained by the Contractor's Competent Person.

G. Compliance Program

1. Contractor's Compliance Program prepared in accordance with 29 CFR Part 1926.62 (e) (2) shall be maintained on-site.

H. Sampling and Laboratory Analysis Reports

1. Maintain on-site all field sampling logs for all personal air samples taken, including copies of laboratory analysis reports and chain of custody records for all sample analyses.

I. Competent Person certification per Sections 1.02 and 1.03.

1.6 CLOSEOUT SUBMITTALS:

A. At the conclusion of the LBP/LCP project, the Contractor shall provide the following closeout submittals:

1. Submit copies of all "Visual Clearance Logs" to the Project Manager for owner's reference.

2. Signed Certification from the Contractor's Competent Person that all required documentation has been provided.

1.7 POSTED WARNINGS & NOTICES

A. The following regulations, warnings and notices shall be posted at the work site in accordance with 29 CFR Part 1926.62.

B. Regulations

1. A copy of applicable Federal, State, and Local regulations shall be maintained at the work site.

C. Warning Signs

1. Warning signs shall be provided at approaches to LBP/LCP control areas. Signs shall be located at a distance from the LBP and LCP control areas that will allow personnel to read the sign and take the necessary protective actions required before entering the LBP/LCP control area. The signs shall comply with the requirements of 29 CFR Part 1926.62.

D. Worker Information

1. Right-to-know notices shall be placed in clearly visible areas of the work site in compliance with Federal, State and Local regulations.

E. Exposure Air Monitoring Results

1. Exposure air monitoring results shall be prepared in order to be easily understood by the workers and shall be placed in a clearly visible area of the work site.

F. Emergency Telephone Numbers

1. A list of telephone numbers shall be posted at the site. The list shall include numbers of the local hospital, emergency squad, police and fire departments, Government and Contractor representatives who can be reached 24 hours per day as well as professional consultants directly involved in the project.

1.8 EQUIPMENT & MATERIALS

A. Sufficient quantities of health and safety materials required by 29 CFR Part 1926.62, and other materials and equipment needed to complete the project, shall be available and kept on the site.

B. Respirators

1. Air-purifying respirators shall be approved by NIOSH for use with dust, fumes and mists having permissible exposure limits less than 0.05 milligrams per cubic meter (i.e. have high-efficiency particulate air [HEPA] filters) and for other hazardous airborne contaminants that may be encountered, as determined by the Competent Person. The Contractor shall furnish, at no cost to personnel/employees, respirators to provide protection from airborne concentrations of lead. Respirators shall comply with the

requirements of 29 CFR Part 1926.62 and shall be used in accordance with 29 CFR Part 1926.62, 29 CFR Part 1926.103 and 29 CFR Part 1910.134.

C. Respirator Cartridges

1. A sufficient supply of respirator cartridges shall be maintained at the work site to provide new cartridges to employees and authorized visitors throughout the duration of the project. Cartridges shall be replaced according to the manufacturer's recommendations, when breathing becomes difficult, or if the cartridges become wet.

D. Protective Clothing

1. The Contractor shall furnish, at no cost to personnel/employee, equipment/ clothing for protection from airborne and waterborne LBP and LCP debris. An adequate supply of these items shall be available for worker and authorized visitor use. Workers and visitors shall not take protective clothing and equipment off the work site at any time. Protective clothing includes:

   a. Coveralls (Whole Body Protective Coverings): Full-body coveralls and head covers shall be worn by workers in the control area as necessary. Sleeves shall be secured at the wrist and pants legs at the ankle with tape. Permeable clothing shall be provided in heat-stress conditions. Where non-disposable coveralls are provided, these coveralls shall be cleaned after each wearing and kept within the control area or decon/airlock (bagged). Cleaning of coveralls and other non-disposable clothing shall be in accordance with the provisions for cleaning in 29 CFR Part 1926.62.
   b. Boots: Work boots with nonskid soles or impermeable work boot covers shall be worn by workers. Where required by OSHA, safety boots (steel toe or steel toe and shank) shall be worn. Paint the uppers of boots red with waterproof enamel. Do not allow boots to be removed from the control area for any reason after being contaminated with LBP or LCP debris. Keep within control area or decon/airlock (bagged).
   c. Gloves: Inner gloves, appropriate for items and hazards encountered, and disposable outer work gloves shall be provided to each worker and shall be worn while the worker is in the control area. Glove material shall be appropriate for the specific chemical exposure. Gloves shall not be removed from the control area and shall be disposed of as LBP or LCP contaminated waste at the end of the work.
   d. Hard Hats: Head protection (hard hats) shall be provided as required by OSHA for workers and authorized visitors. Protective plastic-strap suspension hats shall be used. Hard hats shall be worn at all times when work is in progress. Hard hats shall remain in the control area until the project is completed. Hard hats shall be thoroughly cleaned, decontaminated, dried and bagged before being removed from the control area at the end of the project.
   e. Eye Protection: Fog-proof goggles for personnel engaged in LBP and LCP operations shall be worn when the use of a full-face piece respirator is not required and kept within control area or decon/airlock (bagged) until completion of project.

E. Negative Air Pressure System

1. When a LBP or LCP control area requires the use of an airtight containment barrier, a negative air pressure system shall be used and pressure differential recordings taken. LBP and LCP shall not be removed from the LBP/LCP control area until the proper engineering controls and HEPA filtration systems are in place.

2. HEPA Filter Requirements

   a. The negative air pressure system shall be equipped with approved HEPA filters per UL 586. Negative air pressure equipment shall be equipped with new HEPA filters, and shall be sufficient to maintain a minimum pressure differential of minus 5 Pascals (Pa), equivalent to 0.02 inch of water column relative to adjacent, unsealed areas. Negative air pressure system minimum requirements are listed below.
   b. The unit shall be capable of delivering its rated volume of air with a clean first stage filter, an intermediate filter and a primary HEPA filter in place. The units shall be clean and sealed (intake & exhaust) at all times when not operating in a control area.
   c. The HEPA filter shall be certified as being capable of removing particles as small as 0.3 micrometers at a minimum efficiency of 99.97 percent. 700 hours is the manufacturer life recommendation of a HEPA filter (approximately 1 month of continuous operating).
   d. The unit shall be capable of continuing to deliver no less than 70 percent of rated capacity when the HEPA filter is 70 percent full or measures 620 Pa (2.5 inches of water) static pressure differential on a magnehelic gauge.
   e. The unit shall be equipped with a manometer-type negative pressure differential monitor with minor scale division of 0.02 inches of water and accuracy within plus or minus 1.0 percent. The manometer shall be calibrated in accordance with the manufacturer's recommendations. Record manually manometer readings of the pressure differential between the LBP control area and adjacent unsealed areas at the beginning and end of each workday.
   f. The unit shall be equipped with a means for the operator to easily interpret the readings in terms of the volumetric flow rate of air per minute moving through the machine at any given moment.
   g. The unit shall be equipped with an electronic mechanism that automatically shuts the machine off in the event of a filter breach or absence of a filter.
   h. The unit shall be equipped with an audible horn that sounds an alarm when the machine has shut itself off.
   i. The unit shall be equipped with an automatic safety mechanism that prevents a worker from improperly inserting the main HEPA filter.
   j. The unit shall be ducted through the containment barrier wall to the exterior of the building. The unit shall not be exhausted into any interior areas. If exhausting to the exterior is not feasible, utilize an unoccupied area or room that is large enough to handle the volume of air with two units connected in series. Applicable warning signage shall be posted at this location.

3. Number of Units Required

   a. The air within the containment barrier shall be changed at least once every 15 minutes by a continuously operating negative air pressure system, until the LBP/LCP control area barrier is removed. Filters shall be replaced as necessary to maintain the efficiency of the system. A back-up unit shall be maintained on-site.

4. Auxiliary Generator

   a. If site conditions can't provide power, an auxiliary generator shall be provided. The generator shall not present a carbon monoxide hazard to workers.

5. Discontinuing Negative Air Pressure System

a. The negative air pressure system shall not be shut down during LBP/LCP work unless authorized by the environmental consultant. At the completion of the LBP/LCP work procedures and disposal project, units shall be run until removal is completed satisfactorily and full cleanup has been completed and satisfactory clearance has been achieved. Dismantling of the negative air pressure systems shall conform to the written decontamination procedures. Prefilters shall be removed and properly disposed. The intake and exhaust of the machines shall be sealed with polyethylene to prevent environmental contamination.

F. Expendable Materials

1. Polyethylene Sheet and Bags - General

a. Polyethylene sheet and bags shall be minimum 6-mil thick. Bags shall have pre-printed labels, and 5-inch (minimum) long plastic ties, pointed and looped to secure the filled bags. Polyethylene sheets shall be in roll sizes to minimize seams.

2. Polyethylene Sheet - Flame Resistant

a. Where a potential for fire exists, flame-resistant polyethylene sheets shall be provided. Polyethylene film shall conform to the requirements of NFPA 701.

3. Polyethylene Sheet - Reinforced

a. Reinforced polyethylene sheet shall be provided where high skin strength is required such as where it constitutes the only barrier between the LBP control area and the indoor and outdoor environments. The sheet stock shall consist of translucent, nylon-reinforced or woven-polyethylene thread laminated between two layers of polyethylene film. Films meet flame resistant standards of NFPA 701.

4. Tape and Adhesive Spray

a. Tape and adhesive shall be capable of sealing joints between polyethylene sheets and for attachment of polyethylene sheets to adjacent surfaces. After dry application, tape or adhesive shall retain adhesion when exposed to wet conditions, including amended water. Tape shall be minimum 2 inches wide, industrial strength.

5. Containers

a. DOT approved impermeable containers shall be used to receive and retain LBP and LCP waste and debris and lead contaminated material until disposal. Containers shall be labeled in accordance with EPA, DOT and OSHA standards, as applicable for the type of waste. Waste streams shall be segregated in a manner to reduce the potential volume of hazardous waste generated.

6. Chemicals

a. Chemicals, including caustics and paint strippers, shall be properly labeled, stored in leak-tight containers and properly/safely secured from the general public.

G. Vacuum Systems

1. HEPA filtered vacuum systems shall be used during LBP/LCP operations which generate dust. The systems shall be suitably sized for the project, and filters shall be capable of removing particles as small as 0.3 micrometers at a minimum efficiency of 99.97 percent. Vacuum opening, wands and hoses shall be sealed at all times when not in a control area.

H. Chemical Paint Strippers

1. Chemical paint strippers shall contain no methylene chloride.

I. Chemical Paint Stripper Neutralizer

1. Neutralizers for paint strippers shall be compatible with the substrate and suitable for use with the chemical stripper that has been applied to the surface.

J. Storage of Materials

1. Materials shall be stored in an approved enclosed structure, which protects them from damage, rain, wind, etc. and contamination. During periods of cold weather, plastic materials shall be protected from the cold. Regularly inspect materials to identify damaged or deteriorating items. Damaged or deteriorated items shall not be used and shall be removed from the site as soon as they are discovered. Stored materials shall not present a hazard or an inconvenience to workers, visitors, employees and/or other building occupants.

PART 2 - EXECUTION

2.1 WORK PROCEDURES

A. LBP and LCP work procedures and related work shall be performed in accordance with the accepted Contractor's LBP and LCP Safe Work Practice Compliance Plan, 29 CFR Part 1926.62 and as specified herein. LBP/LCP waste and debris, lead contaminated debris and personal protective clothing and equipment shall be disposed of in compliance with Federal, State, and Local regulations and in accordance with the respective waste stream TCLP testing results.

B. Personal Protection Procedures

1. Respiratory Protection is required for all LBP disturbances. Personnel shall wear and use protective clothing and equipment as specified and required by 29 CFR Part 1926.62 and 29 CFR Part 1910.120. Eating, smoking, drinking, chewing tobacco, chewing gum, applying makeup and use of non-work-related walkie-talkies/phones shall not be permitted in the LBP and LCP control area. Personnel of trades not engaged in the LBP or LCP work procedures and disposal of LBP and LCP shall not be exposed at any time to airborne concentrations of lead equal to or in excess of 30 micrograms per cubic meter of air (30 ug/m^3). Electrical service shall be disconnected when wet removal is performed, and temporary electrical service protected by a ground fault circuit interrupter (GFCI) shall be provided.

C. Safety and Health Procedures

1. The Competent Person shall be present on the work site throughout the LBP and LCP project to supervise, monitor and document the project's health and safety provisions. A daily log shall be maintained showing the results of air sampling tests throughout the project area. LBP and LCP work being conducted within an LBP or LCP control area where an airtight barrier is required shall be stopped if measured airborne lead concentrations, collected during LBP or LCP work procedures, exceed the Action Level.

D. Safety and Health Responsibilities

1. The Competent Person shall:

a. Verify that training meets applicable requirements.
b. Review and approve LBP/LCP Safe Work Practice Compliance Plan for conformance to the applicable referenced standards.
c. Inspect LBP and LCP removal work for conformance with the accepted Safe Work Practice Compliance Plan.
d. Ensure that worker exposure air monitoring activities are in accordance with 29 CFR Part 1926.62.
e. Ensure work is performed in strict accordance with specifications.
f. Ensure hazardous exposure to personnel and to the environment are adequately controlled.
g. The Contractor's Competent Person shall be responsible for directing personal air monitoring and shall also perform visual inspections prior to the visual inspection conducted by the third-Party Environmental Consultant (if applicable), to verify the control areas are free of all visible debris.
h. If required, the Contractor's Competent Person shall coordinate with the owner and the third-party environmental consultant for any control areas requiring final air/wipe testing clearance testing (Action Level/wipe) in accordance with OSHA and/or US Department of Housing and Urban Development (HUD) protocols.

E. Medical Surveillance Procedures

1. Medical surveillance shall be implemented in accordance with the accepted Contractor's LBP/LCP Safe Work Practice Compliance Plan and shall comply with the requirements of 29 CFR Part 1926.62, including the provisions for blood lead level monitoring, medical removal, protection and a physician's written opinion, signed by the physician performing the employee examination. The Contractor's Competent Person shall maintain on-site, a copy of the written opinion for Contractor's employees prior to each employee's commencement of work.

F. Engineering Controls and Containment Structures

1. Engineering and work practice controls are the primary means of maintaining exposures to lead below the PEL. Paint removal and surface preparation activities must keep dust levels at a minimum. Power tools must be equipped with manufacturer equipped vacuum shrouds including an attached HEPA filtered vacuum system.
2. LBP/LCP Control Area

a. The control area is where LBP/LCP work procedures occur and as such shall be considered contaminated. The LBP/LCP control area shall be isolated to prevent LBP/LCP containing dust or debris from passing into adjacent areas. The control

area shall be decontaminated at the completion of the LBP/LCP work procedures and disposal work.

3. Boundary Requirements.

   a. Physical boundaries along with Warning Signage shall be provided around exterior LBP/LCP control areas by taping off the area indicated in the Safe Work Practice Compliance Plan.

4. Control Barriers

   a. The LBP/LCP control area shall be designated and separated from other outside areas with control barriers. The polyethylene sheeting shall mask and seal all openings. The LBP/LCP control area shall be erected according to the Contractors LBP/LCP Safe Work Practice Compliance Plan. Polyethylene sheeting shall be mechanically supported, independent of duct tape or spray adhesive.

5. Exterior Masking and Sealing

   a. Exterior LBP/LCP control area requirements: Where the construction of a contained LBP/LCP control area is impractical or not required based on the method of lead work procedures, a taped-off perimeter shall be installed around the area where the LBP/LCP handling procedures are performed and other requirements for LBP/LCP control areas shall be maintained. Personal monitoring of airborne concentrations is still required and shall be conducted in accordance with 29 CFR Part 1926.62.

6. Hand Wash Station

   a. An operational hand washing station shall be provided to all workers adjacent to each LBP/LCP control area utilizing polyethylene sheeting as a drop cloth. Water shall be hot and cold or warm. Soap dish, continuing supply of soap, and clean towels shall be provided. The hand wash station shall be maintained in a sanitary condition. Waste water shall be collected and placed within 6-mil polyethylene bags and sealed. Bags shall be immediately placed within non-leaking, drums and sealed.

7. Equipment Decontamination

   a. An equipment decontamination area shall be installed at the entrance to each LBP/LCP control area to allow for the cleaning of all equipment utilized on the project. Polyethylene sheeting shall be utilized as a drop cloth, along with a utility tub to clean and capture debris/water during the cleaning process. Water shall be hot and cold or warm. Continuing supply of detergent, and clean towels shall be provided. The equipment decontamination area shall be maintained in a sanitary condition. Waste water shall be collected and placed within 6-mil polyethylene bags and sealed. Bags shall be immediately placed within non-leaking, drums and sealed.

G. Temporary Utilities

1. Temporary equipment as necessary to provide adequate power, light, heat, and water shall be installed, as needed, to accomplish the LBP/LCP operations properly and safely. The Contractor shall maintain the security and maintenance of the utility system in the

LBP/LCP control areas. In the event of a failure of any utility system, the Owner will not be responsible for any loss of time or other expense incurred by the Contractor. In addition to any site-specific temporary utility requirements, the Contractor shall provide:

a. Back-flow protection on all water connections. Fittings installed by the Contractor shall be removed after completion of work with no damage or alteration to existing water piping and equipment.
b. When applicable, heavy-duty abrasion-resistant hoses to provide water to each control area and decontamination area.
c. A hot water heater, if necessary, to provide warm water to the decontamination showers, hand wash station and equipment decontamination area.
d. Electrical service to control areas. Electrical service shall comply with National Electric Code, State and Local requirements and UL standards. Warning signs shall be posted at power outlets, which are other than 110-120 volt power. Only grounded extension cords connected into a GFCI shall be used. Incandescent lamps and light fixtures shall be of adequate wattage to provide good illumination in LBP/LCP control areas.
e. Temporary heating units, when needed, that have been tested and labeled by UL, FM, or another recognized trade association related to the fuel being consumed. Forced air or fan type units shall not be utilized inside a control area. Units shall have tip-over protection.

2.2 LEAD-BASED/CONTAINING PAINT WORK PRACTICES (Use methods as applicable)

A. Component Removal:

1. Components shall be removed intact to the extent practicable. A 6-mil polyethylene drop cloth shall be placed around and/or beneath the component, prior to its removal, to catch any paint chips that may become dislodged. The component shall be wrapped and sealed in a layer of clear 6-mil polyethylene prior to movement to the disposal container. Follow proper disposal requirements. The area around the component removal shall be wet wiped and HEPA vacuumed. The polyethylene sheeting shall be carefully folded in on itself and placed in a 6-mil disposal bag. Containment debris shall be properly stored of in accordance with respective waste stream as per the Contractor’s LBP/LCP Safe Work Practice Compliance Plan

B. Chemical Stripping:

1. Chemical stripping may be used for LBP and LCP removal on surfaces that will be subjected to welding, cutting, torch burning or where it is the only acceptable procedure. No chemical strippers or associated neutralizer chemicals containing methylene chloride shall be used by the Contractor on this project.
2. Horizontal surfaces directly below and in a radial direction from the area where chemical stripping is to be performed shall be covered with 6-mil plastic sheeting and shall also extend ten (10) feet on either side of the control area or to the furthest practical distance to catch any paint chips that may become dislodged.
3. All LBP/LCP on specified surfaces shall be removed to the bare substrate. The job is not considered complete until the substrate is dry, free of paint, debris, and LBP/LCP residue.
4. LBP/LCP stripping agents shall be brushed or troweled on the designated surfaces, or otherwise applied to a minimum thickness in accordance with manufacturer's specifications.

5. The required application/reaction time for stripping will depend upon the ambient temperature, humidity, and thickness of LBP/LCP. If LBP/LCP is not completely removed following the initial application of stripper, additional applications and wet scrapings may be required.
6. Removed LBP/LCP shall not be deposited on the polyethylene containment surfaces but shall be transferred directly into clear 6-mil polyethylene bags from the scraper and sealed. LBP/LCP shall be removed by wet scraping to the maximum extent feasible. If the substrate is to be reused, the removal activities shall not damage the substrate.
7. Any residue not removable by wet scraping shall be washed down to the bare metal substrate with an appropriate, pre-approved solution. LBP/LCP-contaminated wastewater shall be kept to a minimum using wet scrub brushes or sponges. These residues and disposable cleaning media shall also be directly transferred to 6-mil polyethylene bags and sealed. Bags shall be immediately placed within non-leaking, drums and sealed. Free standing water shall be eliminated by use of a drying agent. Contractor to include the segregation and minimization of lead waste from construction and demolition waste in their LBP/LCP Safe Work Practice Compliance Plan .

C. Manual Demolition/Scraping/Cleaning:

1. Manual demolition, scraping, sanding and power tool cleaning with dust collection systems shall be performed in conjunction with engineering and work practice controls meeting the requirements of 29 CFR 1926.62(e)(1).
2. Seal openings of HVAC ductwork and other penetrations (doors, windows, etc.) within the Control Area with two layers of 6-mil polyethylene sheeting. For work on vertical surfaces, place a layer of 6-mil polyethylene sheeting below the area prior to manual demolition/scraping/sanding/cleaning. The sheeting shall extend ten (10) feet on either side of the control area or to the furthest practical distance to catch any paint chips that may become dislodged.
3. Wet methods shall be used during manual scraping, sanding and power tool cleaning with dust collection systems. Local HEPA ventilation shall be utilized in conjunction with manual scraping, sanding and power tool cleaning with dust collection systems. In the case that local HEPA ventilation is not sufficient to control dust hazards, the Contractor shall be required to install engineering controls to meet requirements of specification section 1.06, D., “Negative Air Pressure System”.
4. Removed LBP/LCP shall not be allowed to accumulate on surfaces within the Control Area but shall be HEPA vacuumed or placed directly into 6-mil polyethylene bags. The Contractor shall maintain all surfaces as free as practicable of accumulated lead dust to prevent the dispersal of lead into the work places that are outside of the lead paint control areas. LBP/LCP shall be removed by manual methods to the maximum extent feasible.
5. Debris shall be bagged in 6-mil polyethylene bags, sealed, and secured in leak proof drums. The area around the surfaces subject to work shall be wet wiped and HEPA vacuumed, including the polyethylene sheeting. Upon a satisfactory clearance inspection the cleaned polyethylene sheeting shall be carefully folded in on itself and placed in a 6-mil disposal bag. Containment debris shall be properly stored of in accordance with the respective waste stream as indicated in the contractor’s LBP/LCP Safe Work Practice Compliance Plan . The contractor shall coordinate with the third-party environmental consultant to test the waste streams for disposal.

D. Alternative Lead Work Procedures

1. Any work procedure deviating from the outlined procedures above shall be submitted to the Owner’s third-party Environmental Consultant for review and approval prior to the start of the project. As there are many different components in different areas of the

building(s), it is impractical to address every potential lead work procedure. The intent of alternative lead work procedures shall be to maintain compliance with 29 CFR 1926.62 and maintain airborne concentrations of lead dust below the Action Level of 30 ug/m^3.

2.3 PERSONAL AIR MONITORING, WASTE SAMPLING & CLEARANCE SAMPLING (If Required)

A. During all LBP/LCP removal and disposal operations, the Contractor's OSHA Competent Person shall be on-site inspecting the work to ensure that the health and safety requirements of this contract are satisfied. The owner may elect to have a Third-Party Environmental Consultant on-site to perform visual clearance inspections and/or clearance sampling.

B. Personal Air Monitoring (Provided by the Contractor, as necessary)

1. Personal air monitoring samples for airborne concentrations of lead shall be collected and analyzed in accordance with 29 CFR Part 1926.62. Results shall be reported in micrograms per cubic meter of air. The Competent Person shall use personal air monitoring results to determine the effectiveness of engineering controls, the adequacy of PPE and to determine if proper work practices are being employed. The third-party environmental consultant shall be notified if any personal air monitoring result meets or exceeds 30 ug/m^3 of air. The Contractor shall stop work and take steps to reduce the concentration of lead in the air. Such corrective actions shall be documented in the daily log. Personal air sampling results shall be verbally available within 24-hours of sampling with hard copy reports available within five (5) calendar days of sampling.

C. Waste Sampling and Testing (Provided by Third Party Environmental Consultant)

1. Sampling and testing of all waste streams, shall be in accordance with 40 CFR Part 261, 6 NYCRR Part 371 and SW-846, Chapter 9, Sampling Plan. See Paragraph 2.05 C. of this specification section for waste sampling and analyses requirements.

D. Dust/Wipe Sampling (If Required, will be provided by Third Party Environmental Consultant).

1. Dust/wipe samples shall be taken after clean-up activities have been completed and the control areas passed a visual inspection. Refer to Section 2.01 C. 7. for visual inspection requirements.
2. Sampling for clearance criteria shall be performed in compliance with HUD Guidance document.
3. If clearance fails, the recleaning and any additional costs (dust/wipe sample analyses, etc.) to clear the control area shall be the responsibility of the Contractor. The control area shall remain in place until satisfactory clearance has been achieved.
4. Clearance Levels:

a. Floors: 10 ug/ft^2
b. Window Sills: 50 ug/ft^2
c. Window Wells: 100 ug/ft^2

2.4 ADJACENT AREAS

A. Damage to adjacent areas shall be repaired by the Contractor to the approval of the Owner.

2.5 CLEAN-UP & DISPOSAL

A. Cleanup

1. Daily: Surfaces in the LBP/LCP control area shall be maintained free of accumulations of paint chips, LBP/LCP debris and dust. Spread of dust and debris shall be restricted; waste shall not be distributed over the control area. Dry sweeping or compressed air shall not be used for cleanup. At the end of each shift, the area shall be cleaned of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner and wet wiping the area. LBP/LCP work procedures shall cease during the cleanup.
2. At completion of LBP/LCP work and a satisfactory visual inspection by Third Party Environmental Consultant (if applicable) and OSHA Competent Person, a clean-up shall be performed by the Contractor. This clean-up includes removal of any contaminated material, equipment or debris including polyethylene sheeting from the control area. The polyethylene sheeting shall be sprayed or misted with water for dust control, construction debris removed and polyethylene sheeting wet wiped. Then the sheeting shall be removed by folding it in upon itself.

    a. Lead-contaminated debris shall be containerized in accordance with the Contractor's LBP/LCP Safe Work Practice Compliance Plan Waste bags shall not be overloaded and shall be securely sealed and stored in the designated area.
    b. Removal of surface polyethylene sheeting shall begin from top to bottom. Removal of floor polyethylene sheeting shall begin at the corners and folded in the middle to contain the dust. Polyethylene shall be disposed of as per the Contractor's LBP/LCP Safe Work Practice Compliance Plan Cleaning Equipment. The Contractor shall decontaminate the lead abatement equipment and equipment used in the control area. The wastewater from cleaning shall be contained, sampled and disposed of as specified within Section 2.01 E. 6. and 2.02 B. 7 *and as per* contractor's LBP/LCP Safe Work Practice Compliance Plan.

B. Certification

1. The Contractor's Competent Person shall certify and sign within the log that the respiratory protection for the employees was adequate, the work procedures were performed in accordance with 29 CFR Part 1926.62 and that there were no visible accumulations of LBP/LCP paint/coating or dust on the worksite. Do not remove warning signs at the lead control area or roped-off boundary signs prior to the completion of the Competent Person's signed certification. If applicable, the Contractor's Competent Person's certification shall be forwarded to the Project Manager and the Third Party Environmental Consultant's for review prior to removing warning signs at the lead control area or roped-off boundary signs.

C. Waste Storage and Disposal (Provided by the Contractor) and Sampling/Analysis (Provided by Third Party Environmental Consultant).

PART 3 - NOT USED

END OF SECTION 028310

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Appendix A: LBP and LCP Survey Report Documentation Summary:

For Details, refer to the Environmental Survey Report Included as Part of this Project Manual.

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SECTION 028600 - IDENTIFICATION AND DISPOSAL OF HAZARDOUS WASTE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

A. This specification covers the identification and disposal of hazardous waste, and related hazardous materials associated with the Influent Pumping System Improvements Project located at the Cedar Creek Water Pollution Control Plant, 3340 Merrick Road, Wantagh, NY 11783.

1. The work shall include but not be limited to the removal of the following.

Building	Description of Material	Approximate Quantity (units)
Cedar Creek Water Pollution Control Plant	Assumed PCB Containing Light Ballasts	40 Ballasts
Total Quantity		40 Ballasts

2. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.
3. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply.
4. Working hours shall be as required and approved by the Owner. Removal activities including, but not limited to, work area preparation, gross removal activities, cleaning activities, waste removal, etc. may need to be performed during ‘off-hours’ (including nights and weekends). In addition, multiple mobilizations may be required to perform the work identified in this project. The Contractor shall coordinate and schedule all Work with the facility and Owner’s representative.

1.3 DEFINITIONS

A. Hazardous waste shall be any materials to be disposed that possess at least one of four characteristics (ignitability, corrosivity, reactivity or toxicity) as defined and regulated by the Resource Conservation and Recovery Act (RCRA) and applicable state and federal regulations, or a material specifically identified as hazardous waste by applicable Federal or State lists, in 40 CFR 261 or 6 NYCRR 371, respectively.

A. A Conditionally Exempt/Very Small Quantity Generator (CESQ/VSQG) of hazardous waste shall be a waste handler who generates no more than 100 kilograms per month of listed and/or characteristic hazardous waste, generates no more than 1 kilogram of acute hazardous waste in any calendar month, and stores no more than 1,000 kilograms of listed and/or characteristic hazardous waste or more than 1 kilogram of acutely hazardous waste.

B. A Small Quantity Generator (SQG) of hazardous waste shall be a waste handler who generates no more than 1,000 kilograms per month of listed and/or characteristic hazardous waste, generates no more than 1 kilogram of acute hazardous waste per month, and stores no more than 6,000 kilograms of listed and/or characteristic hazardous waste or more than 1 kilogram of acutely hazardous waste.

C. Large Quantity Generator (LQG) of hazardous waste shall be a waste handler who generates more than 1,000 kilograms per month of listed and/or characteristic hazardous waste, generates more than 1 kilogram of acute hazardous waste per month, or stores more than 6,000 kilograms of hazardous waste or 1 kilogram of acutely hazardous waste.

D. The Owner's Environmental Consultant: The Owner shall provide a third-party environmental consultant to provide pre-work assessments, project monitoring assessments for the construction procedures for the work area, surrounding areas waste sampling, and container storage area, submittal review, and inspection and signoff of all hazardous waste shipments as well as final clearance assessments. The Contractor shall be responsible for the worker protection requirements.

1.4 SUBMITTALS

A. Pre-Work Submittals: Within 7 days prior to the pre-construction conference, the Contractor shall submit an electronic copy of the documents listed below

A. for review, comment and approval prior to the commencement of abatement/removal activities:

1. Training & Certifications

a. Certificate of on-site supervisor for completion of the OSHA 40-hour Health and Safety course for handling hazardous waste and spills, including most recent refresher training.
b. OSHA 8-hour supervisor training for hazardous waste.
c. List of the employees scheduled to perform this work and certificates of workers, for successful completion of the OSHA 40-Hour Health and Safety Course for Hazardous Waste and spills, including most recent refresher training.
d. Valid United States Department of Transportation (DOT) training for supervisor and all employees loading waste and maintaining on-site waste storage area. This training shall include: general awareness / familiarization training; function specific training; safety training; security awareness training; and in-depth security training.
e. Annual hazardous waste RCRA training sign-in sheets for all employees and supervisors working on the project. This training may be either 2 hours, 4 hours or 8 hours.
f. If applicable, Lead Paint certification for each of the employees and supervisors as per EPA.

g. Employees managing Hazardous Waste must also meet the Personnel training requirements in section 6 NYCRR 373-3.2. Provide proof of training for these employees.

2. Transportation & Disposal

a. Valid Hazardous Waste Transporter NYS Part 364 permit for all transporters.
b. Valid Hazardous Waste Transport vehicle permit for all transporters for each state the waste is being transported through to reach the Treatment, Storage and Disposal Facility (TSDF).
b. Valid DOT vehicle permit for Transporters.
c. Transfer Facility Permit (if used) including the name, address and EPA ID No. of the facility, contact person, and acknowledgement letter stating that the facility has the capacity and is permitted to accept the waste from the project site.
d. Final Disposal Facility permit including the name, address and EPA ID No. of the facility, contact person, and acknowledgement letter stating that the facility has the capacity and is permitted to accept the waste from the project site.
e. The TSDF permit(s) must identify the waste material(s) to be received.
f. Draft Land Disposal Restriction (LDR) form.
g. Draft Waste Profile.

3. Site-specific

a. Safety Data Sheet (SDS) for all materials to be removed.
b. If the Contractor introduces any chemical into the work environment, a SDS for each chemical must be presented to the Owner's Representative prior to use.
c. Progress Schedule:

1) Show the complete sequencing of removal activities and the sequencing of Work within each building, wing or section of building.
2) Show the dates for the beginning and completion of each major element of Work including substantial completion dates for each Work Area, building or phase.

d. Project Plan: Provide a description of the methods, procedures and materials to be used in performing the work and handling all hazardous wastes. Also provide a schedule identifying specific work areas and duration. The schedules will be utilized to schedule facility and third-party environmental consultant requirements. Provide plans that indicate the following:

1) Include a sketch showing the location, size, and details of each hazardous waste work area, as well as location and details of the decontamination facilities. All Work Areas/containments shall be numbered sequentially.
2) Waste transport routes to the waste storage container and/or container storage area (CSA).
2) Type of removal activity/technique for each Work Area/containment.
3) The job specific plan for worker protection issues regarding personal protective equipment, the work procedures, and exposure assessment procedures.
4) Collected wastewater disposal/treatment plan.
5) Waste disposal plan (hazardous and non-hazardous waste).

6) Include in the plan, eating, drinking, and sanitary procedures, interface of trades and sequencing of hazardous waste generation.
7) Include site preparation and cleanup procedures.
8) Include plan for hazardous waste segregation and minimization.
9) Include occupational and environmental sampling (if any by the Contractor), frequency and duration of sampling.
10) Proposed location and construction of storage facilities and field office.

e. Health and Safety Plan and Facility Contingency Plan revision information for material handling and emergency procedures.

1) CSA location details.
1) Contractor waste generation details (amount per day, per week or per quarter) in kgs or tons.
2) Waste types being generated.
3) Waste storage details (drums, containers, or dumpsters, types, with cover?).
4) Waste containment details. How is the waste being stored? (indoors or outdoors, is it being contained to prevent impact to adjoining spaces or environment?).
5) Contractor emergency evacuation plan requirements and evacuation route for the project specific areas.
6) Duration of waste generation and contract.
7) Contractor and Project team emergency contact numbers.

4. Do not start work until submittals are returned with the Owner's Representative stamp indicating that the submittal is approved for unrestricted use.

B. On-Site & During Construction:

1. The following submittals, documentation, and postings shall be maintained on-site by the Contractor during abatement activities at a location approved by the Environmental Consultant:

a. Approved pre-work submittals.
b. Project Documents (specifications and drawings).
c. Applicable regulations.
d. Updated licenses/permits and acknowledgement letters for any changes in transporter or disposal site.
e. For each employee, current annual medical respiratory clearance.
f. For each employee, current satisfactory respiratory fit test results.
g. Coordinate with facility for a 30-minute training on the facility contingency plan requirements and contractors emergency action plan. Submit proof of contingency plan training.
h. Contractor shall provide weekly update, including initial container storage dates for each container stored, an approximate estimate of amount of waste being generated during each work-day, week or month that it is stored on-site. The actual weight of the waste, excluding the weight of the dumpster, shall be identified.
i. Toxicity Characteristic Leaching Procedure (TCLP) waste sample results. Contractor shall notify the owners representative and Environmental Consultant for waste stream sampling prior to any waste being removed from the site.

j. Completed Waste Profile form(s). Contractor shall utilize analytical test results from the survey report and / or TCLP results provided by Environmental Consultant, as appropriate, to generate waste profile and LDR form.
k. Completed LDR form.
l. List of emergency phone numbers.
m. Waste disposal log.
n. Daily Project Log.
o. Copy of Waste manifest for each load of waste that is removed from site.
p. Copy of completed hazardous waste manifest including legible transporter and disposal facility information, dates and times of waste shipment departures / arrivals, and signatures, for each load of waste, within 35 days of waste being removed from site.

2. The following documentation shall be maintained on-site by the Environmental Consultant during abatement activities:

a. Valid Environmental Consultant personnel OSHA, RCRA, and DOT training certifications.
b. Proof of current Facility Contingency Plan Training.
c. Consultant Daily Log.
d. Listing of all visual inspections with the date of inspection and the date of signoff on the supervisor's log.
e. Hazardous Materials Survey Report.
f. All TCLP waste sample laboratory results including completed chain of custody forms and valid laboratory NYS DOH ELAP certifications.
g. CSA Inspections – Initial Inspection and Weekly Inspections Thereafter.
h. All applicable waste documentation, including but not limited to Universal Hazardous Waste Manifests, waste profiles, LDR forms, and disposal facility letter(s).

C. Close-out:

1. Within 30 days after project completion, the Contractor shall submit one electronic copy of the closeout-out submittal (requirements listed below) for review and approval prior to the Contractor's final payment.

a. Fully Executed Copies of all completed hazardous waste disposal manifests, Original hazardous waste manifests shall be sent to the Owner or disposal facility state, as applicable. Original WSRs, if applicable, shall be sent to the Contractor
b. Daily progress log.
c. Entry/Exit Logs. Decontamination unit entry/exit log for Hazardous Waste generation work areas (must be separate from any documentation associated with Asbestos removals, unless the material is both Hazardous and ACM).
d. If TSDF transfer facility is utilized, completed hazardous waste manifest from final destination must also be provided. Final destination of waste must be within the United States.

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1.5 PRE-CONSTRUCTION CONFERENCE

A. Prior to start of preparatory Work under this Contract, the Contractor shall attend a pre-construction conference attended by Owner, Facility Personnel, and Environmental Consultant.

A. Agenda for this conference shall include but not necessarily be limited to:

1. Contractor's scope of Work, Work plan, and schedule to include number of workers and shift days and times.
2. Contractor's safety and health precautions including protective clothing and equipment and decontamination procedures.
3. Environmental Consultant's duties, functions, and authority.
4. Contractor's Work procedures including:

    a. Methods of job site preparation and removal methods.
    b. Respiratory protection.
    c. Disposal procedures.
    d. Cleanup procedures.
    e. Fire exits and emergency procedures.

5. Contractor’s required pre-work and on-site submittals, documentation, and postings.
6. Contractor's plan for 24-hour Project security both for prevention of theft and for barring entry of unauthorized personnel into Work Areas.
7. Temporary utilities.
8. Handling of furniture and other movable objects.
9. Storage of Hazardous waste in CSA.
10. Waste disposal requirements and procedures, including Contractor notification to project management and Environmental Consultant for TCLP waste stream sampling, once waste stream generation has commenced, and prior to any waste being removed from site.
11. If applicable, contingency plan training information.

B. In conjunction with the conference the Contractor shall accompany the Owner and Environmental Consultant on a pre-construction walk-through documenting existing condition of finishes and furnishings, reviewing overall Work plan, location of CSA, location of fire exits, fire protection equipment, water supply and temporary electric tie-in.

1.6 APPLICABLE STANDARDS AND REGULATIONS

A. All activities related to the work shall be conducted in compliance with all applicable laws, regulations, and requirements which may include, but not be limited to: EPA, DOT, RCRA, TSCA, OSHA, New York State Department of Environmental Conservation (NYS DEC), New York City Department of Environmental Protection (NYC DEP), and New York City Fire Department.

A. The Contractor is required to secure and maintain all required regulatory permits necessary to perform all aspects of the work.

B. The Contractor shall containerize and store waste in accordance with all applicable regulations. All containers are to be appropriately marked/labeled.

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1.7 PROJECT SUPERVISOR

A. The Contractor shall designate a full-time Project Supervisor who shall meet the following qualifications:

1. The Project Supervisor shall be trained in hazardous waste removal/generation procedures and hazardous waste management in NYS, via a 40-hour HAZWOPER and 8-hour Supervisor training course, as well as appropriate RCRA and DOT training.
2. The Project Supervisor shall have a minimum of one year experience as a supervisor.
3. The Project Supervisor must be able to read and write English fluently, as well as communicate in the primary language of the Workers.

B. If the Project Supervisor is not on-site at any time whatsoever, all Work shall be stopped. The Project Supervisor shall remain on-site until the Project is complete. The Project Supervisor cannot be removed from the Project without the written consent of the Owner and the Environmental Consultant. The Project Supervisor shall be removed from the Project if so requested by the Owner.

C. The Project Supervisor shall maintain a bound Daily Project Log that includes the Waste Disposal Log required by section 4.03 of this specification.

D. The Project Supervisor shall be responsible for the performance of the Work and shall represent the Contractor in all respects at the Project site. The Supervisor shall be the Contractor primary point of contact for the Environmental Consultant.

E. As required by applicable regulations, prior to assignment to hazardous waste work, instruct each employee with regard to the hazards of the generated waste, safety and health precautions, and the use and requirements of protective clothing and equipment, as well as the facility contingency plan and/or Contractor emergency action plan.

PART 2 - PRODUCTS

2.1 PROTECTIVE CLOTHING

A. Provide personnel utilized during the Project with disposable protective whole body clothing, head coverings, and foot coverings. Provide appropriate disposable gloves (i.e. neoprene or butyl gloves for handling PCBs), suitable to prevent hazardous waste skin contact, to protect hands.

A. Provide sufficient quantities of protective clothing to assure a minimum of four (4) complete disposable outfits per day for each individual performing abatement Work.

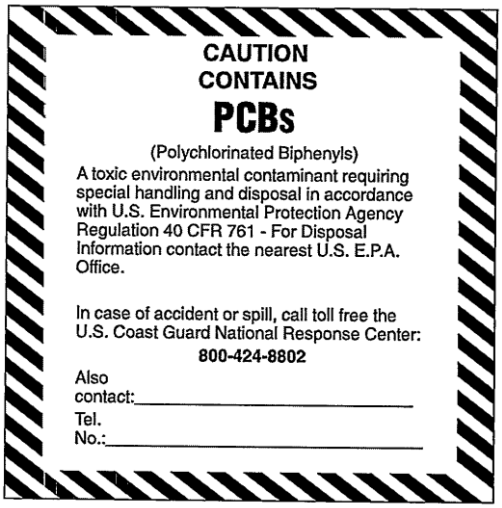
B. Eye protection and hard hats shall be provided and made available for all personnel entering any Work Area.

C. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the Work Area.

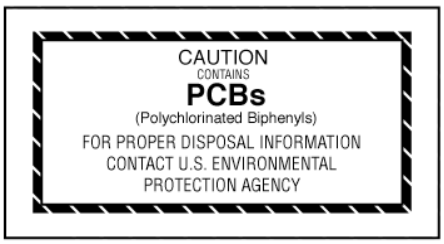
2.2 SIGNS AND LABELS, CONTAINERS

A. Provide warning signs and barrier tapes at all approaches to Hazardous Waste generation Work Areas. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the area.

A. For PCB Hazardous Waste, provide the appropriate “Large PCB Mark” or “Small PCB Mark” (M_L or M_S per 40 CFR 761) as shown below, of sufficient size to be clearly legible, for display on waste containers (bags, boxes, rolloffs or drums) which will be used to contain or transport PCB contaminated material, in accordance with 40 CFR 761. In addition, U.S. Department of Transportation (DOT) 49 CFR Parts 171 and 172 requires the name and UN number of the material to be on the bags or drums, and, if shipped in bulk (rolloffs, Gaylord boxes, etc.) the bulk container must also be labeled: Polychlorinated Biphenyl, solid mixture UN 3432.



M_L



M_S

B. The PCB materials are also NYS Hazardous Waste, and must have a label stating the following on each container.

HAZARDOUS WASTE--Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority, or the U.S. Environmental Protection Agency.

Proper DOT Shipping Name_____
Generator's Name, Address, City, State, ZIP and phone_____
Generator's EPA Identification Number, Waste code_____
Accumulation Start Date _____
Manifest Tracking Number _____

C. Provide 6 mil plastic disposal bags with PCB caution labels.

1. The “Small PCB Label” (M_S per 40 CFR 761) may be used as shown above. Bags shall also be labeled with U.S. DOT required markings per 49 CFR 172, Polychlorinated Biphenyl, solid mixture UN 3432.

2. Labeled PCB waste containers or bags shall not be used for non-PCB waste or trash. Any material placed in labeled containers or bags, whether turned inside out or not, shall be handled and disposed of as PCB waste.

2.3 DAILY PROJECT LOG

A. Provide a Daily Project Log. The log shall contain on title page name, address and phone number of Owner; name, address and phone number of Environmental Consultant; name, address and phone number of Abatement Contractor; and emergency numbers including, but not limited to local Fire/Rescue department.

A. All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted.

B. The Project Supervisor shall document all Work performed daily and note all inspections.

2.4 SCAFFOLDING AND LADDERS

A. Provide all scaffolding and/or staging as necessary to accomplish the Work of this Contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. The type, erection and use of all scaffolding and ladders shall comply with all applicable OSHA construction industry standards.

A. Provide scaffolding and ladders as required by the Environmental Consultant for the purposes of performing required inspections.

2.5 SHIPPING CONTAINERS AND PACKAGING

A. Provide packaging in accordance with 49 CFR 173 Packaging Group 9, such as 30 or 55 gallon capacity fiber, plastic, or metal drums, Gaylord Boxes or other Intermediate Bulk Containers (IBCs), or non-siftable bulk containers, capable of being sealed air and water tight if hazardous waste has the potential to damage or puncture disposal bags. Affix hazardous waste caution labels on lids of drums, and opposite sides of drums or bulk containers, as well as the ends of bulk containers. Recovery or salvage drums must be acceptable for disposal of hazardous waste. Prior approval of drums is required. Drums or containers must meet the required OSHA, EPA (40 CFR Parts 260-264 and 300), and DOT Regulations (49 CFR Parts 171-178). Use of damaged containers shall not be allowed.

2.6 EQUIPMENT AND MATERIALS

A. All dry vacuuming performed under this contract shall be performed with HEPA filter equipped industrial vacuums conforming to ANSI Z9.2.

A. Any power tools used to drill, cut into, or otherwise disturb hazardous material shall be manufacturer equipped with HEPA filtered local exhaust ventilation, unless specified otherwise.

B. All polyethylene (plastic) sheeting used on the Project (including but not limited to sheeting used for critical and isolation barriers, fixed objects, walls, floors, ceilings, waste container) shall be at least 6 mil fire retardant sheeting.

C. Absorbent Material: Clay, soil or any commercially available absorbent used for the purpose of absorbing hazardous or potentially hazardous materials.

2.7 RESPIRATORY PROTECTION

A. Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134. Provide respirator training.

A. Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and shall conform to the OSHA requirements in 29 CFR 1910.134.

B. Respirators shall be individually fit-tested to personnel under the direction of an Industrial Hygienist initially and on a yearly basis. Fit-tested respirators shall be permanently marked to identify the individual fitted, and use shall be limited to that individual.

C. A storage area for respirators shall be provided by the Contractor in the clean portion of the decontamination enclosure where they will be kept in a clean environment

D. The Contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the work day. Filters will be removed and discarded during the decontamination process. Filters cannot be reused. Filters must be changed if breathing becomes difficult.

E. Filters used with negative pressure air purifying respirators shall not be used any longer than one eight (8) hour work day.

F. Any authorized visitor, Worker, or supervisor found in the Work Area not wearing the required respiratory protection shall be removed from the Project site and not be permitted to return.

G. The Contractor shall have at least two (2) Powered Air Purifying Respirators stored on site designated for authorized visitors use. Appropriate respirator filters for authorized visitors shall be made available by the Contractor.

PART 3 - EXECUTION

3.1 HAZARDOUS WASTE GENERATION AND ON-SITE STORAGE

A. All waste shall be stored, handled, transported and disposed of in accordance with all federal, state, and local guidelines and regulations. The Contractor shall obtain all permits, licenses, etc., which are necessary for the storing, transporting and disposing of hazardous waste. The Contractor shall develop all applicable manifests, Waste Profile Sheets, LDR Forms and any other documentation and coordinate with the Owner regarding proper signatures.

A. All hazardous waste generated shall be placed into 6 mil plastic disposal bags or other suitable container upon detachment from the substrate. Large components with residue shall be wrapped in one layer of 6 mil plastic sheeting. Sharp components likely to tear disposal bags shall be placed in fiber drums or boxes and then wrapped with sheeting.

B. All construction and demolition debris determined by the Environmental Consultant to be contaminated with hazardous waste shall be handled and disposed of as hazardous waste.

C. All hazardous waste must be located at or near the point of generation, under the control of the Project Supervisor. Up to 55 gallons may be stored at the point of generation for an indefinite period, but any greater than 55 gallons must be moved within three 3 days to a Container Storage Area (CSA) as specified in 6 NYCRR Section 372.2 "Standards Applicable to Generators of Hazardous Waste", or off-site. Waste may be stored at the CSA for 90 days (large quantity generator) or 180 days (small quantity generator), during which labeling, inspections, and other requirements must be met as described in 6 NYCRR Section 372.2, Section 373-3.1(d) and Subpart 373-3.

D. The Contractor shall identify and classify the hazardous waste generated through the performance of the work as per the governing regulations, and in accordance with the waste stream TCLP results provided by the third-party Environmental Consultant. The Contractor shall utilize the TCLP results to confirm the requirements for handling, storing, transporting and disposing of the hazardous waste.

E. The Third-Party Environmental Consultant shall sample all potential hazardous waste streams for TCLP analyses prior to disposal, in accordance with 40 CFR 261 for hazardous waste. The waste profile, LDR form, and waste transporter permit must be reviewed and approved by the Environmental Consultant prior to any hazardous waste leaving the site. The DOT-trained Environmental Consultant must be on-site for all hazardous waste shipment removals and will be responsible for inspection of the waste shipment as well as signoff on the hazardous waste manifest, on behalf of the owner, to allow the hazardous waste shipment to leave the site.

F. On-site Storage Requirements.

1. Each waste dumpster\container shall have completed hazardous waste label with facility name, correct EPA ID number, full address, waste codes, and waste information.
2. Appropriate hazardous waste storage and contents labels shall also be posted on the containers.
3. Since this is considered a main storage area for the project, third-party Environmental Consultant shall be completing an initial and thence weekly hazardous waste storage area inspection logs. Weekly inspection records shall be maintained for three years.
4. Each dumpster\container shall also post all relevant DOT labels to indicate proper waste types.
5. Each dumpster\container shall identify the accumulation start date. Maximum storage limit is 90 days from the date of accumulation.
6. All dumpsters and containers being stored outside shall meet EPA RCRA container requirements and shall not leak. All dumpsters and containers must be fully covered and protected from the elements as well as secured by lock when not in use.
7. Spill kit shall be maintained in the CSA.
8. Regarding the posting of emergency numbers, Contractor shall coordinate with facility to post all required emergency numbers. Sign shall be posted in the lockable CSA.

G. The CSA and personnel managing it must also meet the following requirements of 6 NYCRR 373:

1. Preparedness and Prevention provisions of Section 373-3.3
2. Secondary containment requirements of 373-2.9(f)(1)
3. Personnel training in section 373-3.2
4. Contingency plans and emergency procedures in section 373-3.4 subparagraph 376.1(g)(1)(v)
5. The containers must be dated when placed in storage, and accumulation times must be observed.
6. The total amount of hazardous waste stored in the CSA at any given time must not exceed the maximum for the current generator status(6,000kg-SQG, no limit-LQG).
7. A label or sign stating "Hazardous Waste" must identify all areas and containers used to accumulate hazardous waste.

I. Closure of the CSA. If a CSA was created specifically for the Hazardous waste generation work, once the work is complete, the Contractor shall immediately close out the CSA, as per 373-3.7(b) and (e).

H. The Contractor is required to provide temporary protection of the building (i.e. roof, window openings, construction joints, etc.) as applicable for the work, at the end of each Work shift so as to maintain the building in a watertight condition. Any damage to the facility caused by inadequate Contractor protection shall be the responsibility of the contractor.

3.2 DISPOSAL OF HAZARDOUS WASTE

A. Transportation And Disposal Site

1. The Contractor's Hauler and Disposal Facility shall be approved by the Owner. Prior to the hazardous waste being removed from the site, written notice must be provided and confirmation received from the intended disposal facility, indicating proper authority to receive the hazardous waste, as well as the ultimate disposal method for the waste. The notice shall be acknowledged in writing via a disposal facility representative’s signature, printed name and title, as well as phone number, in compliance with 6 NYCRR 372.2(b)(2). For disposal within New York State, facilities must be specifically permitted to accept hazardous waste. In addition, The Contractor is responsible for securing appropriate treatment or disposal for the generated hazardous waste streams at a permitted TSDF, if necessary, in compliance with all regulatory requirements, and for obtaining a copy of the waste manifest and waste profile of the treated waste as executed by the TSDF. If the manifest is not returned within 35 calendar days from removal from the site, the contractor shall notify the Owner and the NYS DEC, and initiate an investigation as required.
2. The Contractor shall give at least 24-hour notification prior to removing any waste from the site. Waste shall be removed from the site only during normal working hours unless otherwise specified. No waste may be taken from the site unless the Contractor and Environmental Consultant are present, and the Environmental Consultant authorizes the release of the waste. The DOT-trained Environmental Consultant must be on-site for all hazardous waste shipment removals and will be responsible for inspection of the waste shipment as well as signoff on the hazardous waste manifest on behalf of the owner to allow the hazardous waste shipment to leave the site.

3. The Contractor shall supply all required placard and labeling and shall have an appropriately DOT - trained individual to prepare the waste container and inspect the packaging of the hazardous waste.
4. All hazardous waste generated as part of the project shall be removed from the site within ten (10) calendar days after successful completion of all hazardous waste generation work. However, all disposal facility permits/licenses, waste profiles, LDR forms, hauler permit(s), and all other necessary paperwork must be submitted and approved by the Environmental Consultant before the waste is removed from the site. Waste stream samples shall be collected by the Environmental Consultant for TCLP analysis and the results utilized by the Contractor for waste stream characterization and disposal determination.
5. Upon arrival at the Project Site, the Hauler must possess and present to the Environmental Consultant a valid DEC Part 364 Waste Hauler's Permit. The Environmental Consultant may verify the authenticity of the hauler's permit with the proper authority.
6. The Hauler, with the Contractor and the Environmental Consultant, shall inspect all material in the transport container prior to taking possession and signing the Hazardous Waste Manifests.
7. Transporters shall maintain waste manifest and shipment record forms. All transporters are required to obtain and maintain NYS DEC Part 364 Waste Transporter permits and, if applicable, a NYC Fire Department permit for transporting flammables. The Part 364 Permit shall have the license plate number of the vehicle, the expiration date of the permit, the type of waste the hauler can transport and the TSDF to which the hauler can transport the waste. The transporter must also have all applicable, current waste transportation permits for the states where the proposed disposal facilities are located.

B. Waste Shipment Storage Containers

1. All waste shipment storage containers shall be fully enclosed and lockable (i.e. enclosed dumpster, trailer, etc.).
2. The Environmental Consultant shall verify that the waste shipment storage container and/or truck tags (license plates) match that listed on the DEC Part 364 permit. Any waste shipment storage container not listed on the permit shall be removed from the site immediately prior to storage of any material from the site.
3. The waste shipment storage container shall be plasticized and sealed with one layer of 6 mil plastic. Once on-site, it shall be kept locked at all times, except during load out. The waste shipment storage container shall not be used for storage of equipment or contractor supplies.
4. While on-site, the waste shipment storage container shall be labeled with DEC Hazardous Waste Warning Labels as specified in Section 2.02.
5. The DEC Waste Hauler's Permit number shall be stenciled on both sides and back of the waste shipment storage container.
6. The waste shipment storage container is not permitted to be loaded unless it is properly plasticized, has the appropriate danger signage affixed, and has the permit number appropriately stenciled on the container.
7. The Owner may initiate random checks at the Disposal Site to ensure that the procedures outlined herein are complied with.

C. Hazardous Waste Manifests & Disposal Documentation

1. The Contractor is responsible for securing appropriate treatment or disposal for the waste streams at a permitted TSDF, in compliance with all requirements, and for obtaining a copy of the waste manifest (interim storage and final disposal) as executed by the TSDF. If the manifest is not returned within 35 calendar days from removal from the site, the Contractor shall notify the Owner and the NYS DEC, and initiate an investigation as required. The Contractor shall contact the EPA and file an Exception report if the manifest is not returned within 45 days.
2. A Uniform Hazardous Waste Manifest shall be utilized solely as the waste Manifest for transportation. A hauler billing form or bill of lading may be used if the hauler needs an independent record, but shall not be used as a shipping document.
3. The Manifest, if applicable, shall be completed by the Contractor and verified by the Environmental Consultant that all the information and amounts are accurate and the proper signatures are in place.
4. The Manifest, if applicable, shall have the appropriate signatures of the Owner's Representative (the Generator) and the Hauler representative prior to any waste being removed from the site.
5. Copies of the completed Manifest, if applicable, shall be retained by the Environmental Consultant and shall remain on-site for inspection.
6. Upon arrival at the Disposal Site, the Manifest, if applicable, shall be signed by the Disposal Facility operator to certify receipt of hazardous and asbestos wastes covered by the manifest, respectively.
7. The Disposal Facility operator shall return the original Manifest to the Owner's Representative or the disposal facility state as required by the DEC in 6 NYCRR 372 within 35 days. The Environmental Consultant must call the facility to investigate if the Manifest is not returned within 35 days and contact the DEC and file an Exception report if not returned within 45 days.
8. Copies of all waste disposal manifests as well as originals shall be submitted by the Contractor to the Owner with the final close-out documentation.
9. The Contractor must also submit reports and records per the requirements of 6 NYCRR 372.2.
10. Payment for disposal of hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of hazardous waste delivered is returned for each load of waste removed from the site.
11. Unless directed otherwise, the Contractor shall file the annual report and fee report, if applicable, for the hazardous waste shipped, and provide closure notification to EPA and DEC.

END OF SECTION 028600

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APPENDIX A

SAMPLE BLANK PCB LDR FORM

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NEW YORK STATE GENERATOR RESTRICTED WASTE NOTIFICATION/CERTIFICATION FOR PCB WASTES

ALL NEW YORK STATE GENERATORS WHO GENERATE PCB WASTES MUST ATTACH THIS ADDENDUM TO THE UNIFORM HAZARDOUS WASTE MANIFEST
(THIS NOTIFICATION/CERTIFICATION IS ONLY APPLICABLE WITHIN THE STATE OF NEW YORK)

GENERATOR NAME: EPA ID NO.:

SIGNATURE: DATED:

MANIFEST NO:

This addendum to the uniform hazardous waste manifest must be completed for any New York State regulated hazardous waste generated in the State of New York. This form ensures that New York State generators comply with the notification requirements of 6 NYCCR Part 376. All New York State generators shipping PCB waste which is a New York State regulated hazardous waste must check the box and indicate the applicable waste code below.

☐ Check Here: The waste associated with the above manifest includes New York State Regulated PCB waste which is land restricted in the State of New York and is subject to 6 NYCRR Part 376.4(f). This waste shall be disposed of in accordance with 40 CFR 761. Pursuant to 376.4(f) (l) (i), B002 waste from any source other than a spill may not be stabilized or mixed with any other substance to conform with any provision of 40 CFR Part 761 regarding land disposal if the disposal occurs in the state of New York.

Check all which apply:

☐ B001 - PCB oil (concentrated) from transformers, capacitors, etc.

☐ B002 - Petroleum oil or other liquid containing 50 ppm or greater of PCBs, but less than 500 ppm PCBs.

☐ B003 - Petroleum oil or other liquid containing 500 ppm or greater of PCBs.

☐ B004 - PCB articles containing 50 ppm or greater of PCBs, but less than 500 ppm PCBs, excluding small capacitors.

☐ B005 - PCB articles, other than transformers, that contain 500 ppm or greater of PCBs, excluding small capacitors.

☐ B006* - PCB transformers. *PCB transformers* means any transformer that contains 500 ppm PCB or greater.

☐ B007* - Other PCB wastes, including contaminated soil, solids, sludges, clothing, rags and dredge material.

* Generators are required to certify that their B006 and/or B007 waste can be land disposed in accordance with 40 CFR Part 761 without further treatment if:

a. The waste is a B006 and is a transformer which has been drained and flushed pursuant to 40CFR761.60(b)(l)(i)(B) or

b. The waste is a B007 and does not contain PCBs which have been deliberately solicited.

☐ Check here if the B006 and/or B007 waste associated with this manifest conforms with either “a” or “b” and is intended for land disposal and sign this form at the top of the page. In accordance with 6 NYCRR Part 376.1 (g) (l)(ii) the generator makes the following certification:

“I certify under penalty of law that I personally have examined and am familiar with the waste, through analysis and testing or through knowledge of the waste, to support this certification that the waste complies with the treatment standards specified in part 376, section 376.4 and all applicable prohibitions set forth in subdivision 376.3(b) of Part 376 or RCRA section 3..04(d). I believe that the information I submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting a false certification, including the possibility of a find and imprisonment. “

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SECTION 028700 - REMOVAL AND DISPOSAL OF UNIVERSAL WASTE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. This specification covers the removal and disposal of Universal Waste, including lamps such as fluorescent and high-intensity discharge (HID) lamps, mercury-containing equipment (MCE) such as thermostats and switches, batteries, and pesticides (not PCB lighting ballasts) associated with the Influent Pumping System Improvements Project located at the Cedar Creek Water Pollution Control Plant, 3340 Merrick Road, Wantagh, NY 11783.

B. Universal Wastes are regulated by the United States Environmental Protection Agency (EPA) under 40 CFR Part 273 and by New York State Department of Environmental Conservation (NYS DEC) under 6 NYCRR (New York Codes, Rules and Regulations) Part 374-3. The EPA regulation identifies Universal Waste that includes MCE and aerosol cans whereas the NYS DEC regulation addresses mercury thermostats only and does not include aerosol cans. Universal Waste was expanded to include MCE by NYS DEC's Commissioner Policy CP-39, "Mercury-Containing Equipment" promulgated May 8, 2006. This CP-39 was issued to align with EPA's inclusion of MCE. MCE shall be recycled as per current regulations, instead of disposed as Universal Waste. NYS DEC did not include aerosol cans as Universal Waste; therefore, aerosol cans are to be disposed of as hazardous waste. Demolition and removal of materials shall be as required to support the work.

C. The work shall include but not be limited to the removal of the following:

Building & Floor	Description of Material	Approximate Quantity (lbs/units)
Cedar Creek Water Pollution Control Plant	4' Fluorescent Light Tubes	80 Bulbs
Total Quantity		80 Bulbs

D. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.

E. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply.

F. Working hours shall be as required and approved by the Owner. Removal activities including, but not limited to, work area preparation, gross removal activities, cleaning activities, waste

removal, etc. may need to be performed during 'off-hours' (including nights and weekends). In addition, multiple mobilizations may be required to perform the work identified in this project. The Contractor shall coordinate and schedule all Work with the facility and Owner's representative.

1.3 SUBMITTALS

A. Pre-Work Submittals: Within seven (7) days prior to the pre-construction conference, the Contractor shall submit an electronic copy of the documents listed below for review and approval prior to the commencement of activities:

1. Training & Certifications

   a. Certificate of on-site supervisor for completion of the OSHA 40-hour Health and Safety course for handling hazardous waste and spills, including most recent refresher training.
   a. OSHA 8-hour supervisor training for hazardous waste.
   b. List of the employees scheduled to perform this work and certificates of workers, for successful completion of the OSHA 40-Hour Health and Safety Course for Hazardous Waste and spills, including most recent refresher training.
   c. Valid United States Department of Transportation (DOT) training for supervisor and all employees loading waste and maintaining on-site waste storage area. This training shall include: general awareness / familiarization training; function specific training; safety training; security awareness training; and in-depth security training.
   d. Employees managing Universal Waste must also meet the Personnel training requirements of EPA 40 CFR Section 273.36. Provide proof of training for these employees.

2. Transportation & Disposal

   a. Valid Universal Waste Transporter NYS Part 364 permit for all transporters.
   b. Valid Universal Waste Transport vehicle permit for all transporters for each state the waste is being transported through to reach the Treatment, Storage and Disposal Facility (TSDF).
   c. Valid DOT vehicle permit for Transporters.
   d. Transfer Facility Permit (if used) including the name, address and EPA ID No. of the facility, contact person, and acknowledgement letter stating that the facility has the capacity and is permitted to accept the waste from the project site.
   e. Final Disposal Facility permit including the name, address and EPA ID No. of the facility, contact person, and acknowledgement letter stating that the facility has the capacity and is permitted to accept the waste from the project site.
   f. The TSDF permit(s) must identify the waste material(s) to be received.
   g. Draft Waste Profile.

3. Site-specific

   a. Safety Data Sheet (SDS) for all materials to be removed.

b. If the Contractor introduces any chemical into the work environment, a SDS for each chemical must be presented to the Owner's Representative for review and approval prior to use.

c. Progress Schedule:

1) Show the complete sequencing of removal activities and the sequencing of Work within each building, wing or section of building.
2) Show the dates for the beginning and completion of each major element of Work including substantial completion dates for each Work Area, building or phase.

d. Project Plan: Provide a description of the methods, procedures and materials to be used in performing the work and handling all universal wastes. Also provide a schedule identifying specific work areas and duration. The schedules will be utilized to schedule facility and third-party environmental consultant requirements. Provide plans that indicate the following:

1) Include a sketch showing the location, size, and details of each universal waste generation work area, as well as location and details of the decontamination facilities. All Work Areas/containments shall be numbered sequentially.
2) Waste transport routes to the waste storage container and/or container storage area (CSA).
3) Type of removal activity/technique for each Work Area/containment.
4) The job specific plan for worker protection issues regarding personal protective equipment, the work procedures, and exposure assessment procedures.
5) Waste disposal plan (universal and non-hazardous waste).
6) Include in the plan, eating, drinking, and sanitary procedures, interface of trades and sequencing of universal waste generation.
7) Include site preparation and cleanup procedures.
8) Include plan for universal waste segregation and minimization.
9) Include occupational and environmental sampling (if any by the Contractor), frequency and duration of sampling.
10) Proposed location and construction of storage facilities and field office.

e. Health and Safety Plan information for material handling and emergency procedures.

1) CSA location details.
1) Contractor waste generation details (amount per day, per week or per quarter) in kgs or tons.
2) Waste types being generated.
3) Waste storage details (drums, containers, or dumpsters, types, with cover?).
4) Waste containment details. How is the waste being stored? (indoors or outdoors, is it being contained to prevent impact to adjoining spaces or environment?) Appropriate fire extinguisher(s) and spill kit included?.
5) Contractor emergency evacuation plan requirements and evacuation route for the project specific areas.
6) Duration of waste generation and contract.
7) Contractor and Project team emergency contact numbers.

B. On-Site & During Construction:

1. The following submittals, documentation, and postings shall be maintained on-site by the Contractor during abatement activities at a location approved by the Environmental Consultant:

a. Approved pre-work submittals.
b. Project Documents (specifications and drawings).
c. Applicable regulations.
d. Updated licenses/permits and acknowledgement letters for any changes in transporter or disposal site.
e. For each employee, current annual medical respiratory clearance.
f. For each employee, current satisfactory respiratory fit test results.
g. Contractor shall provide weekly update, including initial container storage dates for each container stored, an approximate estimate of amount of waste being generated during each work-day, week or month that it is stored on-site. The actual weight of the waste, excluding the weight of the dumpster, shall be identified.
h. Completed Waste Profile form(s).
i. List of emergency phone numbers.
j. Waste disposal log.
k. Daily Project Log.
l. Copy of Waste manifest/shipment record for each load of waste that is removed from site.
m. Copy of completed universal waste manifest/shipment record including legible transporter and disposal facility information, dates and times of waste shipment departures / arrivals, and signatures, for each load of waste, within 35 days of waste being removed from site.

2. The following documentation shall be maintained on-site by the Environmental Consultant during abatement activities:

a. Valid Environmental Consultant personnel OSHA, RCRA, and DOT training certifications.
b. Consultant Daily Log.
c. Listing of all visual inspections with the date of inspection and the date of signoff on the supervisor’s log.
d. Environmental Survey Report.
e. All applicable waste documentation, including but not limited to Universal Waste Manifest/shipment records, waste profiles, and disposal facility letter(s).

1.4 DEFINITIONS

A. Large Quantity Handler (LQH) of Universal Waste shall be a waste handler who accumulates 5,000 kilograms or more of Universal Waste at any time. This designation as a large quantity handler of Universal Waste is retained through the end of the calendar year in which 5,000 kilograms (11,000 pounds) or more total of Universal Waste is accumulated. The LQH shall notify the EPA, acquire or coordinate with a facility regarding an EPA identification number, and provide records for each shipment. The LQH shall ensure all employees are thoroughly

familiar with proper waste handling and emergency procedures, relative to their responsibilities during normal facility operations and emergencies.

B. Small Quantity Handler of Universal Waste (SQH) shall be a waste handler who does not accumulate 5,000 kilograms (11,000 pounds) or more of total Universal Waste (batteries, pesticides, MCE, or lamps, calculated collectively) at any time.

C. Destination Facility shall be a facility that can legally accept Universal Waste from off-site so that the Universal Waste can be treated, disposed, or recycled in accordance with regulatory requirements.

D. Universal Waste Transporter shall be anyone who transports Universal Waste. In New York, Universal Waste Transporters that transport greater than 500 pounds of Universal Waste in a single shipment must be a permitted Universal Waste Transporter pursuant to Federal and State regulations. Proper notification with the receiving handler agreeing to receive the shipment is required by the Universal Waste Transporter.

E. Universal Waste consists of the following discarded materials, as identified in 40 CFR Part 273 and 6 NYCRR 374-3: Fluorescent light and high-intensity discharge (HID) lamps, mercury thermostats, batteries, and pesticides. CP-39 expanded thermostats to MCE as discussed in section 1.01 above. Removed or replaced MCE must be delivered to a designated mercury collection site as per current NYC DEC regulations. Disposal of MCE in a solid waste management facility is prohibited. PCB ballasts/capacitors from light fixtures shall not be treated as Universal Waste; they shall be handled and disposed of as hazardous waste. See the Hazardous Waste Disposal Specification for these wastes.

1.5 PROJECT SUPERVISOR

A. The Contractor shall designate a full-time Project Supervisor who shall meet the following qualifications:

1. The Project Supervisor shall be trained in hazardous waste removal/generation procedures and hazardous waste management in NYS, via a 40-hour HAZWOPER and 8-hour Supervisor training course, as well as appropriate RCRA and DOT training.
2. The Project Supervisor shall have a minimum of one year experience as a supervisor.
3. The Project Supervisor must be able to read and write English fluently, as well as communicate in the primary language of the Workers.

B. If the Project Supervisor is not on-site at any time whatsoever, all Work shall be stopped. The Project Supervisor shall remain on-site until the Project is complete. The Project Supervisor cannot be removed from the Project without the written consent of the Owner and the Environmental Consultant. The Project Supervisor shall be removed from the Project if so requested by the Owner.

C. The Project Supervisor shall maintain a bound Daily Project Log.

D. The Project Supervisor shall be responsible for the performance of the Work and shall represent the Contractor in all respects at the Project site. The Supervisor shall be the Contractor primary point of contact for the Environmental Consultant.

E. As required by applicable regulations, prior to assignment to universal waste work, instruct each employee with regard to the hazards of the generated waste, safety and health precautions, and the use and requirements of protective clothing and equipment, as well as the Contractor emergency action plan.

PART 2 - PRODUCTS

2.1 PROTECTIVE CLOTHING

A. Provide personnel utilized during the Project with disposable protective whole body clothing, head coverings, and foot coverings. Provide appropriate disposable gloves, suitable to prevent skin contact, to protect hands.

B. Provide sufficient quantities of protective clothing to assure a minimum of four (4) complete disposable outfits per day for each individual generating or packaging Universal Waste.

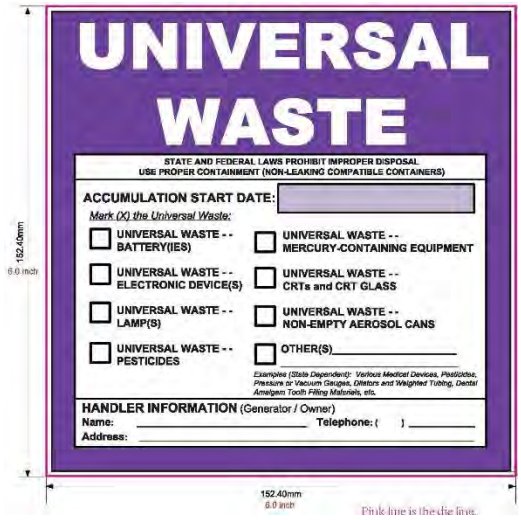
C. Eye protection and hard hats shall be provided and made available for all personnel entering any Work Area.

D. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the Work Area.

2.2 SIGNS AND LABELS, CONTAINERS

A. Provide warning signs and barrier tapes at all approaches to Universal Waste generation Work Areas. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the area.

B. Universal waste containers must be marked with the words that clearly indicate the type of waste in the container, for example, “Universal waste – Batteries” or “Universal waste – Bulbs” as per 40 CFR 273.13 and 273.34;



2.3 DAILY PROJECT LOG

A. Provide a Daily Project Log. The log shall contain the name, address and phone number of Owner; name, address and phone number of Environmental Consultant; name, address and phone number of Abatement Contractor; and emergency numbers including, but not limited to local Fire/Rescue department.

B. All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted.

C. The Project Supervisor shall document all Work performed daily and note all inspections.

2.4 SCAFFOLDING AND LADDERS

A. Provide all scaffolding and/or staging as necessary to accomplish the Work of this Contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. The type, erection and use of all scaffolding and ladders shall comply with all applicable OSHA construction industry standards.

B. Provide scaffolding and ladders as required by the Environmental Consultant for the purposes of performing required inspections.

2.5 SHIPPING CONTAINERS AND PACKAGING

A. Provide packaging in accordance with 49 CFR 173 Packaging Group 9, such as 30 or 55 gallon capacity fiber, plastic, or metal drums, Gaylord Boxes or other Intermediate Bulk Containers (IBCs), or non-siftable bulk containers. Affix universal waste caution labels on lids of drums, and opposite sides of drums or bulk containers, as well as the ends of bulk containers. Recovery or salvage drums must be acceptable for disposal of universal waste. Prior approval of drums is required. Drums or containers must meet the required OSHA, EPA (40 CFR Parts 260-264, 273 and 300), and DOT Regulations (49 CFR Parts 171-180). Use of damaged containers shall not be allowed.

2.6 EQUIPMENT AND MATERIALS

A. All dry vacuuming performed under this contract shall be performed with HEPA filter equipped industrial vacuums conforming to ANSI Z9.2.

B. All polyethylene (plastic) sheeting used on the Project (including but not limited to sheeting used for critical and isolation barriers, fixed objects, walls, floors, ceilings, waste container) shall be at least 6 mil fire retardant sheeting.

C. Absorbent Material: Clay, soil or any commercially available absorbent used for the purpose of absorbing hazardous or potentially hazardous materials.

PART 3 - EXECUTION

3.1 GENERATING UNIVERSAL WASTE

A. Employee training shall ensure that all employees are thoroughly familiar with proper waste handling and emergency procedures, relative to their responsibilities during normal operations and emergencies, as well as to the type of waste they are handling.

B. MCE shall be segregated from other Universal Wastes to allow for required recycling.

C. Battery Labels: The container(s) holding intact batteries shall be labeled or marked as “Universal Waste – Battery(ies)”, “Waste Battery(ies)”, or “Used Battery(ies)”.

D. Lamp Labels: The container(s) holding lamps shall be labeled or marked as “Universal Waste – Lamp(s)”, “Waste Lamp(s)”, or “Used Lamp(s)”.

E. MCE Labels: The container(s) holding MCE shall be labeled or marked as “Universal Waste – Mercury-Containing Equipment”, “Waste - Mercury-Containing Equipment”, or “Used Mercury-Containing Equipment”.

F. Mercury Thermostat Labels: The container(s) holding mercury thermostats only may be labeled or marked as “Universal Waste – Mercury Thermostat(s)”, “Waste Mercury Thermostat(s)”, or “Used Mercury Thermostat(s)”.

G. Pesticide Labels: The container(s) holding pesticides shall be labeled or marked as “Universal Waste – Pesticide(s)” or “Waste Pesticide(s)”.

H. Once the properly labeled containers holding the Universal Waste have been filled and sealed, they shall be stored in designated accumulation areas as agreed upon by the Owner’s Representative and Contractor. They shall not be stored in transportation vehicles, or on-site for more than one year from the date the waste storage was initiated.

I. Documentation when Universal Waste in storage was first accumulated shall be provided. This is to be done by dating and labeling the waste with the date of the earliest accumulation that can document the length of time the Universal Waste has been accumulated.

J. Maintenance of an inventory system on-site that identifies the earliest date that any Universal Waste in a group of Universal Waste items or a group of containers of Universal Waste became a waste was received.

K. Any waste developed from the work that exhibits one or more characteristics of hazardous waste, that are not specifically identified by EPA and NYS DEC as Universal Waste, must be handled accordingly and not as a Universal Waste. See the Hazardous Waste Disposal Specification section 02 86 00 for those wastes types.

3.2 DISPOSAL OF UNIVERSAL WASTE

A. Transportation And Disposal

1. The Contractor's Hauler and Disposal Facility shall be approved by the Owner. The Contractor is responsible for securing appropriate treatment or disposal for the generated universal waste streams at a permitted TSDF, if necessary, in compliance with all regulatory requirements, and for obtaining a copy of the waste manifest/shipping record and waste profile of the treated waste as executed by the TSDF.
2. The Contractor shall give at least 24 hour notification prior to removing any waste from the site. Waste shall be removed from the site only during normal working hours unless otherwise specified. No waste may be taken from the site unless the Contractor and Environmental Consultant are present, and the Environmental Consultant authorizes the release of the waste. The DOT-trained Environmental Consultant must be on-site for all universal waste shipment removals and will be responsible for inspection of the waste shipment.
3. All universal waste generated as part of the project shall be removed from the site within ten (10) calendar days after successful completion of work. However, all disposal facility permits/licenses, waste profiles, hauler permit(s), and all other necessary paperwork must be submitted and approved by the Environmental Consultant before the universal waste is removed from the site. Waste stream samples, if required, shall be collected by the Environmental Consultant for TCLP analysis and the results utilized by the Contractor for waste stream characterization and disposal determination.
4. Upon arrival at the Project Site, the Hauler must possess and present to the Environmental Consultant a valid New York State Department of Environmental Conservation Part 364 Waste Hauler's Permit. The Environmental Consultant may verify the authenticity of the hauler's permit with the proper authority.
5. The Hauler, with the Contractor and the Environmental Consultant, shall inspect all material in the transport container prior to taking possession and signing the Universal Waste Manifest/shipping record.

B. Waste Shipment Storage Containers

1. All waste shipment storage containers shall be fully enclosed and lockable (i.e. enclosed dumpster, trailer, etc.).
2. The Environmental Consultant shall verify that the waste shipment storage container and/or truck tags (license plates) match that listed on the New York State Department of Environmental Conservation Part 364 permit. Any waste shipment storage container not listed on the permit shall be removed from the site immediately prior to storage of any material from the site.
3. Once on-site, it shall be kept locked at all times, except during load out. The waste shipment storage container shall not be used for storage of equipment or contractor supplies.
4. While on-site, the waste shipment storage container shall be labeled with Universal Waste Labels.
5. The waste shipment storage container is not permitted to be loaded unless it is properly plasticized, has the appropriate danger signage affixed.
6. The Owner may initiate random checks at the Disposal Site to ensure that the procedures outlined herein are complied with.

C. Waste Manifest/Shipment Records & Disposal Documentation

1. A Universal Waste Manifest/Shipping Record (UWMSR) shall be utilized solely as the waste record documentation for transportation. A hauler billing form or bill of lading may

be used if the hauler needs an independent record, but shall not be used as a shipping document.

2. The UWMSR, shall be completed by the Contractor and verified by the Environmental Consultant that all the information and amounts are accurate and the proper signatures are in place.
3. The UWMSR, if applicable, shall have the appropriate signatures of the Owner's Representative (the Handler) and the Hauler representative prior to any waste being removed from the site.
4. Copies of the completed UWMSR, shall be retained by the Environmental Consultant and shall remain on-site for inspection.
5. Originals of all UWMSRs and disposal logs (copies are acceptable for electronic closeout submittal review) shall be submitted by the Contractor to the Owner with the final close-out documentation.
6. Payment for disposal of universal waste will not be made until a signed copy of the manifest/shipment record from the treatment or disposal facility certifying the amount of universal waste delivered is returned for each load of waste removed from site, the originals are furnished to the Owner.
7. Off-Site Shipment of Universal Waste

    a. Off-Site shipments shall meet the requirements for off-site shipments and handlers / transporters are prohibited from sending or taking Universal Waste to a place other than a designated Universal Waste handler or a Universal Waste destination facility.
    b. LQHs of Universal Waste must notify EPA in writing and develop an EPA identification number or coordinate with the facility regarding use of their EPA identification number, prior to exceeding 5,000 kilograms of Universal Waste on-site.
    c. SQHs do not need to notify EPA, receive an EPA identification number or keep records of shipments of Universal Waste.
    d. LQHs must keep a record of all Universal Waste shipments received or sent off-site and must retain those records for at least three (3) years from the date of receipt or shipment. Records may include invoices, manifest/shipment records, logs, bills of lading, or other shipping documents.
    e. The Contractor shall provide certified copies of all receipts obtained from designated mercury recycling collection sites within 30 days of MCE acceptance by collection site.
    f. The Contractor shall furnish all certified copies of manifest/shipment records (interim storage and final disposal) within regulatory requirements. Within 30 days from acceptance of the waste by the disposal facility, the Contractor shall provide the Owner with Certificate of Disposal documents, as a requirement for final payment.

END OF SECTION 028700

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SECTION 030100 – MAINTENANCE OF CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all labor, materials, equipment and appliances required for the complete execution of concrete rehabilitation to existing structures as determined by field survey directed by the Engineer and in accordance with the requirements of the Specifications as specified herein.

B. Principal items of work include:

1. The Contractor shall determine by field survey, in conjunction with the Engineer, the extent of concrete to be repaired, stabilized and resurfaced. Areas to be replaced or modified by new work shall not be included. Report of field survey shall be submitted by the Contractor to the Engineer for review and approval prior to starting work.
2. Preparation for repairing, stabilizing and resurfacing exterior and interior cast-in-place concrete floors, walls, ceilings, platforms, steps and the like.

C. Related Sections:

1. Section 030551 “Concrete Bonding Agents”
2. Section 030555 “Concrete Admixtures and Additives”
3. Section 031500 “Concrete Accessories”
4. Section 033100 “Structural Concrete”
5. Section 036000 “Grout”

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 503.4 - Standard Specifications for Repairing Concrete with Epoxy Mortars.

B. ASTM International:

1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
4. ASTM C33 - Standard Specification for Concrete Aggregates.
5. ASTM C109/C109M - Standard Test Method for Compressive strength of Hydraulic Cement Mortars (Using 2-in. or (50 mm) Cube Specimens).
6. ASTM C150 - Standard Specification for Portland Cement.

7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
8. ASTM C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
9. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
10. ASTM C881/C881M – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
11. ASTM C496/C496M - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
12. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
13. ASTM C1042 - Standard Test Method for Bond Strength of Latex Systems Used With Concrete By Slant Shear.
14. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
15. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
16. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

C. American Welding Society:

1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Shop drawings showing proposed methods and corresponding area to be repaired.

C. Samples of all materials proposed to be used.

D. Material certifications and technical data sheets on all grouts, mortars, chemical resins, sealers, aggregates and repair products specified.

E. Name, address and detailed qualifications of firm to which the Contractor intends to award the work under this Section.

1.4 QUALITY ASSURANCE

A. The Contractor shall furnish the name of all subcontractors which he proposes to use for this work including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, polyurethane, polymer-modified and cement-based compounds.

B. Approved applicator qualifications shall include:

1. A minimum five years experience in applying epoxy, polyurethane and polymer-modified and cement-based compounds similar to those specified in this Section.
2. A letter from the manufacturer of the specified materials, on the manufacturer’s letterhead, signed by an officer of the company, stating that the subcontractor/applicator

has been trained in the proper techniques for the preparation of the surface, and proper methods for mixing, placing, curing, and caring of the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

1.5 QUALIFICATIONS

A. A minimum five years experience in applying epoxy, polyurethane and polymer-modified and cement-based compounds similar to those specified in this Section.

B. Design reinforcement splices under direct supervision of Professional Engineer experienced in design of this Work and registered in the State of New York.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.

B. All materials shall be delivered in original unopened and undamaged cartons with packing bearing the name of manufacturer.

C. Cementitious materials shall be stored in waterproof locations to prevent intrusion of moisture and other damage from the elements. Containers showing evidence of damage will be rejected.

D. Aggregates shall be stored in separate bins to prevent mixing with foreign particles.

E. Any materials that have hardened, partially set, become caked and/or been contaminated or deteriorated shall be rejected.

F. Handle materials with care to prevent damage or contamination.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials utilized in the repair of the existing structures shall be suitable for use in a water treatment facility and shall conform to USEPA and USPHS standards for surface contact with public water supplies.

2.2 WATER

A. The water used for mixing concrete repair products shall be clear, potable and free of deleterious substances.

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2.3 AGGREGATE

A. All aggregates shall conform to ASTM C33 and the requirements listed below:

1. Pea Gravel: Pea gravel shall meet the gradation of New York State size #9 and meet all material requirements specified in Section 703 for coarse aggregate as described by the New York State Department of Transportation Standard Specifications and shall be clean and free from deleterious matter. Pea gravel shall contain no limestone.

2.4 EPOXY BONDING AGENT

A. Bonding agents shall be a two (2) component, 100% solids, 100% reactive compound epoxy adhesive suitable for use on dry or damp surfaces.

B. Bonding Agents shall be ASTM C881 and AASHTO 235 compliant and suitable for use under ACI 503.1, ACI 503.2, ACI 503.3 and ACI 503.4.

C. Bonding compounds shall conform to the following properties:

Property	Test	Time	Result
Bond Strength - Plastic Concrete to Hardened Concrete, Moist Cure	ASTM C882	2 days	1,700 psi (min.)
		14 days	2,200 psi (min.)
Compressive Strength	ASTM D695	28 days	11,000 psi (min.)
Tensile Strength	ASTM D638	7 day	6,900 psi (min.)
Water Absorption	ASTM D570	7 Day	0.35% (max.)

D. Acceptable Products and Manufacturers:

1. Sikadur 32, Hi-Mod – Sika Chemical Co.
2. Euco #435 Epoxy system – Euclid Chemical Co.
3. Or Approved Equal.

2.5 STRUCTURAL CRACK REPAIR MATERIAL

A. Structural crack repair material shall be a two-com]\\ponent, polymer-modified cementitious mortar and shall conform to USEPA/USPHS standards for surface contact with potable water supplies.

Characteristic	Test Method	Results
Bond Strength	ASTM C882	2,200 psi
Splitting Tensile Strength	ASTM C496	750 psi
Flexural Strength	ASTM C293	2,000 psi

Compressive Strength	ASTM D695	6,500 psi

B. Manufacturers:

1. The Euclid Chemical Company Model Duraltop Gel.
2. Sika Corporation Model Sika Top 123 Plus.
3. Or Approved Equal.

2.6 EPOXY CRACK REPAIR BINDER

A. Epoxy crack repair binder shall be a two-component, 100 percent solids, high-modulus, low viscosity epoxy adhesive designed for structural repair.

Characteristic	Test Method	Results
Bond Strength	ASTM C882	2,000 psi at 2 days
Tensile Strength	ASTM D638	7,000 psi
Compressive Strength	ASTM D695	10,000 psi

B. Manufacturers:

1. The Euclid Chemical Company Model Duralcrete Epoxy System.
2. Sika Corporation Model Sikadur 35, Hi-Mod LV.
3. Or Approved Equal.

2.7 FLEXIBLE POLYURETHANE CRACK REPAIR MATERIAL

A. Flexible polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophilic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough flexible foam seal that is impenetrable to water.

B. Manufacturers:

1. De Neef Construction Chemicals Model Hydro-Active Flex LV.
2. Prime Resins Model Prime Flex 900 XLV.
3. 3M Construction Markets Model Scotch Seal 5600 Chemical Grout.
4. Or Approved Equal.

2.8 RIGID POLYURETHANE CRACK REPAIR MATERIAL

A. Rigid polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophobic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough rigid foam seal that is impenetrable to water.

B. Manufacturers:

1. De Neef Construction Chemicals Model Hydro-Active Cut.
2. Prime Resins Model Prim Flex 920.
3. Sika Corporation Model Sikafix HH.
4. Or Approved Equal.

2.9 SPALL REPAIRS NOT REQUIRING FORMWORK

A. Spall repairs not requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar and shall have minimum 28-day compressive strength of 7,000 psi.

B. Manufacturers for spall repair mortar for use in horizontal applications:

1. The Euclid Company Model Duraltop Flowable Mortar.
2. Sika Corporation Model Sikatop 122 Plus.
3. Or Approved Equal.

C. Manufacturers for spall repair mortar for use in vertical applications:

1. The Euclid Company Model Duraltop Gel.
2. Sika Corporation Model Sikatop 123 Plus.
3. Or Approved Equal.

D. All spall repair materials shall conform to USEPA/USPHS standards for surface contact with potable water supplies.

2.10 SPALL REPAIRS REQUIRING FORMWORK

A. All spall repairs requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 6,000 psi. Each unit of mortar shall be mixed with Saturated Surface Dry (SSD) pea gravel to form the repair material following the manufacturer's recommendations.

B. Manufacturers:

1. The Euclid Company Model Duraltop Flowable Mortar.
2. Sika Corporation Model Sikatop 111 Plus
3. Or Approved Equal.

C. All spall repair materials shall conform to USEPA/USPHS standards for surface contact with potable water supplies.

2.11 WATERPROOF MEMBRANE PATCH

A. Waterproof membrane patch shall be a hypalon sealing strip secured to the concrete substrate with an epoxy adhesive.

B. Manufactures:

1. Sika Corporation Model Sikadur Combiflex.
2. Or Approved Equal.

2.12 CEMENT BASED TEXTURED COATING

A. Manufacturers:

1. The Euclid Company Model Duraltop Coating.
2. Sika Corporation Model Sikatop 144.
3. Or Approved Equal.

2.13 SEALANT

A. Sealant shall be a two-component polyurethane sealant. Primers and bond breakers shall conform to the sealant manufacturer's recommendations.

2.14 EXPANSION JOINT FILLER

A. Expansion joint filler shall be as specified in Specification 03 15 00.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All exterior work shall be performed during dry weather and appropriate temperature conditions in accordance with the manufacturer's recommendations. All unfinished work shall be protected during inclement weather with tarpaulins or heavy gage polyethylene sheeting.

B. All work in spaces within structures shall be performed at temperature and conditions suitable for proper curing in accordance with the manufacturer's recommendations.

C. Concrete rehabilitation work shall be coordinated with other work being performed.

D. Scaling, broke, loose and disintegrating materials shall be removed by use of hand tools or power driven saws, down to solid unyielding material.

E. All surfaces shall be thoroughly cleaned of efflorescence, oils, grease and other objectionable material in area to be repaired in accordance with the manufacturer's recommendations.

3.2 EPOXY BONDING AGENT

A. As directed by the Engineer, an epoxy bonding agent shall be used to adhere fresh concrete to existing concrete. Existing concrete surfaces shall be roughened prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Repair material shall be placed while bonding agent is still tacky. If bonding agent cures prior to placement of repair material, bonding agent shall be reapplied.

B. Repairing concrete with epoxy mortars shall conform to all the requirements of ACI 503.4, and as specified herein.

3.3 ANTI-CORROSION COATING

A. Reinforcing steel cut or exposed during alteration and/or repair operations shall be sandblasted, cleaned and coated with an anti-corrosive coating.

B. Coating shall thoroughly cover all exposed parts of the steel and shall be applied according to manufacturer's recommendations.

3.4 STRUCTURAL CRACK REPAIR

A. As directed by the Engineer, all existing structural cracks 1/16-inch and wider to be repaired shall utilize a structural crack repair material. Rout crack to ¾-inch wide by ¾-inch deep V-notch to expose sound concrete.

B. Where rebar has deteriorated, crack shall be routed to expose ¾-inch all around rebar. The resulting void in concrete shall be patched flush with the existing concrete surface using structural crack repair material.

3.5 EPOXY CRACK REPAIR

A. Cracks ¼-inch and Narrower: As directed by the Engineer, all existing structural cracks ¼-inch or narrower to be repaired shall be pressure injected with an epoxy crack repair binder into the prepared crack. Crack surface shall be sealed and injection ports installed per manufacturer's recommendations.

1. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete.
2. Once the surface sealing material has cured, inject crack with epoxy crack repair binder using pressure injection equipment as directed by the manufacturer.

B. Cracks wider than ¼-inch: As directed by the Engineer, all existing structural cracks wider than ¼ -inch to be repaired shall be gravity fed an epoxy crack repair binder into the prepared crack.

1. Concrete surface shall be routed to form a minimum ¼-inch wide by ¼-inch deep V-notch and the crack cleaned to remove all loose and foreign particles. Crack shall be filled with clean, dry sand then epoxy crack repair binder poured into V-notch, completely filling crack.
2. As binder penetrates into crack additional binder shall be applied to the V-notch.

3.6 RIGID AND FLEXIBLE POLYURETHANE CRACK REPAIR

A. As directed by the Engineer, all existing, leaking cracks ¼-inch and narrower to be repaired shall be pressure injected with a waterproof hydrophilic or hydrophobic injection grout into the prepared crack. Crack surface shall be sealed and injection ports installed per manufacturer's recommendations.

B. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface and the existing concrete.

C. Once the surface sealing material has cured, inject crack with waterproof hydrophilic or hydrophobic injection grout using pressure injection equipment as directed by the manufacturer.

3.7 SPALL REPAIR

A. As directed by the Engineer, all voids or spalled areas to be repaired shall be chipped back a minimum of 1/8-inch to sound concrete and the area cleaned and repaired to original dimensions with spall repair patching material according to manufacturer's recommendations.

B. All patching shall provide a final finished surface which is flat, level and even with the existing concrete surface. Repair mortar shall not be feathered to meet existing concrete surface.

C. Final patching on horizontal surfaces shall receive a finish consistent with the finish on the existing structure.

3.8 EXPANSION JOINT REPAIR

A. Remove all sealant and breaker and joint filler.

B. Remove all unsound concrete on the joint faces as directed by the Engineer.

C. Remove all laitance and provide a clean dry surface.

D. Prepare an epoxy mortar by combining epoxy crack repair binder with aggregates following manufacturer's instructions.

E. Restore surface to original dimensions by toweling epoxy mortar onto the existing substrate in a manner to ensure bonding following manufacturer's instructions.

F. Cure repair following manufacturer's instructions.

G. Replace joint filler and sealant as indicated on the Contract Drawings.

3.9 WATERPROOF MEMBRANE PATCH

A. As directed by the Engineer, existing concrete areas requiring a textured patch shall be thoroughly cleaned and the waterproof membrane patch applied according to manufacturer's recommendations.

3.10 CEMENT BASED TEXTURED COATING

A. As directed by the Engineer, existing concrete areas requiring a textured coating shall be thoroughly cleaned and the cement based textured coating applied according to manufacturer's recommendations.

B. All other concrete rehabilitation work as directed by the Engineer shall be completed prior to applying coating.

3.11 CURING

A. All repair materials utilized shall be cured in strict accordance with manufacturer recommendations.

3.12 CLEANING

A. Pumps and hoses used for crack repair shall be completely flushed. A sharp sided tool such as a putty knife or trowel shall be used to remove excess material from walls, floors, etc. Material shall be cured before removing.

B. The uncured polyurethane chemical grout shall be cleaned from tools with an approved solvent. The cured polyurethane chemical grout can only be removed mechanically.

C. The uncured polymer-modified Portland cement mortar shall be cleaned from tools with water. The cured polymer-modified Portland cement mortar can only be removed mechanically.

D. Excess materials caused by work under this Section shall be cleaned from existing surfaces by the use of power sanders and the surfaces shall be vacuumed clean and readied to receive final cleaning and finishing specified under other sections of the specifications. All cracks shall be sanded and shall lie in the same plane as adjacent surfaces.

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E. Misplaced sealants shall be removed using methods and materials recommended by the manufacturers, and the finished work and work area shall be left in a neat and clean condition.

END OF SECTION 030100

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SECTION 030551 - CONCRETE BONDING AGENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Epoxy Bonding Agents (Adhesive) for cast-in-place concrete.

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Concrete Institute:

1. ACI 503.1 – Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive

   a. ACI 503.2 – Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

2. ACI 318 – Building Code Requirements for Structural Concrete

C. ASTM International:

1. ASTM C881 – Epoxy-Resin-Base Bonding Systems for Concrete.
2. ASTM C882 – Bond Strength of Epoxy Resin Systems Used with concrete by Slant Shear
3. ASTM D570 – Standard Test Method for Water Absorption of Plastics
4. ASTM D638 – Standard Test Method for Tensile Properties of Plastics
5. ASTM D648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
6. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics

D. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO 235 – Standard Specification for Epoxy Resin Adhesives

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data, properties, including surface preparation and placement instructions.

B. Safety Data Sheets.

1.4 QUALITY ASSURANCE

A. Products used in the work of this section shall be produced by manufacturer’s who are regularly engaged in the manufacturer and/or supply of similar items for at least five (5) years and which have a history of successful production, acceptable to the Engineer.

B. The Contractor shall provide an adequate number of trained workmen experienced in the work of this Section.

C. Workmen shall have received training of the use of the products of this Section by a manufacturer’s representative.

D. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall instruct the Contractor's personnel in the mixing, proper use and application of the bonding agents.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in manufacturer's original, unopened containers with proper labels intact. Damaged containers shall be removed from the project site.

B. Store in a dry shelter in accordance with manufacturer’s instructions. Maintain storage area temperature within limits set by the manufacturer.

C. Keep containers sealed until ready for use.

D. Protect materials during handling, mixing and application to prevent damage or contamination.

E. Condition the materials in accordance with manufacturer’s instructions prior to use.

F. Mix, apply and clean-up materials in accordance with all safety and weather conditions required by the manufacturer, or as modified by applicable rules and regulations of local, state and federal authorities.

G. Consult Material Safety Data Sheets (MSDS) for complete handling recommendations.

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PART 2 - PRODUCTS

2.1 BONDING AGENTS

A. Bonding agents shall be a two (2) component, 100% solids, 100% reactive compound epoxy adhesive suitable for use on dry or damp surfaces.

B. Bonding Agents shall be ASTM C881 and AASHTO 235 compliant and suitable for use under ACI 503.1, ACI 503.2, ACI 503.3 and ACI 503.4.

C. Bonding compounds shall conform to the following properties:

Property	Test	Time	Result
Bond Strength - Plastic Concrete to Hardened Concrete, Moist Cure	ASTM C882	2 days	1,700 psi (min.)
		14 days	2,200 psi (min.)
Compressive Strength	ASTM D695	28 days	11,000 psi (min.)
Tensile Strength	ASTM D638	7 day	6,900 psi (min.)
Water Absorption	ASTM D570	7 Day	0.35% (max.)

D. Acceptable Products and Manufacturers:

1. Sikadur 32, Hi-Mod – Sika Chemical Co.
2. Euco #452 Epoxy system – Euclid Chemical Co.
3. Or Approved Equal

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive bonding agents. Do not begin surface preparation unacceptable conditions are corrected.

3.2 SURFACE PREPARATION

A. Prepare all contact surfaces in accordance with manufacturer’s recommendations.

B. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

C. Prepare surfaces mechanically to provide a surface profile in accordance with manufacturer’s instructions.

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3.3 MIXING

A. Ensure components are at proper temperature prior to mixing.

B. Mix components in accordance with manufacturer's instructions.

C. Mix only quantity that can be applied within its pot life.

3.4 APPLICATION

A. All work shall be done in strict accordance with manufacturer's recommendations, including special precautions, procedures and limitations.

B. Apply bonding agents in accordance with manufacturer's instructions. Ensure bonding agent, substrate and air temperatures are within the manufacturer's specified limits.

3.5 CLEAN-UP

A. Clean-up in accordance with manufacturer's instructions.

END OF SECTION 030551

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SECTION 030555 - CONCRETE ADMIXTURES AND ADDITIVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Admixtures and additives for cast-in-place concrete.

B. Related Sections:

1. Section 030551 “Concrete Bonding Agents”
2. Section 031113 “Structural Cast-in-Place Concrete Forming”
3. Section 031500 “Concrete Accessories”
4. Section 032100 “Reinforcing Steel”
5. Section 032200 “Welded Wire Fabric Reinforcing”
6. Section 033100 “Structural Concrete”
7. Section 033900 “Concrete Curing”
8. Section 036000 “Grout”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Concrete Institute:

1. ACI 211.1 – Standards Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
2. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete
3. ACI 212.3R – Chemical Admixtures for Concrete
4. ACI 212.4R – Guide for Use of High-Range Water-Reducing Admixtures (Superplasticizers) in Concrete
5. ACI 301 – Specifications for Structural Concrete.
6. ACI 302.1R – Guide for Concrete Floor and Slab Construction
7. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete
8. ACI 304.2R – Placing Concrete by Pumping Methods

9. ACI 304.4R – Placing Concrete with Belt Conveyors
10. ACI 305.1 – Standard Specifications for Hot Weather Concreting
11. ACI 305 – Hot Weather Concreting.
12. ACI 306.1 – Standard Specification for Cold Weather Concreting
13. ACI 306R – Cold Weather Concreting
14. ACI 318 – Building Code Requirements for Structural Concrete

C. ASTM International:

1. ASTM C94/C94M – Standard Specification for Ready-Mixed Concrete.
2. ASTM C143/C143M – Standard Test Method for Slump of Hydraulic Cement Concrete.
3. ASTM C150 – Standard Specification for Portland Cement.
4. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
5. ASTM C494/C494M – Standard Specification for Chemical Admixtures for Concrete.
6. ASTM C595 – Standard Specification for Blended Hydraulic Cements.
7. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
8. ASTM C989 – Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
9. ASTM C1017/C1017M – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
10. ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures.

D. New York State Department of Transportation Standard Specifications (NYSDOT-SS):

1. Section 501-2.03 – Concrete Batching Facility Requirements
2. Section 501-3.03 – Concrete Mixing, Transporting and Discharging

1.3 SUBMITTALS

A. Product Data: Submit data for all additives and admixtures.

B. Concrete Mix Designs for all mixes with proposed admixtures to be included.

C. Identify chloride content of admixtures and whether or not chloride was added during manufacturing.

D. Certification of Compatibility

1. Contractor shall provide certification that all materials and admixtures are compatible with each other.

E. Laboratory Test Data:

1. Laboratory test reports by the supplier of chemical admixtures containing information on the chloride ion content and alkali content expressed as Na2O equivalent. Test reports are not required for air entraining admixtures used at dosages less than 130 ml per 100 kg (2 fl oz per 100 lb) or cement of nonchloride chemical admixtures used at maximum dosages less than 325 ml per 100 kg (5 fl oz per 100 lb). Both the chloride ion and total

alkali content of the admixtures are to be expressed in percent by mass of cement for a stated or typical dosage of the admixture.

2. Laboratories supplying test reports or data shall provide evidence that the laboratory is properly equipped and qualified to perform the tests method(s) in conformance with ASTM C1077 and C1222.

1.4 QUALITY ASSURANCE

A. Products used in the work of this section shall be produced by manufacturer's who are regularly engaged in the manufacturer and/or supply of similar items for at least five (5) years and which have a history of successful production, acceptable to the Engineer

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide admixtures produced by established reputable manufacturers, and use in compliance with the manufacturer's printed instructions.

B. All admixtures shall be provided by manufacturers capable of providing qualified field service representation.

C. All admixtures shall be compatible with other admixtures and cementitious materials.

D. Admixtures shall not contain more chloride ions than present in municipal drinking water.

E. Do not use admixtures containing calcium chloride.

F. Mix Designs not containing fly ash shall include air entraining and water-reducing admixtures as required. High-range water reducing admixtures may be added to improve workability. High-range water reducing admixtures shall be used to facilitate pumping.

G. Mix Designs containing fly ash shall include air entraining and high-range water-reducing admixtures as required.

H. Do not air entrain interior concrete floors and suspended slabs in buildings that will receive a trowel finish. Do not allow entrapped air content to exceed 3 percent.

I. Do not use admixtures which have not been incorporated and tested in the accepted design mixes, unless otherwise authorized by the Engineer.

2.2 WATER REDUCING ADMIXTURE

A. The admixture shall conform to ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.

B. Acceptable Products and Manufacturers:

1. WRDA with Hycol – W.R. Grace & Co.
2. Eucon WR-75 – Euclid Chemical Co.
3. MasterPozzolith 200 – Master Builders
4. Or Approved Equal

2.3 WATER REDUCING RETARDING ADMIXTURE

A. The admixture shall conform to ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.

B. Acceptable Products and Manufacturers:

1. Eucon WR-75 – Euclid Chemical Co.
2. MasterSet R 100 – Master Builders
3. Plastiment XR – Sika Chemical Corp.
4. Or Approved Equal

2.4 HIGH RANGE WATER REDUCING RETARDING ADMIXTURE (SUPERPLASTICIZER)

A. The admixture shall conform to ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.

B. Acceptable Products and Manufacturers:

1. Daracem 19 or Daracem 100 – W.R. Grace & Co.
2. Eucon 37 – Euclid Chemical Co.
3. MasterRheobuild 1000 – Master Builders
4. Sikament SPMN – Sika Chemical Co.
5. Or Approved Equal.

2.5 AIR ENTRAINING ADMIXTURES

A. The admixture shall conform to ASTM C-260 and not contain more chloride ions than present in municipal drinking water.

B. Acceptable Products and Manufacturers:

1. Darex AEA – W.R. Grace & Co.
2. Eucon Air Mix – Euclid Chemical Co.
3. MasterAir AE 200 – Master Builders
4. Sika-AIR – Sika Chemical Co.
5. Or Approved Equal

2.6 NON-CHLORIDE ACCELERATING ADMIXTURES

A. The admixture shall conform to ASTM C 494/C 494M requirements for Type C accelerating and not contain more chloride ions than present in municipal drinking water.

B. Non-chloride accelerating admixtures shall only be used during cold weather concreting.

C. Acceptable Products and Manufacturers:

1. MasterSet FP 20 – Master Builders
2. SikaSet NC – Sika Chemical Co.
3. Accelguard 80 – Euclid Chemical Co.
4. Or Approved Equal

2.7 PROHIBITED ADMIXTURES

A. Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted. No admixture shall cause an increase in shrinkage when tested in accordance with ASTM C494 and ASTM C157

PART 3 - EXECUTION

3.1 GENERAL

A. Accurately proportion admixtures in accordance withy those established in the design mix.

B. Admixtures shall be added in accordance with manufacturer’s printed instructions.

3.2 READY MIX CONCRETE

A. Ready Mix Concrete Plants shall be provided with Admixture Dispensing Systems equipped with calibrated systems that meet the following:

1. A sufficient number of dispensing systems to supply the concrete mixture specified.
2. The ability to dispense each admixture through its own measuring system
3. Accurate measurement within the tolerance limits specified in Table 501-4, Batching Tolerances.
4. A bypass valve to obtain a calibrated sample of admixture from each measuring device.
5. Uniform distribution of admixture throughout the mix within the specified mixing period.
6. When multiple admixtures are added, no direct contact with each other prior to mixing.
7. An approved automatic admixture dispensing system in plants equipped with automated proportioning systems.
8. Volumetric measuring devices interlocked with the automated proportioning equipment that insures the preset quantity has been actually measured and completely discharged.
9. A readable indication at the operator's normal work station of the actual quantity batched.
10. Interlock the admixture system with the automated proportioning system so that aggregate and/or cement weigh hopper discharge gates cannot be opened until the preset quantity of admixture has been batched or discharged.
11. Recordation of the presence of admixture is dependent on completion of admixture discharge.

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3.3 BATCH MIXING AT SITE

A. Batch mixing of admixtures on-site shall not be permitted without prior approval of the Engineer.

3.4 REDOSAGE

A. Redosage of admixtures on-site shall not be permitted without prior approval of the Engineer.

END OF SECTION 030555

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SECTION 031113 - STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formwork for cast-in place concrete.
2. Shoring, bracing, and anchorage.
3. Form stripping.

B. Related Sections:

1. Section 079200 “Joint Sealants”
2. Section 031500 “Concrete Accessories”
3. Section 032100 “Reinforcing Steel”
4. Section 032200 “Welded Wire Fabric”
5. Section 033100 “Structural Concrete”
6. Section 033500 “Concrete Finishing”
7. Section 033900 “Concrete Curing”
8. Section 036000 “Grout”

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 302.1 - Recommended Practice for Concrete Floor and Slab Construction
4. ACI 318 - Building Code Requirements for Structural Concrete.
5. ACI 347 - Guide to Formwork for Concrete.
6. ACI 350.4R-04 - Design Considerations for Environmental Engineering Concrete
7. ACI 350-06 - Code Requirements for Environmental Engineering Concrete Structures

B. American Forest and Paper Association:

1. AF&PA - National Design Specifications for Wood Construction.

C. National Institute of Standards and Technology (NIST):

1. NIST Voluntary Product Standard PS 1 - Structural Plywood.
2. NIST Voluntary Product Standard PS 20 – American Softwood Lumber Standard

D. APA – The Engineered Wood Association (APA/EWA)

E. West Coast Lumber Inspection Bureau:

1. WCLIB - Standard 17 Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

A. Design of all formwork, shoring and bracing shall be prepared by a Professional Engineer licensed in the State of New York.

B. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 301, 302, 318 and 347; and all applicable Federal, State and Municipal codes and regulations including revisions to date of contract to achieve concrete shape, line and dimension as indicated on the Contract Drawings.

C. Design, erect, support and maintain formwork so that it will safely support vertical and lateral loads that might be applies, until such loads can be supported by the concrete structure.

D. Carry vertical and lateral loads to ground by formwork systems and in-place construction that has attained adequate strength for that purpose.

E. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.

F. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibratory frequency, ambient temperature, foundation pressures, stresses, lateral stability and other factors pertinent to the safety of the structure.

G. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placement operations, using wedges or jacks or a combination thereof.

H. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

I. Support form facing material by structural members spaced sufficiently close to prevent objectionable deflection.

J. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities, and within allowable tolerances.

K. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.

L. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Formwork Shop Drawings: Prepared by or under the supervision of a qualified New York State licensed professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork, shoring and bracing are Contractor's responsibility.

C. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring. Submit details of form types, method of form construction and erection, design computations and location of form joints, form ties and embedded items. Formwork shop drawings shall include the following as a minimum:

1. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
2. All joint locations shall be shown and detailed on the drawings.
3. Means of leakage prevention for concrete exposed to view in finished construction.
4. Sequence and timing of erection and stripping of formwork.
5. Required compressive strength of concrete at time of formwork stripping
6. Height of concrete lift and height of concrete drop during concrete placement.
7. Vertical, horizontal and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
8. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.
9. Procedure and schedule for removal of shores.

D. Product Data: Submit data with descriptions and installation instructions for:

1. Form Materials
2. Form Systems
3. Form Ties
4. Form Spreaders
5. Corner Formers
6. Form Coatings
7. Form Release Agents

E. Design Data: Signed and sealed by Professional Engineer registered in the State of New York

1. Indicate design data for formwork and shoring.
2. Indicate loads transferred to structure during process of concreting and shoring.
3. Structural calculations to support design of formwork and shoring.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, ACI 302, ACI 318 and ACI 347.

B. For wood products furnished for work of this Section, comply with AF&PA.

C. Perform Work in accordance with all applicable Federal, State and Municipal codes and regulations including revisions to date of contract.

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1.6 QUALIFICATIONS

A. Design formwork under direct supervision of Professional Engineer experienced in design of this Work and registered in the State of New York.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. Deliver void forms and installation instructions in manufacturer's packaging.

C. Store off ground in ventilated and protected manner to prevent contamination deterioration from moisture.

D. Handle materials with care to prevent damage or contamination

1.8 COORDINATION

A. Coordinate this Section with other Contracts and sections of work, requiring attachment of components to formwork.

PART 2 - PRODUCTS

2.1 GENERAL FORMWORK REQUIREMENTS

A. Form Material: At the discretion of the Contractor subject to acceptance of the Engineer.

B. Exposed Concrete Surfaces

1. Construct formwork for exposed (painted or unpainted) concrete surface with smooth faced undamaged plywood or other type panel materials approved by the Engineer to provide continuous, straight, smooth as-cast surfaces.
2. Furnish panels (plywood or other accepted panel materials) in the largest practical sizes to minimize the number of joints.

C. Strength

1. Provide form material with sufficient strength to withstand pressure of newly placed concrete without excessive and objectionable bow or deflection.

2.2 WOOD FORM MATERIALS

A. Lumber Forms:

1. Application: Use for edge forms and unexposed finish concrete.

2. Boards: 6 inches or 8 inches in width, shiplapped or tongue and groove, “Standard” Grade Douglas Fir, conforming to WCLIB Standard Grading Rules for West Coast Lumber or approved equal.
3. Surface boards on four sides.

B. Plywood Forms:

1. Application: Use for exposed finish concrete.
2. Forms: All plywood shall conform to NIST PS 1; full size 4 x 8 feet panels; each panel labeled with grade trademark of APA/EWA.
3. Plywood for general exposed finish concrete: Minimum of 5/8 inch thick; APA/EWA “B-B Plyform Structural I Exterior” grade.
4. Plywood where “Smooth Finish” is required, as indicated on Contract Drawings: APA/EWA “HD Overlay Plyform Structural I Exterior” grade, minimum of 3/4 inch thick.

C. Hardboard Forms:

1. Application: Use for lining forms for exposed finish concrete where “Smooth Finish” free from grain markings is required.
2. Tempered smooth-one-side (SIS), minimum of 3/16 inch thick conforming to PS 58.
3. Shingle nails or other nails with thin, flat heads and thin shanks should be used to fasten the sheets to the backup lumber.
4. Edges of adjacent sheets shall be nailed to the same backing boards to prevent slight offsets that may accentuate joints.
5. Joints between adjacent sheets shall be filled with plaster, putty or tape and sanded to make the joints invisible.
6. Holes for form ties should be drilled from the face side to avoid tearing the board.
7. The surface of the board should be oiled, and the material thoroughly wet for several hours prior to being used.

2.3 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Contract Drawings.

B. Verify the concrete cover of all reinforcement after form placement. When formwork placement results in insufficient concrete cover over reinforcement, the formwork shall be removed and reset to maintain the required concrete cover unless otherwise directed by the Engineer.

C. Examine the substrate and conditions under which the work of this Section is to be performed, and correct unsatisfactory conditions that would prevent proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Conform to ACI 347, except as specified herein.

B. Initially and before re-use, forms shall be cleaned and a coat of non-staining form release agent applied per manufacturer's instructions.

1. Care shall be taken to avoid splashing of oil on reinforcing steel or existing concrete.
2. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes which may be affected by the agent.

3.3 INSTALLATION

A. Section 017000 "Execution and Closeout": Requirements for installation.

B. Earth Forms:

1. Earth forms are not permitted.

C. Formwork - General:

1. Construct forms complying with ACI 347, to exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in finished structures.
2. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces
3. Forms shall be, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
4. All form joints shall be backed-up to assure that the edges of abutting panels are in the same plane, straight and true, and forced tightly together to minimize fins. The quality of the form contact surfaces shall be subject to the acceptance of the Engineer.
5. Provide falsework and bracing to ensure stability of the formwork. Strengthen all formwork liable to be overstresses by construction loads.
6. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
7. Camber forms where necessary to achieve ACI 301 tolerances.
8. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.

9. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at the bottom of the forms to allow flushing water to drain. Close ports with tight fitting panels, flush with the inside face of the forms, neatly fitted so that the joints will not be apparent in exposed concrete.
10. Provide openings for offsets, sinkages, keyways, recesses, moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts and other features required. Use selected materials to obtain required finishes.
11. Form openings and construction which accommodates installation by other trades whose materials and products must be fabricated before opportunity exists to verify the measurements of adjacent construction which affects such installations, shall be accurately sized and located as dimensioned on the Contract Drawings. In the event that deviation from the Drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions as accepted by the Engineer, without additional expense to the Owner.

D. Forms – Falsework and Bracing:

1. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301, 318 and 347.
2. Erect falsework and support, brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place construction.
3. Construct falsework so that adjustments can be made for take-up and settlement.
4. Provide wedges, jacks or camber strips to facilitate vertical adjustments.
5. Carefully inspect falsework and formwork during and after concrete placement operations to detect abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.

E. Forms for Exposed Concrete

1. Drill forms to suit ties used to prevent leakage of concrete mortar around the tie holes. Do not splinter forms by driving ties through improperly prepared holes
2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
3. Use extra studs, walers and bracing to prevent objectionable bowing forms between studs and to avoid bowed appearance in concrete. Do not use narrow strip form material which will produce bow.
4. Assemble forms so that they may be readily removed without damage to exposed concrete surfaces.

F. Forms for Smooth Finish Concrete:

1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

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G. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

H. Obtain Engineer’s approval before framing openings in structural members not indicated on Contract Drawings.

I. Corner Treatment:

1. Unless shown otherwise, form 3/4”chamfers with strips on external corners of columns, walls, girders, beams, foundation walls projecting beyond overlying masonry, and other external corners that will be exposed.
2. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

J. Provisions of Other Trades:

1. Provide openings, slots, reglets, recesses, sleeves, bolts, anchors, inserts, etc.. in concrete formwork to accommodate the work of other trades.
2. Verify sizes and location of openings, slots, recesses sleeves, bolts, anchors, inserts and chases with the trade(s) requiring such items.
3. Accurately place and securely support items to be built into the forms.

K. Do not patch formwork.

3.4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer’s specifications. Do not coat forms for concrete indicated to receive “scored finish”. Apply form coatings before placing reinforcing steel.

E. Do not allow excess form release agent to accumulate in forms or to come into contact with surfaces which will be bonded to fresh concrete.

3.5 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. General:

1. Set and build into the work anchorage devices and other embedded items required for other work attached to, or supported by, cast in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

2. Those trades whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to install embedded items before the concrete is placed.
3. Electrical conduit, junction boxes, pipes, sleeves, inserts and similar items shall be placed in the concrete in accordance with all of the requirements of the Building Code and authority having jurisdiction. Such items shall be protected to the extent they are not displaced or damaged during the placing of concrete.

B. Install formed openings for items to be embedded in or passing through concrete work.

C. Locate and set in place items required to be cast directly into concrete.

D. Position recessed reglets for brick veneer masonry anchors in accordance with spacing and intervals as shown or specified.

E. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

F. Waterstops:

1. Waterstops shall be installed so as to form a continuous watertight diaphragm without displacing reinforcement.
2. Adequate provisions shall be made to support and completely protect the waterstops during the progress of the work. Waterstops shall be wire tied to the steel reinforcement to prevent movement during placement.
3. Splices shall be made in conformance with the recommendations if the waterstop manufacturer.

G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

H. Form Ties:

1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete. Patch with cement mortar to match adjacent surface color and texture.
3. Form ties for liquid containment structures shall leave no metal or other material except concrete within1-1/2 inch of the formed surface. Patch with cement mortar to match adjacent surface color and texture.
4. Leave inner rods in concrete when forms are stripped. Rods remaining in place in liquid containment structures:

    a. Shall be provided with an integral waterstop.
    b. Shall provide a cone shaped depression at least 1-inch in diameter and 1-1/2 inches deep to allow for filling and patching. Patch with cement mortar to match adjacent surface color and texture.

5. Through ties that are to be completely removed form liquid containment structures should be tapered over the portion that passes through the concrete.

    a. The large end of the tapered tie should be positioned on the liquid side of the wall.

6. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Contract Drawings.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Joints

1. Provide isolation, control, contraction, expansion and construction joints in accordance with the following.
2. Continue reinforcing steel and wire fabric across construction joints where not indicated as being free to move.
3. Install premolded joint filler at locations shown. Extend joint filler from bottom of concrete up flush to finish concrete surfaces or hold down below finish surface as detailed.
4. Make splices in premolded filler in manner to preclude penetration of concrete between joint faces.
5. Concrete shall not be allowed to enter the joint or space for the sealant and backing rod and destroy the proper function of the joint.
6. The surface of all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.
7. All joints shall be clean and free from dirt, debris before primer and sealer are applied.
8. Construction Joints:

    a. Construction joints shall be as shown on the Contract Drawings where structural integrity is affected, otherwise, the Contractor shall submit descriptions of the joints and their locations to the Engineer of approval.
    b. Unless otherwise shown of the Contract Drawings, construction joints shall be made and located so as not to impair the strength of the structure. Provisions shall be made for transfer of shear and other forces through the joints.
    c. Construction joints in floors shall be located within the middle third of spans of slabs, beams and girders. Joints in girders shall be offset a minimum of two times the width of the intersecting beams.
    d. Beams, girders, or slabs supported by columns or walls shall not be cast or erected until concrete in the walls or vertical supports members is no longer plastic
    e. Beams, girders, haunches, drop panels, and capitals shall be placed monolithically as part of a slab system, unless otherwise shown in the Contract Drawings.
    f. Construction joints shall be perpendicular to the main reinforcement
    g. Construction joints in water retaining structures shall have an integral continuous waterstops extending above the waterline and stopping nine inches below the top surfaces of the concrete.
    h. In non liquid containing structures aterstops shall be provided at all construction joints below grade in walls or slabs that enclose an accessible area.
    i. The maximum distance between horizontal joints in slabs and vertical joints in walls shall be 30’-0” unless otherwise indicated on the Contract Drawings.
    j. All corners shall be part of a continuous placement.
    k. Construction joints shall not be located closer than 5 feet from any corner.
    l. The elapsed time between casting adjoining concrete shall be at least 48 hours.
    m. The surfaces of all construction joints shall be prepared in accordance with the requirements of ACI 301.

n. Immediately before new concrete is placed, all construction joints shall be wetted and standing water removed
o. All construction joints shall be bonded by one of the following methods:

1) The use of an approved bonding agent applied in accordance with manufacturer's recommendations.
2) The use of Portland cement grout of similar proportions to the concrete applied in an acceptable manner.

p. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
q. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
r. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
s. Arrange joints in continuous line straight, true and sharp.

9. Control Joints in Liquid Containing Structures

a. Provide control joints as shown on the Contract Drawings.
b. Construct joints as Detailed in the Drawings.
c. Control joints in water retaining structures shall have an integral continuous waterstop.
d. The maximum distance between horizontal joints in slabs and vertical joints in walls shall be 30'-0" unless otherwise indicated on the Contract Drawings.
e. The maximum distance between horizontal joints in walls shall be 12'-0" unless otherwise indicated on the Contract Drawings.

10. Control Joints in building floor slabs on grade.

a. Provide control joints as shown on the Contract Drawings
b. Control joints shall have a maximum spacing of 20 feet in each direction.
c. Form control joints by inserting prefabricated strip into fresh concrete until the top surface of the strip is flush with the surface.
d. After the concrete has cured for at least seven days, remove inserts and clean loose debris from the groove.
e. Caulk in accordance with the requirements of Section 079200.
f. The sawcutting of control joints in lieu of forming shall not be allowed unless otherwise indicated on the Contract Drawings.

1) Where allowed, joints shall be sawed within 24 hours of concrete placement.
2) Sawcutting shall not take place until the concrete can support foot traffic without impressions or other surface damage.

g. Unless otherwise noted in the Contract Drawings, control joints shall be:

1) Reinforced Concrete: 1/2-inches deep
2) Unreinforced Concrete: 1/3 of concrete thickness.

11. Expansion Joints

a. Provide expansion joints as shown on the Contract Drawings.
b. All expansion joints shall include a compressible preformed joint filler and joint sealant.
c. A nine inch center-bulb type waterstops shall be provided:

1) For all expansion joints in water retaining structures.
2) All expansion joints below grade in walls or slabs that enclose an accessible area.

d. Reinforcement or other embedded items bonded to the concrete (except dowels in floors bonded only on one side of a joint) shall not be permitted to extend continuously through any expansion joint.

12. Isolation Joints in slab on grade

a. Provide isolation joints in slabs on grade at points of contact between slabs on grade and vertical surfaces where indicated
b. Caulk in accordance with the requirements of Section 079200.

13. Sealant Slots

a. Where premolded joint filler is held down below finished concrete face, install in the form a water-soaked wood strip of dimensions shown to form after its removal a proper sized slot to receive the sealant.

K. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. All pipes and sleeves passing through the concrete of liquid containing structures shall include an integral waterstop.
3. Piping and conduit shall be so fabricated and installed that cutting, bending or displacement of reinforcement from its proper location will not be required.
4. Do not embed wood or uncoated aluminum in concrete.
5. Obtain installation and setting information for embedded items furnished under other Specification sections.
6. Securely anchor embedded items in correct location and alignment prior to placing concrete.
7. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.
8. Locate anchor bolts as shown on the Contract Drawings and on the Shop Drawings. Obtain necessary templates as required for the proper setting of anchor bolts and other items for equipment as required
9. Assist other trades and Contracts in the installation of piping, pipe sleeves, conduit and similar items where such items are to be installed in concrete. Provide frames to securely hold anchor bolts and anchorage devices in place during construction, and take care that no displacement occurs during the pouring of concrete.

L. Openings for Items Passing Through Concrete:

1. Frame openings in concrete where indicated on Contract Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:

1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Contract Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not be permitted.

O. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.6 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 FORM REUSE

A. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable and shall be replaced.

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3.8 SHORES AND SUPPORTS

A. Comply with ACI 347 for shoring and reshoring in multi-story construction, and as specified herein.

B. Submit a shore removal and reshoring schedule and drawings for the Engineer's review before proceeding with this work

C. Do not proceed until the schedule and drawings have been reviewed.

3.9 FORM REMOVAL

A. Forms shall not be removed without the permission of the Engineer. In general, forms shall not be removed until the concrete has hardened sufficiently to support its own load safely, plus any superimposed loads that might be placed thereon.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

D. The following schedule shall be considered the minimum period before formwork can be removed under normal conditions with the use of Type II cement. Its use shall not relieve the contractor of responsibility for the safety and appearance of the structure.

Type of Form	Above 60°F	50°- 60°F	40°- 50°F
Columns 5' high	24 hours	36 hours	72 hours
Columns 5' – 10' high	3 days	5 days	7 days
Columns 10' high	5 days	7 days	10 days
Walls 10' high	24 hours	36 hours	72 hours
Walls 5' – 10' high	3 days	5 days	7 days
Beam Side Forms	24 hours	36 hours	72 hours
Beam Bottom Forms	14 days	18 days	21 day6s
Slabs up to 6' Span*	5 days	7 days	14 days
Construction Joint	24 hours	36 hours	72 hours
Bulkheads	24 hours	36 hours	72 hours

* For slabs more than six (6) foot span add twelve (12) hours for each additional foot over five (5) feet.

1. When the temperature to which the forms or concrete surfaces are exposed to falls below 40°F, the forms shall remain in place an additional time equal to the time of the sub-40°F exposure. If form insulation is used, concrete surface temperature shall apply.
2. The Engineer may modify the form removal schedule if compressive tests indicate that the in-place concrete is of sufficient strength. Methods of field curing the cylinders shall simulate that of the concrete and shall be approved by the Engineer. All such tests shall be at the option and expense of the Contractor.
3. When Type III cement or retarders are used, the form removal schedule above does not apply and may be modified by the Engineer.

E. Immediately following the removal of the forms, the projecting ties shall be removed and all holes filled with grout flush with the wall. Care shall be taken to use the same brand of cement and same mix proportions used in the wall to prevent color differences.

F. Care shall be taken in removing forms, wales, shoring, supports and form ties to avoid spalling or marring the concrete. Patching as may be required shall be started immediately upon removal of the forms.

3.10 ERECTION TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301 and ACI 318.

B. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301.

3.11 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

B. Notify the Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

C. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION 031113

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SECTION 031500 - CONCRETE ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form Ties
2. Chamfer Strips
3. Dovetail Anchor Slots
4. Concrete Inserts
5. Sealant Material for Concrete Joints
6. Bar Supports for Steel Reinforcement (brick and blocks not permitted)
7. Waterstops
8. Concrete Joints and Joint Materials
9. All other concrete accessories required to complete the work.

B. Related Sections:

1. Section 031113 “Structural Cast-in-Place Concrete Forming”
2. Section 032100 “Reinforcing Steel”
3. Section 032200 “Welded Wire Fabric Reinforcing”
4. Section 033100 “Structural Concrete”
5. Section 033500 “Concrete Finishing”
6. Section 033900 “Concrete Curing”
7. Section 036000 “Grout”
8. Section 079200 “Joint Sealants”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Concrete Institute:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Specifications for Structural Concrete.

3. ACI 318 – Building Code Requirements for Structural Concrete.
4. ACI 347 – Guide to Formwork for Concrete.

C. American Hardboard Association

1. AHA A135.4 – Basic Hardboard

D. ASTM International:

1. ASTM D412 – Standard test Method for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
2. ASTM D570 – Standard Test Method for the Water Absorption of Plastics.
3. ASTM D746 – Standards Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
4. ASTM D747 – Standard Test Method for Apparent Bending Modulus of Plastics by Means of Cantilever Beam.
5. ASTM D792 – Standard Test Method for Density and Specific Gravity of Plastics by Displacement.
6. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
7. ASTM D1752 – Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion
8. ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness.
9. ASTM D5249 – Backer Material for Use with cold and Hot Applied Joint Sealants in Portland Cement Concrete and Asphalt Joints.
10. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.

E. U.S. Army Corps of Engineers:

1. CRD-C-572 – Polyvinylchloride Waterstop

1.3 PERFORMANCE REQUIREMENTS

A. Vapor Retarder Permeance: Maximum 1 perm when tested in accordance with ASTM E96, Procedure A.

1.4 SUBMITTALS

A. Manufacturer’s specifications and other data required to demonstrate compliance with the specific requirements.

B. Manufacturer’s recommended instructions for:

1. Installing concrete accessories.
2. Splicing non-metallic waterstops.

C. On the concrete reinforcement and concrete formwork shop drawings clearly show in detail the locations of all concrete joints, accessories, insets and embedded items of other trades; and

show details of how all joints, accessories, insets and embedded items of other trades are held in place during concrete placement.

D. Test results from independent testing laboratories showing compliance with these specifications. Sworn affidavits or statements from suppliers are not acceptable.

E. Furnish manufacturer's certification or test results identifying physical characteristics.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, ACI 302, ACI 318, ACI 350 and ACI 347

1.6 QUALIFICATIONS

A. Products used in the work of this section shall be produced by manufacturer’s who are regularly engaged in the manufacturer and/or supply of similar items for at least five (5) years and which have a history of successful production, acceptable to the Engineer.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver concrete accessories and installation instructions in original manufacturer's packaging.

B. Store off ground in ventilated and protected manner to prevent contamination, and deterioration from moisture.

C. Protect from UV exposure.

1.8 COORDINATION

A. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 - PRODUCTS

2.1 FORM TIES

A. Characteristics:

1. Factory fabricated, adjustable length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
2. Snapoff Metal Form ties:

    a. Snapoff metal form ties with integral waterstops shall be provided for all liquid containment structures and below grade walls which have occupied interior spaces.
    b. Snapoff ties shall be designed so that:

1) The portion remaining with the concrete after removal of exterior parts is at least 1-1/2 inches from the formed concrete surface
2) A cone shaped a hole not larger than 1-inch diameter and 1-1/2 inches deep remains in the concrete surface. The minimum diameter of the hole shall not be less than 3/8 inch.

c. Snapoff metal form ties used with concrete formliner shall be 316 stainless steel.

3. The tie holes shall be filled with a cement mortar to match color and texture of the adjacent concrete surfaces.

B. Acceptable Manufacturers:

1. Dayton Superior Concrete Accessories
2. Or Approved equal

2.2 CHAMFER STRIPS

A. Characteristics:

1. Type: Triangular fillets with nailing flange
2. Material: Extruded vinyl
3. Size: ¾-inch x ¾-inch or as indicated on the Contract Drawings.

B. Acceptable Manufacturers:

1. Greenstreak
2. Vinylex Waterstop & Accessories
3. Dayton Superior Concrete Accessories
4. Or Approved equal

2.3 WATERSTOPS

A. Polyvinylchloride (PVC) Waterstops

1. PVC material shall be compounded from virgin PVC resins and shall contain no reclaimed, reground or reworked materials. The material shall meet the following physical property requirements.

Property	Test	Requirement
Tensile Strength (psi)	ASTM D412	1400 min
Ultimate Elongation (%)	ASTM D412	280 min
Hardness, Type A Durometer	ASTM D2240	65-88
Stiffness in Flexure (psi)	ASTM D747	750 min
Specific Gravity	ASTM D792	1.38 max.
Water Absorption in 48 hrs.(%)	ASTM D570	.5 max.
Low Temperature Brittleness	ASTM D746	No sign of failure @ 35ºF
Accelerated Aging		
- Tensile Strength (psi)	CRD-C-572	1500 min.

- Elongation (%)	CRD-C-572	300 min
Effect of Alkali in 7 Days		
- Weight Change (%)	CRD-C-572	-.10 to +.25
- Hardness, Type A Durometer	CRD-C-572	± 5 max.
- Tensile Strength Change (%)		-15 max.

2. Construction and Control Joints

   a. Type: Ribbed Flat
   b. Size: 6-inch wide x 3/8-inch thick (minimum at any point) with 5/8-inch rib and center bulb.
   c. Head Pressure Rating: 175 ft water
   d. Securely wired to reinforcement
   e. Split units may be used instead of splitting the formwork.

3. Expansion Joints

   a. Type: Ribbed with center bulb
   b. Size: 9-inch wide x 3/8-inch thick (minimum at any point) with ½-inch ID, 1” OD center bulb (minimum)
   c. Head Pressure Rating: 175 ft water

4. Acceptable Manufacturers:

   a. No. CR-9380 and No. CR-6380 Wirestop by Paul Murphy Plastics Company;
   b. No. RLB9 and No. RB6-38 by Vinylex;
   c. No. 718 and No. 70S by Greenstreak;
   d. Or Approved Equal.

B. Hydrophilic Waterstops

1. Hydrophilic waterstops shall be installed where new concrete is placed against existing concrete and watertightness is required and as shown on the Contract Drawings.
2. Hydrophilic waterstops shall be manufactured from a natural rubber product that has been chemically bonded to a hydrophilic agent. The product shall undergo expansion when exposed to moisture. The hydrophilic waterstop shall have an embedded stainless steel mesh to direct expansion in the thickness direction and restrict expansion in the longitudinal direction. The product shall develop an expansion pressure not less than 400 psi. The product shall withstand a hydraulic head pressure of a minimum of 150 feet. The product shall be suitable for use in wastewater and wastewater anaerobic sludge digester applications.
3. Physical Properties

Property	Test Method	Requirement
Hardness Hs	JIS K 6253	A30
Tensile Strength	JIS K 6251	0.9 MPa
Elongation	JIS K 6251	560 %
Specific Gravity	JIS K 6350	1.18
Change in Volume		120 %
Change in Mass		≤ 5.0 %

4. Hydrophilic waterstop shall be installed in conjunction with a hydrophilic paste. This paste shall be used to secure the hydrophilic waterstop to the surface of the concrete.
5. Install hydrophilic waterstop and hydrophilic paste in accordance with the manufacturer's recommendations.
6. Acceptable Manufacturer's

    a. Adeka Corporation

        1) Waterstop: Ultra Seal MC-2010MN
        2) Hydrophilic Paste: Ultra Seal P-201

    b. BBZ USA, Inc.

        1) Waterstop: Duroseal Gasket Type 2010
        2) Hydrophilic Paste: Duroseal Paste

    c. Greenstreak

        1) Waterstop: Hydrotite
        2) Hydrophilic Paste: Leakmaster

    d. Or Approved Equal

2.4 JOINT MATERIALS

A. Expansion Joint Filler

1. Characteristics

    a. Type: Preformed, closed cell Joint Filler
    b. Material: superior grade polyethylene, non-extruding PVC or Virgin homogeneous sponge rubber conforming to ASTM D1752, Type I. Granulated materials shall not be permitted. Where required, backer material shall conform to ASTM D 5249.
    c. Joint filler material shall be held back for sealants.
    d. Thickness: As required

2. Acceptable Manufacturers

    a. A.P. S. Cork
    b. W.R. Meadows, Inc.
    c. Sonolastic Expansion Joint Filler by Sonneborn
    d. Rodofoam II by W.R. Grace

e. Or Approved equal

B. Isolation Joint Filler Material

1. Characteristics

a. Type: Preformed closed cell rigid foam, cork, or non-impregnated fiberboard.
b. Thickness: As required
c. Joint filler material shall be held back for sealants.

2. Acceptable Manufacturers

a. Conflex LT by Masonite Corporation Building Products
b. Or Approved equal.

C. Control Joint Strips

1. Characteristics

a. Type: Prefabricated 1/8-inch thick tempered hardboard conforming to AHA A135.4, Class 1 In lieu of hardboard strips, rigid polyvinyl chloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to control cracking. Such strips shall have a removable top section.
b. Dimensions:

1) Width: 1/8 inch
2) Depth:

a) Reinforced Concrete: ½-inch deep
b) Unreinforced Concrete: $^1/_3$ of concrete thickness

D. Sealants:

1. Sealants for expansion joints in structures designed for submerged conditions to either contain or hold out liquids including groundwater such as process basins, basements, flow channels, galleries, etc. shall be polysulfide material. Sonneborn "Sonolastic - Two-Part," Tamms Industries "Hornflex," or approved equal.
2. Sealants for non-submerged conditions are as specified in Joint Sealants Section 079200.

E. The joint fillers shall be compatible as a back-up material, with regard to the sealant not bonding to or being stained by the backup. If the joint filler is a material that will bond to the sealant, polyethylene tape or backing rods shall be used to cover the backup. The polyethylene and backing rod material shall be of a type that will not bond to the sealant.. Construction joints for interruptions in slabs on grade concrete placements shall be fabricated from 18 gage galvanized steel shaped to form a tongue-and-groove mechanical key joint. Preformed knock-out holes shall be provided. The unit shall be the same depth as the concrete. "Vulco Screed Joint II" (free flow) as made by Vulcan, "Tongue & Groove" joint #95 as made by Heckmann, "Keyed Kold Joint" as made by Burke, or approved equal.

F. Construction joints for interruptions in concrete placement in mat foundations, beam and slab systems, and walls shall be made from lumber with custom cut holes or slots to pass all

reinforcing through and with standard keyway and waterstop. These "bulkheads" are to be securely fastened to the deck, wall, and/or beam forms. They shall be the same depth as the concrete section and produce dense, clean, sharp edges (top, bottom and side) when stripped.

G. A dowel and sleeve combination shall be provided at expansion joints in concrete slabs or walls as shown on the Drawings. Smooth steel dowels shall be provided with a close fitting sleeve of pipe or conduit. The plain steel dowel shall conform to ASTM A572 or A588 with 50 ksi yield strength. One end of the sleeve shall be sealed against concrete intrusion by capping, plugging or crimping. The sleeve shall provide positive means to assure l-inch free travel of the dowel after installation. The dowel shall be lubricated with grease just prior to installation of the sleeve.

2.5 BAR SUPPORTS

A. Bar supports shall be a non-bleeding and non-staining material where concrete surfaces remain exposed. Plastic tipped or stainless steel protected bar supports shall be used for this purpose.

B. Bar supports bearing on grade, insulation, or soft material shall be continuous runner type supplied with continuous welded-on plates to assure proper support of reinforcing. Individual high chair supports will not be considered adequate.

C. The use of brick or block support for reinforcement shall not be permitted.

2.6 VAPOR BARRIER

A. Characteristics

1. Type: Polyethylene sheets, minimum thickness 10 mils.

2.7 MEMBRANE WATERPROOFING

A. Membrane waterproofing shall be liquid applied polyurethane elastomer.

2.8 OTHER ACCESSORIES

A. As shown or required.

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise shown or specifies, install concrete accessories in accordance with Section 031113 and Section 033100.

B. Install factory fabricated products in accordance with manufacturer’s printed instructions.

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3.2 CHAMFER STRIPS

A. Install chamfer strips on external corners.

3.3 VAPOR BARRIER

A. Do not lay vapor barrier sheeting until immediately prior to placing of reinforcing and concrete.

B. Use the greatest widths and lengths practicable to eliminate joints wherever possible.

C. Seal all vapor barrier seams as recommended by the manufacturer.

D. Patch and seal all vapor barrier breaks as recommended by the manufacturer.

E. Do not place concrete over vapor barrier until all breaks have been patched and sealed.

F. Concrete placement must not damage vapor barrier. Place a 2-inch layer of approved damp compactable fill over vapor barrier before placing concrete.

3.4 WATERSTOPS

A. Installation

1. Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm.
2. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Waterstops shall be wire tied to the steel reinforcement. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.
3. Splices shall be made by certified trained personnel using approved equipment and procedures.
4. All waterstops shall have a minimum of 2 inches of cover.

B. PVC Waterstop Splices

1. Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding.
2. The correct temperature shall be used to sufficiently melt without charring the plastic.
3. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.
4. Edge welding will not be permitted.
5. Centerbulbs shall be compressed or closed when welding to non-centerbulb type.
6. Waterstop splicing defects which are unacceptable include, but are not limited to the following:

    a. Tensile strength less than 80 percent of parent section.

b. Free lap joints.
c. Misalignment of centerbulb, ribs, and end bulbs greater than 2 mm 1/16 inch.
d. Misalignment which reduces waterstop cross section more than 15 percent.
e. Bond failure at joint deeper than 2 mm 1/16 inch or 15 percent of material thickness.
f. Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 13 mm in 3 m 1/2 inch in 10 feet.
g. Visible porosity in the weld area, including pin holes.
h. Charred or burnt material.
i. Bubbles or inadequate bonding.
j. Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

C. Hydrophilic Waterstop Splices

1. Ends to be joined shall be miter cut with sharp knife or shears. The ends shall be adhered with cyanacryiate (super glue) adhesive.
2. When joining hydrophilic type waterstop to PVC waterstop, the hydrophilic waterstop shall be positioned as shown on the drawings. A liberal amount of a single component hydrophilic sealant shall be applied to the junction to complete the transition.

3.5 CONSTRUCTION JOINTS FOR SLABS ON GRADE

A. Construction joints are placed in the slab where the concreting operations are concluded for the day in conformity with a predetermined joint layout (i.e., at location of control or isolation joints).

B. If concreting is interrupted long enough at any time for the placed concrete to harden, a construction joint shall be used, the location of which shall be approved by the Engineer.

C. If possible, construction joints should not be located nearer than 5 feet from any other joint to which they are parallel.

D. NOTE: Foundation mats are not slabs on grade.

3.6 CONSTRUCTION JOINTS FOR SUPPORTED MEMBERS

A. Construction joints shall be located near the middle third of spans of slabs, beams, or girders, unless a beam intersects a girder at the location, in which case joints in the girders shall be offset a distance equal to twice the width of the beam.

B. Provisions shall be made for transfer of shear and other forces through construction joints by means of ledges, extended bars, dowels, etc.

C. Construction joints in supported slabs shall be arranged such that the slab dimensions do not exceed a 2:1 length to width ratio. Beams, girders, or slabs supported by concrete columns or walls shall not be cast or erected until concrete in the vertical support members has an age of at least 12 hours. Beams, girders, column capitals, and haunches shall be considered as part of a slab system and shall be placed monolithically therewith

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3.7 EXPANSION JOINTS

A. Expansion joints shall be provided as shown on the Drawings.

B. Reinforcement or other fixed items embedded or bonded into the concrete shall not be run through expansion joints.

C. Provide appropriate expansion dowels as shown.

D. Install waterstop.

E. Dress edges of concrete corners to provide a smooth, uniform edge.

3.8 ISOLATION JOINTS FOR SLABS ON GRADE

A. The floor shall be separated structurally from other building elements to accommodate differential movement.

B. Isolation joints shall be used at junctions with walls, columns, foundations, and footings, or other points of restraint, such as drain pipes, chimneys, sumps, stairways, etc.

C. Joint material shall be removed to the depth required for installation of the sealant.

3.9 CONTROL JOINTS IN SLABS ON GRADE

A. Control Joints in Slabs on Grade shall be provided as shown on the Drawings.

B. In the event none are shown or are only partially shown, no slab larger than 5 feet shall be constructed without a control joint.

C. Joints shall be formed either with a premolded joint insert.

D. The width of the premolded joint insert or saw cut shall be a minimum of 1/4-inch and a depth of 1-1/2 inches.

E. The joints shall be filled with sealant.

F. NOTE: Foundation mats with two layers of reinforcement are not slabs on grade.

3.10 CONTROL/CONSTRUCTION JOINTS IN WALLS

A. Wall control/construction Joints shall be placed at locations as shown on the Drawings or at maximum intervals of 30 feet.

B. Locate control joints to line up with masonry control joints as shown on the architectural drawings.

C. Wall control joints require special V-strip chamfers on both faces as detailed on the Drawings and interruption of 50 percent of the horizontal reinforcement. The top two bars in a wall shall be uninterrupted through the joint.

D. The joint layout shall be shown on the reinforcing shop drawings, in exposed areas carefully incorporated in the concrete finish work.

E. When wall placements must be terminated, construction joints shall be installed in advance of the day's placement.

F. Waterstops shall be installed at all control/ construction joints in tanks, flow channels, basements, roof decks, etc., which are intended to hold liquid or keep areas dry.

G. It is the Contractor's responsibility to layout the waterstops and assure continuity of intended design.

H. All construction joints shall be wetted immediately before new concrete placement.

I. Joints shall be thoroughly vibrated during concrete placement.

J. The control/construction joints shall be filled with sealant.

3.11 SEALANT

A. Where joint filler is flush with the adjacent concrete, enough filler material shall be removed so the joint can be sealed to the specified depth.

B. The sealant shall be installed in accordance with the manufacturer's instructions. Primer shall be applied as recommended by the manufacturer.

C. The sealant depth shall be controlled by the use of joint-fillers or back-up materials. The back-up material shall be non-impregnated and compressible; such as backer rod.

D. Backer rod shall be about 1/8-inch larger in diameter than the width of the joint to allow for compression.

E. Where the depth of the joint does not permit the use of backer rod, a bond breaker (polyethylene strip) must be used to prevent bonding to the back of the joint.

F. Sealant shall be applied to both sides of all joints where accessible.

G. Joint wide and sealant depth:

Joint Width Inches	Sealant Depth at Midpoint
0.25 to 0.50 inches	0.25 inches
0.50 to 1.00 inches	0.375 to 0.50 inches
1.0 to 2.0 inches	1.50 inches

END OF SECTION 031500

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SECTION 032100 - REINFORCING STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reinforcing bars.
2. Reinforcement accessories.

B. Related Sections:

1. Section 031113 “Structural Cast-in-Place Concrete Forming”
2. Section 032100 “Reinforcing Steel”
3. Section 033100 “Welded Wire Fabric Reinforcing”
4. Section 033100 “Structural Concrete”
5. Section 031500 “Concrete Accessories”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 315 Details and Detailing of Concrete Reinforcement
3. ACI 315R Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
4. ACI 318 - Building Code Requirements for Structural Concrete.
5. ACI 350.4R-04 - Design Considerations for Environmental Engineering Concrete
6. ACI 350-06 - Code Requirements for Environmental Engineering Concrete Structures
7. ACI 530.1 - Specifications for Masonry Structures.
8. ACI SP-66 - ACI Detailing Manual.

C. ASTM International:

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
6. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

D. American Welding Society:

1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

E. Concrete Reinforcing Steel Institute:

1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Shop Drawings:

1. Prior to rebar detailing and fabrication, the Contractor shall submit his proposed joint locations and waterstop details for review. When the construction joint locations have been finalized, the Contractor shall provide the reinforcing steel fabricator with the locations of the joints and notify the steel fabricator to proceed with the reinforcing steel shop drawings.
2. Show locations of all construction, expansion, isolation, control and other joints in the concrete work.
3. Show detail layouts of jointing and reinforcement, including dimensions, bar sizes, openings and spacings, locations, types and and quantities of reinforcing steel, bending and cutting schedules, splicing, welds, stirrup spacing, supporting and spacing devices, and similar items required for the proper construction of the work.
4. Include the bar schedules, the individual weight of each bar, the total weight of each bar size, and the total weight on each schedule list.
5. Manufacturer’s specifications and other data required to demonstrate compliance with specific requirements.
6. A complete bill of materials list showing all items to be furnished and installed under this Section.

C. Certificates:

1. Submit AWS qualification certificates for welders employed on the Work.
2. Submit certified copies of mill test certificates of reinforcement materials analysis.

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1.4 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI - Manual of Standard Practice

B. Prepare shop drawings in accordance with ACI SP-66.

1.5 QUALIFICATIONS

A. Welders: AWS qualified within previous 12 months.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

1.7 COORDINATION

A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. General Requirements:

1. All reinforcement shall be as shown on the Contract Drawings and conform with the below listed requirements.

B. Deformed Reinforcement: ASTM A615/A615M; 60 ksi yield strength, steel bars:

1. Unfinished.

C. Deformed Reinforcement - Welded: ASTM A706/A706M; 60 ksi yield strength, steel bars:

1. Unfinished.

D. Deformed Bar Mats: ASTM A184/A184M; fabricated from ASTM A615/A615M 60 ksi yield strength, steel bars:

1. Unfinished.

E. Deformed Bar Mats - Welded: ASTM A184/A184M; fabricated from ASTM A706/A706M 60 ksi yield strength, steel bars:

1. Unfinished.

F. Stirrup Steel: ANSI/ASTM A82:

1. Unfinished

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage, annealed type, galvanized.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic tipped steel type; size and shape to meet Project conditions.

2.3 FABRICATION

A. Fabricate concrete reinforcement to shapes and dimensions indicated in accordance with CRSI Manual of Practice, ACI SP-66 and ACI 350-06.

B. Fabrication tolerances shall be in accordance with the CRSI “Manual of Standard Practice”

C. Bend reinforcement cold; heating of bars shall not be permitted.

D. Once bent, do not straighten or rebend bars; reject bars which show evidence of reduced cross-section or kinks.

E. Weld reinforcement in accordance with AWS D1.4.

F. Splices:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
2. Where welded splices are permitted, conform to AWS D1.4.
3. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Indicate location of splices on shop drawings.
4. Minimum lap for Grade 60 steel shall be as follows:

Bar Size	Top Bars in Beams and Slabs And Horizontal Wall Bars		All Other Bars
#4	2’-2”		2’-0”
#5	2’-8”		2’-0”
#6	3’-2”		2’-6”
#7	4’-8”		3’-6”
#8	5’-4”		4’-0”
#9	6’-0”		4’-0”
#10	6’-8”		5’-2”

G. Unacceptable materials: Reinforcement with any of the following defects will not be permitted in the work:

1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
2. Bends or kinks not indicated on the Contract Drawings or final Shop Drawings.
3. Bars with reduced cross-sections due to excessive rusting or other causes.

2.4 SOURCE QUALITY CONTROL

A. Make completed reinforcement available for inspection at manufacturer's factory prior to packaging for shipment. Notify the Engineer at least seven days before inspection is allowed.

B. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Place reinforcement and embedded items as shown on the Contract Drawings, support and secure against displacement. Do not deviate from required position beyond specified tolerance.

B. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy the bond with concrete

C. Drill required holes for rebars into existing concrete and embed rebars using anchoring compound where required

D. Reinforcing supports:

1. Provide sufficient number of supports and of strength necessary to carry reinforcement.
2. Locate and support concrete reinforcement utilizing chairs, runners, bolsters, spacers, and hangers in accordance with CRSI "Manual of Standard Practice".
3. Do not use stones, brick, wood blocks, or pieces of broken concrete to support reinforcing steel.
4. Do not place reinforcing bars more than 2-inches beyond the last leg of any continuous bar support.
5. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
6. Do not weld crossing reinforcement bars for assembly except as permitted by the Engineer.

E. Set ties so ends are directed into concrete, not toward exposed concrete surfaces.

F. Do not displace or damage vapor retarder.

G. Accommodate placement of formed openings.

H. Space reinforcement bars with minimum clear spacing in accordance with ACI 318.

1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.

I. Maintain concrete cover around reinforcement as follows:

Reinforcement Location			Minimum Concrete Cover Inches
Concrete cast against and permanently exposed to earth			3
Concrete exposed to earth, weather or work mat slab	Slabs and Joists Beams and Columns-Stirrups, Spirals and Ties Walls Footings and Base Slabs-Formed Surfaces and Top of Footings and Base Slabs		2
	Beams and Columns-Primary Reinforcement		2.5
Concrete not exposed to earth or in contact with earth	Slabs and joists:	No. 14 and No 18 bars	1-1/2
		No. 11 and smaller	3/4
	Beams and Columns	Stirrups, Spirals and Ties	1-1/2
	Beams and Columns	Primary Reinforcement	2
	Walls	No. 11 and smaller	3/4
	Walls	No. 14 and No 18 bars	1-1/2
Concrete exposed to water or sewerage	Slabs, walls		3

J. Splice reinforcing where indicated on Drawings.

K. Bond and ground reinforcement in accordance with requirements of Section 260526.

L. Ensure reinforcement is clean and free of rust, scale, paint, grease, and other objectionable materials.

3.2 ERECTION TOLERANCES

A. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

B. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

3.3 FIELD QUALITY CONTROL

A. Provide free access to Work and cooperate with the Engineer.

B. Field inspection of reinforcing will be performed by the Engineer

C. Reinforcement Inspection:

1. Placement Acceptance: Specified material requirements and specified placement tolerances.
2. Welding: Inspect welds in accordance with AWS D1.1.
3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
4. Weldability Inspection: Inspect for reinforcement weldability when formed from steel other than ASTM A706/A706M.
5. Continuous Weld Inspection: Inspect reinforcement as required by ACI 318
6. Periodic Weld Inspection: Other welded connections.

END OF SECTION 032100

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SECTION 032200 - WELDED WIRE FABRIC REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Welded Wire Fabric Reinforcing

B. Related Sections:

1. Section 032100 “Reinforcing Steel”
2. Section 033100 “Structural Concrete”
3. Section 031500 “Concrete Accessories”
4. Section 031113 “Structural Cast-in-Place Concrete Forming”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Concrete Institute:

1. ACI 301 – Specifications for Structural Concrete.
2. ACI 318 – Building Code Requirements for Structural Concrete.
3. ACI 315 Details and Detailing of Concrete Reinforcement
4. ACI 315R Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
5. ACI 350.1-01 / 350.1R-01 – Tightness Testing of Environmental Engineering Concrete Structures and Commentary
6. ACI 350.2R-04 – Concrete Structures for Containment of Hazardous Materials
7. ACI 350.3-06 – Seismic Design of Liquid-Containing Concrete Structures and Commentary
8. ACI 350.4R-04 – Design Considerations for Environmental Engineering Concrete
9. ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures
10. ACI SP-66 – ACI Detailing Manual.
11. ACI 506.2-13 – Specification for Shotcrete
12. ACI 506R-16 – Guide to Shotcrete

C. ASTM International:

1. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
2. ASTM A185/185M – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
3. ASTM A496 – Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
4. ASTM A497 – Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
5. ASTM A704/A704M – Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.

D. American Welding Society:

1. AWS D1.4 - Structural Welding Code – Reinforcing Steel.

E. Concrete Reinforcing Steel Institute:

1. CRSI – Manual of Standard Practice.
2. CRSI – Placing Reinforcing Bars.

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Shop Drawings:

1. Indicate sizes, locations, and quantities and types of welded wire fabric.
2. Manufacturer’s specifications and other data required to demonstrate compliance with specific requirements.
3. A complete bill of materials list showing all items to be furnished and installed under this Section.

C. Certificates:

1. Submit certified copies of mill test certificates of reinforcement materials analysis.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI – Manual of Standard Practice

B. Prepare shop drawings in accordance with ACI SP-66.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

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1.6 COORDINATION

A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Welded Steel Wire Fabric: ASTM A1022/A1022M, plain type; in flat sheets:

1. Unfinished

2.2 SOURCE QUALITY CONTROL

A. Make completed reinforcement available for inspection at manufacturer's factory prior to packaging for shipment. Notify the Engineer at least seven days before inspection is allowed.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh.

B. Place as shown on the Contract Drawings, support and secure against displacement. Do not deviate from required position beyond specified tolerance.

C. Locate and support concrete reinforcement utilizing chairs, runners, bolsters, spacers, and hangers in accordance with CRSI "Manual of Standard Practice". Do not use stones, brick, wood blocks, or pieces of broken concrete to support reinforcing steel.

D. Set ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Do not displace or damage vapor retarder.

F. Accommodate placement of formed openings.

3.2 FIELD QUALITY CONTROL

A. Provide free access to Work and cooperate with the Engineer.

B. Field inspection will be performed by the Engineer.

END OF SECTION 032200

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SECTION 033100 - STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for the following:

1. All cast-in-place concrete required for the completion of the work.

B. Related Sections:

1. Section 030551 “Concrete Bonding Agents”
2. Section 030555 “Concrete Admixtures and Additives”
3. Section 031113 “Structural Cast-in-Place Concrete Forming”
4. Section 031500 “Concrete Accessories”
5. Section 032100 “Reinforcing Steel”
6. Section 032200 “Welded Wire Fabric Reinforcing”
7. Section 033500 ‘Concrete Finishing”
8. Section 033900 “Concrete Curing.”
9. Section 079200 “Joint Sealants”
10. Section 036000 “Grout”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Concrete Institute:

1. ACI 211.1-91 - Standards Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
2. ACI 214R-02 - Evaluation of Strength Test Results of Concrete
3. ACI 214R-03 - Guide for Obtaining Cores and Interpreting Compressive Strength Results
4. ACI 301 - Specifications for Structural Concrete.
5. ACI 302.1R-04 - Guide for Concrete Floor and Slab Construction
6. ACI 304R-00 - Guide for Measuring, Mixing, Transporting, and Placing Concrete
7. ACI 304.2R-96 – Placing Concrete by Pumping Methods
8. ACI 304.4R-95 – Placing Concrete with Belt Conveyors

9. ACI 305.1-06 - Standard Specifications for Hot Weather Concreting
10. ACI 305 - Hot Weather Concreting.
11. ACI 306.1 - Standard Specification for Cold Weather Concreting
12. ACI 306R-88 – Cold Weather Concreting
13. ACI 309R-05 – Guide for Consolidation of Concrete
14. ACI 318-08 - Building Code Requirements for Structural Concrete
15. ACI 350.1-01 / 350.1R-01 – Tightness Testing of Environmental Engineering Concrete Structures and Commentary
16. ACI 350.3-06 - Seismic Design of Liquid-Containing Concrete Structures and Commentary
17. ACI 350.4R-04 - Design Considerations for Environmental Engineering Concrete
18. ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures

C. ASTM International:

1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
6. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
9. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C227 – Potential Alkali Reactivity of Cement Aggregate Combinations (Mortar Bar Method)
11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C294 – Standard Descriptive Nomenclature of Constituents of Concrete Aggregates
13. ASTM C295 – Standards Guide to Petrographic Examination of Aggregates for Concrete
14. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
15. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
16. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
17. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
18. ASTM C666/C666M – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
19. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
20. ASTM C823/C823M - Standard Practice for Examination and Sampling of Hardened Concrete in Construction
21. ASTM C856 – Standard Practice for Petrographic Examination of Hardened Concrete
22. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
23. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

24. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
25. ASTM C1077 – Standard Practice for Laboratories Testing concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
26. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
27. ASTM C1218/C1218M - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
28. ASTM C1222 – Practice for Evaluation of Laboratories Testing H\ydraulic Cement
29. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
30. ASTM C1260 - Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)
31. ASTM C1293 - Test Method for Concrete Aggregates by Determination of Length Change of Concrete Due to Alkali-Silica Reaction (Concrete Prism Test)
32. Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method).

D. New York State Department of Transportation Standard Specifications (NYSDOT-SS):

1. Section 501-2.03 - Concrete Batching Facility Requirements
2. Section 501-3.03 - Concrete Mixing, Transporting and Discharging
3. Section 703 - Aggregates

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Product Data: Submit data for all materials and admixtures, including but not limited to the following as applicable:

1. Portland Cement: Brand and manufacturer’s name.
2. Fly ash: Brand and manufacturer’s name.
3. Aggregates: Name and location of source, and DOT test numbers

C. Concrete Mix Design Data:

1. Submit trial concrete mix designs, including slump, admixtures, air-entrainment, water-cement ratio, and results of 1-day, 3-day, 7-day or 28-day compressive strength tests for each concrete strength and type of concrete. Indicate what will be added at the batch plant and what will added to the mix at the site. Alternate sources of materials require separate individual mix designs.
2. When materials change or strengths change, additional mix designs will be submitted at the contractor’s cost.
3. Submit separate mix designs when admixtures are required for the following:

    a. Hot and cold weather concrete work.

4. Identify mix ingredients and proportions, including admixtures.
5. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

D. Certification of Compatibility

1. Contractor shall provide certification that all materials and admixtures are compatible with each other.

E. Laboratory Test Data:

1. Laboratory test reports by the supplier of the aggregates containing data on the mineralogy (ASTM C295) and potential reactivity of the aggregates as specified in Section 2.01 herein.
2. Laboratory test reports by the supplier of the Portland Cement containing the alkali content of the cement in percent expressed as Na2O equivalent.
3. Laboratory test reports by the supplier of the pozzolanic material demonstrating compliance with the subsection 2.2.
4. Laboratory test reports by the supplier of chemical admixtures containing information on the chloride ion content and alkali content expressed as Na2O equivalent. Test reports are not required for air entraining admixtures used at dosages less than 130 ml per 100 kg (2 fl oz per 100 lb) or cement of nonchloride chemical admixtures used at maximum dosages less than 325 ml per 100 kg (5 fl oz per 100 lb). Both the chloride ion and total alkali content of the admixtures are to be expressed in percent by mass of cement for a stated or typical dosage of the admixture.
5. Laboratories supplying test reports or data shall provide evidence that the laboratory is properly equipped and qualified to perform the tests method(s) in conformance with ASTM C1077 and C1222.

F. Mill test certificates and test reports for cement indicating compliance with these specifications

G. Test results for aggregates, water and field tests

H. Concrete supplier, as well as location and type of batching plant

I. Detailed methods of placing concrete, including sequence of placement, type of equipment (pumps or chutes) and expected size of each placement.

J. Working drawings, showing number, location and details of construction joints, and concrete pour sequences, to scale

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, 318 and 350 as applicable.

B. Conform to ACI 305 when concreting during hot weather.

C. Conform to ACI 306 when concreting during cold weather.

D. Acquire cement and aggregate from one source for Work.

1.5 SOURCE QUALITY CONTROL

A. Portland Cement - Mill test certificates identifying chemical and physical analysis.

B. Aggregates - Perform tests by an approved independent testing laboratory, prior to use, to show compliance with these specifications:

1. Such tests which have been made within six (6) months prior to the use of the aggregates will be acceptable.
2. Gradation tests shall be performed at the point of use.
3. The source of the material shall not be changed without retesting.
4. All aggregates shall be tested for compliance with the specifications at a minimum of one year intervals during the course of the work.
5. Coarse aggregates shall be obtained from a NYSDOT approved operating source.

C. Water - Questionable sources of water, as determined by the Engineer, shall be tested in accordance with AASHTO T26 and ACI 301.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

1.7 COORDINATION

A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type II - Moderate. Tricalcium aluminate (C3A) shall be limited to a maximum of seven (7) percent. Use only approved brands without change for the entire project. Cement used throughout the entire project shall be uniform in color so as not to detract from the appearance of the exposed concrete.

B. Fine Aggregate: Natural sand conforming to the requirements of ASTM C33.

1. Soundness of the aggregate shall conform to the following:

a. Sodium sulfate: Maximum seven (7) percent loss.

a. Magnesium sulfate: Maximum fifteen (15) percent loss.
b. Organic impurities shall not be allowed.
c. Sand exhibiting a color darker than the referenced color shall be rejected.

C. Coarse Aggregate: Crushed gravel or crushed stone meeting the requirements of ASTM C33 and NYSDOT specification 703.02. Gradation shall conform to the Table 703-4 of the NYSDOT specification with the maximum size aggregate for various types of work as follows:

1. No. 1A size with not more than ten (10) percent passing a #4 sieve:

a. Bond Beam Fill

2. No. 1 size:

a. Slabs less than seven (7) inches in depth

1) Beams, girders and columns less than twelve (12) inches in width

3. Use a mixture of No. 1 size and No. 2 size conforming to the following gradation for general work having a cross-sectional dimension of 12 inches or greater:

Primary Size	Percent Passing
1-1/2”	100
1”	90-100
¾”	60-90
½”	22-50
¼”	0-6

D. Water: ACI 318; potable, without deleterious amounts of chloride ions. Water from an unpotable source must be approved by the engineer prior ton use

2.2 AGGREGATE EVALUATION FOR ALKALI-SILICA REACTION POTENTIAL

A. Aggregates used in concrete shall conform to the requirements of ASTM C33. Testing and evaluation for alkali-silica reaction are summarized below:

1. Petrographic analysis in accordance with ASTM C295 shall identify the constituents of the fine and coarse aggregate. Fine and coarse aggregate containing more than the following quantities of constituents shall be considered potentially reactive:

a. Optically strained, microfractured, or microcrystalline quartz exceeding 5.0%.

1) Chert or chalcedony exceeding 3.0%
2) Tridymite or cristobalite exceeding 1.0%
3) Opal exceeding 0.5%
4) Natural volcanic glass in volcanic rocks exceeding 3.0%

2. Aggregates shall be screened by ASTM C1260. Aggregate sources which exhibit ASTM 1260 mean mortar bar expansion at 14 days exposure greater than 0.10% shall be considered potentially reactive.
3. Aggregates considered potentially reactive by 2.2.A .1 or 2.2.A.2 may be further evaluated by ASTM C1293. Aggregate sources which exhibit mean concrete prism expansion at one year greater than 0.04%, shall be considered potentially reactive. Aggregate sources exhibiting expansions no more than 0.04% and demonstrating no prior evidence of reactivity in the field shall be considered nonreactive.
4. Aggregates that have shown evidence of reactivity in service shall be considered potentially reactive regardless of the results of 2.2.A.1, 2.2.A.2, and 2.2.A.3. Determination of reactivity in structures must include:

a. Petrographic analysis of cores by ASTM C856

1) Visual examination of cracking and expansion of elements of the structure
2) Evaluation of available data, including construction records.

B. When aggregates are determined to be potentially reactive with alkalies, an evaluation of the effectiveness of the pozzolan in controlling the deleterious expansion of the design mix shall be determined in conformance with the requirements of 2.3.E below; or the aggregate shall not be used.

2.3 CONCRETE MIX

A. All mix designs shall be proportioned in accordance with Section 4.3 (Field Experience) or Section 4.4 (Trial Batches) of ACI 318-83, and ACI 350-06 Section 5.3 (Proportioning on the basis of field experience, trial mixtures, or both). If trial batches are used, they shall be established by an approved commercial testing laboratory employed by the Contractor. The proposed mix design shall be designed to achieve an average strength as follows .

28 Day Compressive Strength f'_c	Required Average Compressive Strength f'_{cr}
≤ 5000 psi	f'_c + 1200 psi
> 5000 psi	$1.10f'_c$ + 700 psi

B. Mix design submittals shall indicate the amounts of all ingredients including cement, admixtures and the weight of the aggregates stated in a saturated surface dry condition.

C. Concrete Class designations:

Class	28 Day Compressive Strength	Maximum Water to Cement Ratio (W/C) By Weight	
		Non-Air Entrained	Air Entrained
A	5,000 psi	0.42	0.35
B	4,000 psi	0.56	0.46
C	3,000 psi	0.68	0.58
D	2,500 psi	0.74	0.64

1. The various classes of concrete shall be designated as follows:
2. All concrete shall be Class “A” , Air Entrained and watertight unless otherwise noted below:

   a. Structural concrete for buildings shall be Class A cast-in place concrete.
   b. Concrete for buried thrust blocks shall be Class D.
   c. Concrete for bollards and fence posts shall be Class C.

D. In addition to the requirements above, these specific requirements shall be considered in the mix design:

1. All concrete slabs less than eight (8) inches in thickness, when placed in temperatures below 50°F, shall contain the specified non-chloride accelerator.
2. All concrete shall contain an approved water reducing admixture or an approved high range water reducing admixture (superplasticizer)
3. All pumped concrete, watertight concrete and concrete with a water to cement ratio below 0.50 shall contain the high range water reducing admixture
4. Cement contents shall be chosen to provide the minimum strengths for each class as shown in the Concrete Class Table above. The amount of cement content, however, shall not be less than the following:

    a. Class "A": 600 pounds per cubic yard
    b. Class "B": 550 pounds per cubic yard
    c. Class “C”: 515 pounds per cubic yards
    d. Toppings: 600 pounds per cubic yard (for Metal Pan Stairs)

5. All concrete exposed to weather, or water, or subject to freezing shall be air-entrained with an approved entraining admixture.
6. Concrete in contact with ductile iron or cast iron surfaces shall not contain fly ash.

E. When aggregates are determined to be potentially reactive with alkalies, an evaluation of the pozzolan cement combination in the proposed design mix shall be performed in conformance with ASTM C1567. Cementitious materials-aggregate combinations that exhibit ASTM C1567 mean mortar bar expansion at 14 days exposure of less than or equal to 0.10% shall be considered acceptable to control ASR expansion.

F. Slump

1. All concrete containing the high range water reducing admixture (superplasticizer) shall have a maximum slump of eight (8) inches unless otherwise directed by the Engineer. Prior to the addition of the superplasticizer, the concrete shall be tested at the job site and a slump of two (2) inches to three (3) inches shall be verified. The plasticizer may then be added to increase the slump to the approved level. No water shall be added after superplasticizer is added.
2. All concrete not containing a high range water reducing admixture (superplasticizer) shall conform to these maximum slump values, plus or minus one (1) inch:

    a. Reinforced concrete-general 4"
    b. Non-reinforced concrete 3"
    c. Pavements, sidewalks 3"
    d. Heavy mass concrete 3"
    e. Slabs on grade 3"
    f. Floor toppings 2"

3. The values listed above are specified as the "working limit." The average slump values shall be less than the "working limit."
4. Tolerances shall be as per ASTM C94 except that the plus tolerance shall be limited to the "working limit." A deviation of one (1) inch shall be allowed for such occasional batches of concrete that may inadvertently exceed the "working limit". Batches of concrete with slumps exceeding the "working limit" will be rejected if the Contractor fails to comply promptly with the Engineer’s instructions to reduce the slump of the concrete within the "working limit." The Contractor shall not increase mixing time, add

dry materials or otherwise modify a rejected batch for the purpose of conforming to slump limits.

5. Concrete that has been rejected for failure to meet the slump limits shall not be salvaged for use in the work. Rejected concrete shall be replaced at no additional cost to the Owner.
6. Concrete containing the high range water reducing admixture (superplasticizer) may be given additional superplasticizer only when approved by the Engineer. If a time delay has occurred wherein the slump has decreased to a level that is significantly below the maximum approved level, additional admixture may be added to increase the slump to the maximum level, but no additional water shall be added.

G. Air Content

1. Air content for air entrained concrete shall be controlled within the following limits:

a.	General Work	4% to 7%
b.	Concrete exposed to frost	4.5% to 7.5%
c.	Concrete exposed to salt	4.5% to 7.5%
d.	Concrete with maximum 3/4 inch aggregate	4.5% to 7.5%

H. Rate of Hardening

1. Concrete mixes shall be designed to produce the following rates of hardening:

a. General concrete with the following ambient temperatures:

1) 50° - 85° Fahrenheit - normal rate of hardening
2) 80° Fahrenheit - retarded rate of hardening
3) 50° Fahrenheit - accelerated rate of hardening

b. Mass concreting with following ambient temperature:

1) 40° Fahrenheit - retarded rate of hardening

2. Should the contractor feel it advantageous to use modified rates of hardening to improve workmanship or facilitate his work, consideration will be given by the Engineer

I. Mixing Water Control

1. The quantity of mixing water used in the concrete mix shall be determined by the Contractor with the amount used conforming to the various limits on specified slump. However, if the slump of the concrete should exceed the maximum specified slump, the Engineer will direct the Contractor to reduce the quantity of mixing water. Concrete consistency shall be uniform from batch to batch.
2. If deemed necessary by the Engineer during the course of the work, moisture determinations of the aggregates shall be made and aggregate weights and water requirements adjusted accordingly.
3. When concrete is transported in units approved for mixing, the addition of not more than ten percent (10%) of the total design water will be permitted at the job site to obtain the specified initial slump.

a. Any addition of water shall be followed by at least thirty (30) revolutions in the mixing speed range.

1) Not more than two (2) additions of water will be allowed at the point of deposition before discharge.
2) No retempering, defined as the addition of water after the mix has obtained its specified initial set, will be permitted.
3) No water shall be added to the mix after the addition of the superplasticizer.

J. Batching and Mixing

1. Batching

a. The Contractor shall have at his disposal a modern and dependable batch plant within a reasonable distance from the work.

1) The batch plant shall conform to the requirements of the NYSDOT specification 501-2.03 and shall be approved by the NYSDOT.
2) The batching and mixing shall conform to ACI 304 and to the NYSDOT specification 501-3.03.
3) The batching shall be done only with materials previously approved by the Engineer

2. Mixing Transporting and Discharging

a. Conform to ASTM C94 and to the NYSDOT specification 501-3.03.

1) Wastewater must be discharged and not used as mixing water for the next batch.
2) Maximum interval between successive truckloads of concrete discharged into the work shall not exceed thirty (30) minutes when the portion of the work being placed requires more than one load of concrete.

K. Average Compressive Strength Reduction: Not permitted.

L. Bag mixed or hand mixed concrete on site not permitted.

PART 3 - EXECUTION

3.1 PRE-CONCRETE CONFERENCE

A. At least 35 days prior to start of the concrete construction schedule, the Contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete construction.

B. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor's superintendent
2. Laboratory responsible for the concrete design mix.

3. Laboratory responsible for field quality control.
4. Concrete subcontractor.
5. Ready - mix concrete producer.
6. Admixture manufacturer (s).
7. Concrete pumping contractor.

C. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Owner and Engineer.

D. The minutes shall include a statement by the admixture manufacturer(s) indicating that the proposed mix design and placing techniques can produce the concrete quality required by these specifications.

E. The Engineer will be present at the conference. The Contractor shall notify the Engineer at least 10 days prior to the scheduled date of the conference.

3.2 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.3 PREPARATION

A. Chip existing concrete surfaces where indicated to minimum ½" depth, or to the depth necessary to remove localized deterioration, and roughen the surfaces.

B. Apply epoxy bonding compound to existing concrete surfaces as follows:

1. Remove grit and dirt from surface by vacuuming or by means of an air jet.
2. Clean concrete surfaces, removing all grease, oil, dirt, foreign materials, and surface laitance, and expose the aggregate.
3. Mix and apply epoxy bonding compound in accordance with the manufacturer's instructions.

C. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

D. All surfaces that will be in contact with the poured concrete shall be free from standing water, mud, debris, frost, snow and ice.

E. Earth surfaces which are absorptive shall be moistened to a depth of one (1) inch.

F. When the ambient temperature is above 40° Fahrenheit, all subgrade surfaces shall be wetted down with cool water just prior to placement.

G. All reinforcing bars and/or embedded parts shall be cleaned of any coating of oil, grease, ice, dried mortar or any other foreign matter that will prevent bond with the concrete. Any reinforcing bars and/or embedded parts requiring cleaning shall be treated with a bonding agent.

H. Joints

1. Provide expansion and construction joints with planes normal to direction of pressure.
2. Joints shall be provided with suitable keys, waterstops and dowels.
3. Place joints as shown on the plans, the submitted pour sequence drawings, and in accordance with ACI 318 and 350.
4. Joints shall be as specified in Section 031500.

I. Reinforcement

1. Provide concrete reinforcement as shown on the plans and the submitted shop drawings.
2. Reinforcement shall be in conformance with the requirements of Section 032100 and 032200.

J. Formwork:

1. Provide formwork in accordance with the requirements of Section 031113.

K. The Contractor shall build into the concrete such items as reinforcing steel, inserts, sleeves, waterstops, etc., as shown on the Contract Drawings or as specified.

1. All embedded items shall be accurately located and securely fastened in place to prevent displacement during the placement of the concrete.
2. The Contractor shall cooperate with all other trades in permitting ample time for the placement of all necessary sleeves, inserts, conduits, hangers, etc. required for their trades.
3. If in the judgment of the Engineer, the embedded items are placed in such a manner to reduce the structural adequacy of the structure, the Contractor shall take the necessary corrective steps.

L. All anchor bolts for structural steel and mechanical equipment shall be carefully set as shown on the contract drawings and as shown on the fabricator's and manufacturer's reviewed anchor bolt setting plans.

M. All form work, embedded parts, reinforcements, foundation surfaces and joints involved in the work must be inspected by the Engineer.

3.4 PLACING CONCRETE

A. General Requirements

1. Place concrete in accordance with ACI 304.and with these specifications.
2. Conform to the requirements of ACI306R and 305R for placement of concrete in cold and hot weather respectively, and the applicable subsections below.
3. If pumping is used as a method of concrete placement, conform to the requirements of ACI 304, and the applicable subsection below.

4. Notify testing laboratory and the Engineer a minimum 24 hours prior to commencement of operations.
5. Place in dry and take precautions to prevent water from entering or lying in formwork where concrete is being placed or is setting.

    a. Do not place concrete on or next to frozen surfaces. Unless otherwise specified, do not add salts, chemicals or admixtures to the concrete.

        1) Transfer concrete from mixer to point of placement as rapidly as practical; prevent formation of cold joints.

6. Adequate manpower and equipment in the form of buckets, buggies, chutes, conveyors, or other approved means shall be provided and properly maintained by the Contractor to ensure continuous operations.
7. Utilize equipment and methods of placing which will permit rapid placing of concrete of the required consistency, preclude segregation and loss of water from the mix:

    a. Convey concrete by use of conveyors, pipes, chutes, or sprouts to a point not more than 3 feet from its final position.

        1) Do not change material proportions or consistency of concrete to facilitate mixing and placing.
        2) Do not use any pipes, chutes or other equipment made of aluminum.
        3) Deposit concrete vertically, using chutes, elephant trunks or other suitable devices to limit free fall to five (5) feet.

8. Regulate air entrainment and slump within specified limits.
9. Place concrete with the time limit stipulated by the epoxy bonding compound manufacturer. If such time limit should expire prior to placement of the concrete, remove the epoxy bonding compound and reapply.
10. Place formed concrete as nearly as practicable in its final position in continuous horizontal layers not more than eighteen (18) inches thick. When the time between successive layers exceeds one (1) hour, the specified water reducing, retarding admixture, Type "D", will be required to delay initial set so that proper consolidation of lifts can occur and cold joints are avoided.
11. When a column-slab combination or a wall-slab combination pour is scheduled, the column or wall shall have taken its initial set before concreting is continued on the slab. Beams, girders, brackets, column capitals and haunches shall be considered as part of the floor system and shall be placed integrally therewith.
12. Following a discontinuance or interruption in the placement of the concrete, all accumulations of mortar splashed upon the reinforcing steel and the surfaces of the forms shall be removed.
13. Dried mortar chips and dust shall not be puddled into the plastic concrete.
14. Avoid formation of laitance and accumulation of excessive water on surface of concrete as it is deposited. Remove accumulated water before placing additional concrete.
15. Ensure reinforcement, inserts, joints and other embedded elements are not disturbed during concrete placement.
16. The forms or formwork shall not be jarred or the exposed reinforcement disturbed in any manner after the concrete has taken its initial set.
17. Prepare concrete specimens required for tests. Cure and protect concrete cylinders at the site.

B. Pneumatic Placement

1. Pneumatic placement of concrete will be permitted only if authorized by the Engineer, in writing.
2. All Concrete Placement General Requirements above shall apply to the pneumatic placement of concrete as applicable.
3. The equipment shall be suitable in kind and adequate in capacity for the work.
4. The equipment shall be operated and placed so that no vibrations result which may damage freshly placed concrete.
5. The machine shall be located as close as practicable to the place of deposit.
6. The position of the discharge end of the line shall not be more than eight (8) feet from the point of deposit.
7. The discharge lines shall be horizontals or inclined upward from the machine.
8. At the conclusion of placement, the entire equipment shall be thoroughly cleaned.

C. Pumping

1. Pump placement of concrete will be permitted only if authorized by the Engineer, in writing.
2. All Concrete Placement General Requirements above shall apply to the pneumatic placement of concrete as applicable.
3. Pumping equipment shall be of a type designed to handle the type and volume of concrete to be conveyed without segregation.
4. The pumping distance shall be within the limits recommended by the pump manufacture.
5. The pump equipment shall be operated so that a continuous stream of concrete is produced without air pockets.
6. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that will not produce contamination of the concrete or separation of the concrete ingredients.
7. Prior to starting the pumping operations, the equipment and pipeline shall be thoroughly lubricated with a cement slurry in a manner approved by the Engineer.
8. After the pumping operation has been completed, the entire equipment shall be thoroughly cleaned.

D. Interruption of Concreting

1. Should the placement of concrete be suspended or unavoidably interrupted, keyways and bulkheads shall be provided and steps taken to prevent feather edging when work is eventually resumed. Horizontal surfaces shall be roughened for bond. Joint preparation and bonding shall be in compliance with the Section 03 15 00. Areas with cold joints are unacceptable and shall be removed and redone at no additional cost to the Owner.

3.5 COLD WEATHER CONCRETING

A. All concreting operations in cold weather, when temperatures are at, or expected to be below 40° Fahrenheit, shall conform to ACI 306R and 306.1.

1. Special attention is drawn to the minimum required placing and curing temperatures.

B. Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near freezing weather.

C. No frozen materials nor materials containing ice shall be used.

D. Only the specified non-chloride accelerator may be used. Calcium chloride or admixtures containing more than one-tenth percent (0.1%) chloride ions are not permitted.

E. Concrete damaged by freezing shall be removed and replaced at the Contractor's expense.

3.6 HOT WEATHER CONCRETING

A. All concrete operations during hot weather shall conform to the requirements of ACI 305R and 305.1.

B. Care shall be taken to protect the concrete or to schedule operations to avoid problems with flash set or conditions that produce excessively rapid drying.

C. During hot weather, consideration shall be given to maintaining the temperature of the cement, aggregates and mixing water, such that the temperature of the concrete at the time of delivery to the job site in no case exceeds 90° Fahrenheit.

D. When the temperature of the concrete exceeds 80° Fahrenheit, the water reducing, retarding admixture, Type "D", may be required.

3.7 CONCRETE CONSOLIDATION

A. Concrete shall be consolidated during and immediately after depositing and worked into corners and around embedded elements, leaving no voids or honeycombed surfaces. The consolidation shall be in conformance with ACI 309 in all respects and shall be accomplished by mechanical vibration subject to the following conditions:

1. The vibration shall be internal, unless special authorization is given by the Engineer for external vibration.
2. Vibrators shall be capable of transmitting vibration to the concrete at frequencies recommended by ACI 309, "Guide for Consolidation of Concrete".
3. The intensity of the vibration shall be such as to visibly affect the mass of concrete by a slump of one (1) inch over a radius of eighteen (18) inches.
4. The Contractor shall supply a sufficient number of vibrators to properly consolidate each pour immediately after it is placed. Standby vibrators in good condition shall be readily available, if needed, during concrete placement.
5. Vibrators shall not be applied directly to the reinforcement or to the forms. They shall not be used to make the concrete flow in the forms over distances so great as to cause segregation.

B. Vibration shall be supplemented by spading as necessary to ensure smooth surfaces and well consolidated concrete. Form surfaces and corner locations that are difficult to consolidate with vibrators shall be consolidated by spading.

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3.8 CONCRETE FINISHING

A. Finish concrete surfaces in conformance with the requirements of Section 033500.

3.9 CURING AND FORM REMOVAL

A. Cure concrete in conformance with the requirements of Section 033900.

B. Concrete form removal shall be in conformance with the requirements of Section 031113.

3.10 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed by the Engineer and the Owner's testing laboratory.

B. The Contractor shall provide facilities necessary to obtain and handle representative samples of materials to be tested and shall furnish all necessary cooperation and assistance as requested by the Engineer. The Contractor shall provide sufficient notification to the Owner and Engineer and shall plan and schedule his operations to allow adequate time for all required testing and inspection.

C. The Owner and/or Engineer will be responsible for the field control of all concrete and may reject batches for high slump, uncontrolled air entrainment or delays. Written reports will be issued after the testing is complete. However, if at any time the results are questionable, the Contractor will be notified immediately so that corrective steps may be taken. All tests and reports submitted for review will be only for those specific items used in the work.

D. The criteria for the acceptance of concrete shall be as detailed in ACI 318, Chapter 4; ACI350-06, Section 5.5 (Evaluation and acceptance of concrete); and include the following tests:

1. Strength Test Samples:

a. Sampling Procedures: ASTM C172.

1) Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured.
2) Sample concrete and make one set of five (5) cylinders for each distinct structure:

a) Every 50 cu yds or less of each class of concrete placed each day and not less than one set for each 5,000 sf of surface area for slabs and walls
b) When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
c) Make one additional cylinder during cold weather concreting, and field cure.

b. The making, pick-up and curing of the cylinders shall be the responsibility of the testing laboratory, however:

1) The Contractor shall be responsible for the curing of field cured cylinders.
2) The Contractor shall cooperate in protecting the cylinders and in notifying the testing lab of scheduled pours. The report shall indicate the mix proportions, air content, slump, batching time, placing time and a detailed description where the tested concrete was place in the structure. All items shall be completely filled in on each test report.

2. Field Testing:

a. Slump Test:

1) Slump tests shall be made for each batch/compressive strength sample and/or as frequently as directed.
2) Test Method: ASTM C143/C143M.

b. Air Content Testing:

1) Air content tests shall be made each time slump tests are taken of concrete required to be air entrained.
2) Test Method: ASTM C173/C173M (Volumetric Method) or ASTM C231 (Pressure Method).

c. Temperature Testing:

1) Measure temperature each time slump tests are taken.
2) Method: ASTM C1064/C1064M.
3) The Contractor shall provide two (2) infrared/laser hand-held temperature scanner/thermometers, for use by the Owner/Engineer.

d. Portland Cement Testing:

1) Cement stored at the job site or in storage at the concrete suppliers plant for over 60 days shall be subjected to complete tests to determine compliance with ASTM C150.

3. Cylinder Compressive Strength Testing:

a. Test Method: ASTM C39/C39M.
b. Test Acceptance: In accordance with ACI 350-06.
c. Test two (2) cylinders at seven (7) days.
d. Test two (2) cylinder at twenty-eight (28) days.
e. Test one (1) cylinder at forty (40) days or as directed by the Engineer.

E. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

F. Investigation of Low Strength Test Results

1. Low-strength cylinder test results shall be evaluated by obtaining and testing core samples as detailed in ASTM C42/C42M and ACI 318, Chapter 4, Section 4.7.4 - Investigation of Low-Strength Test Results.
2. Low-strength core test results shall be evaluated by performing load tests as detailed in ACI 318, Chapter 20.
3. A minimum of three (3) cores shall be obtained for each failed strength test from concrete represented by failed strength test.
4. Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction if so directed by the Engineer, or shall be replaced, at the Contractor's expense.
5. The Contractor shall pay all costs incurred in providing the additional testing and/or analysis.

G. Delivery Tickets

1. The Engineer shall be provided with delivery tickets for each truckload of concrete delivered to the project site.
2. Delivery Tickets shall show information required by ASTM C94

3.11 PATCHING

A. Allow the Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the Engineer upon discovery.

C. Patch imperfections as directed by Engineer in accordance with ACI 318.

3.12 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of the Engineer for each individual area.

END OF SECTION 033100

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SECTION 033500 - CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Finishes for concrete.

B. Related Sections:

1. Section 031113 “Structural Cast-in-Place Concrete Forming”
2. Section 031500 “Concrete Accessories”
3. Section 033900 “Concrete Curing.”
4. Section 030551 “Concrete Bonding Agents”
5. Section 030555 “Concrete Admixtures and Additives”
6. Section 079200 “Joint Sealants”
7. Section 033100 “Structural Concrete”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 302 - Guide for Concrete Floor and Slab Construction
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 318-08 - Building Code Requirements for Structural Concrete
5. ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Manufacturer’s specifications and other data required to demonstrate compliance with the specific requirements.

C. Manufacturer's recommended instructions and recommendations on mixing handling, placement, and appropriate uses for each type of material and product used in the work of this Section.

D. Material Safety Data Sheets.

E. Manufacturer's certification or test results identifying physical characteristics.

F. Test Panels:

1. The Contractor shall construct a 4' x 4' mockup cast-in-place panels of each concrete finish type to be provided for the approval of the Engineer. Panels shall be a minimum of 12" thick and provided with steel reinforcing.
2. Use form ties the same as those approved and with the form tie pattern similar to that approved.
3. Test panels shall include chamfer corner treatment and reveal rustication with form joints.
4. Plug the tie holes as specified to determine the correct mortar mixture to match the panel color. If required, remove and replace tie hole plugging mortar until an acceptable color match is obtained. After the sample panels have been approved, intentionally damage and patch portions of the finish surface of the panels for the purpose of determining the correct mixture for patching mortar and patching technique to match the original panel color and surface.
5. The approved mock-up panels shall remain in place during construction as the standard of workmanship for the project.
6. The mock-up panels shall be removed at the direction of the Engineer.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, ACI 302 and ACI 318.

1.5 QUALIFICATIONS

A. Throughout the progress of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills and who shall be present at the site and direct all work under this Section.

B. In the execution of the work of this Section, use an adequate number of skilled workmen who are thoroughly ACI trained and experienced in the requirements of this Section.

C. In acceptance or rejection of the work performed under this Section, the Engineer will make no allowance for lack of skill on the part of the workmen.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.

B. General:

1. Conform to ACI 301, ACI 302 and ACI 318.

C. Delivery of Materials

1. Deliver materials in manufacturer's original unopened and undamaged containers, with information accurately representing container contents.
2. Include the following information on the label:

   a. Name of material and supplier.
   b. Installation, handling and protection requirements.

3. Deliver materials in sufficient quantities to allow uninterrupted continuity of the work.

D. Storage of Materials

1. Store materials in original, undamaged containers with manufacturer's labels and seals intact.
2. Store all materials in a dry, enclosed area, off the ground and away from all possible contact with water and in a location where temperature can be constantly maintained between 60F and 75F and out of direct sunlight.
3. Prevent damage to materials during storage primarily by minimizing the amount of time they are stored at the job-site before being incorporated into construction systems

E. Protection:

1. Use all means necessary to protect the materials of this Section before, during and after installation to protect the work and materials of all other trades.

F. Replacement:

1. In the event of damage, immediately, make all repairs and replacements necessary to the satisfaction of the Engineer

1.7 COORDINATION

A. Section 013000 “Administrative Requirements”: Coordination and project conditions.

B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR SEALER

A. Acceptable Products

1. Sonoglaze HS by Sonneborn
2. Masterseal 330 by Master Builders
3. Eucothane by Euclid Chemical.

4. Or Approved Equal

2.2 CONCRETE FLOOR HARDENER

A. Acceptable Products – Liquid Floor Hardener

1. Lapidolith by Sonneborn
2. Pena-Lith by W.R. Meadows
3. Hornolith by Tamms
4. Surfhard by Euclid Chemical.
5. Or Approved Equal

B. Acceptable Products – Non-metallic Aggregate Floor Hardener

1. Harcol by Sonneborn
2. Maximent by Master Builders
3. Surflex by Euclid Chemica
4. Or Approved Equal

2.3 NON-SLIP SHAKE-ON AGGREGATE

A. Acceptable Products

1. Frictex NS by Sonneborn
2. A-H Alox by Anti-Hydro
3. Non-Slip by Euclid Chemical.
4. Or Approved Equal

2.4 BITUMINOUS WALL DAMPPROOFING

A. Acceptable Products

1. Asphalt emulsion per ASTM D1227, Type 4
2. Sealtight Sealmastic Emulsion – Type 2
3. Karnak Corporation Karnak 220A
4. Or Approved Equal

2.5 CONCRETE REPAIR MATERIALS

A. Concrete repair materials are specified in part 3

2.6 CURING

A. For limited use, to cure the grout used in a Type V finish, liquid curing compound shall be used.

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2.7 PATCHING MORTAR

A. Acceptable Products

1. Harris Specialty Chemicals "Waterplug"
2. Tamms Industries "Speed Plug"
3. Or Approved Equal

PART 3 - EXECUTION

3.1 FINISHES ON FORMED CONCRETE SURFACES

A. After removal of forms, the finishes described below shall be applied in accordance with Section 3.5 Concrete Finish Schedule. Unless the finish schedule, Contract Drawings, or Specifications specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.

1. Type I Rough or Board Form Finish: All fins, burrs and other projections left by the forms shall be removed. All holes left by removal of ties, and all other holes, depressions, or voids shall be filled solid with cement grout after first being thoroughly wetted. Honeycombs shall be chipped back to solid concrete as directed, prior to patching with cement grout. Holes shall be filled with a small tool that will permit packing the hole solidly with cement grout. Cement grout shall consist of one-part cement to three parts sand, and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface. The surface shall be thoroughly cleaned of all stains or discolorations that will interfere with the final finish.
2. Type II Smooth Form Finish: Concrete shall be cast against forms constructed of plywood, preformed steel, glass fiber reinforced plastic, sheet steel, or boards (lumber forms) lined with tempered hardboard, or other approved materials.

    a. Form material shall not have torn grain, worn edges, patches of holes from previous use, or other defects which would impair the texture of the concrete surface.
    b. Form material shall utilize sheets as large as practicable in an orderly and symmetric configuration.
    c. Other aspects of the finish shall conform to the requirements of the rough form finish.

3. Type III Grout Cleaned: Where this finish is required, it shall be applied after completion of Type II finish. After the concrete has been pre-dampened, a slurry consisting of one-part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 30 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats and scrubbed into the surface using a rotary motion. Any surplus material shall be removed by scraping and then rubbing with clean burlap. The finish shall be kept damp for at least 36 hours after application.
4. Type IV Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish no later than four (4) hours following form removal. No rubbing shall

be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities require it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted.

5. Three (3) categories of rubbed finish shall be provided as defined below:

Type "IVA":	Surfaces shall be rubbed until all marks are obliterated and a uniformly smooth finish is obtained
Type "IVB":	Surfaces shall be rubbed until they are uniformly smooth, but complete obliteration of all marks is not required.
Type "IVC":	All fins, burrs, and projections shall be removed. Any honeycomb or tie-holes shall be filled and patched.

   a. Begin rubbing within four (4) hours of the removal of the formwork and expedite to completion as rapidly as practicable.
   b. Rub surfaces with carborundum and water until all fins, bubbles, hollows and other defects are removed.
   c. Do not use grout or mortar in the rubbing process. Plastering of surfaces will not be allowed.
   d. Use power tools with hand work limited to inaccessible corners or small areas.
   e. After the rubbing is completed and the surface has dried, rub the surface with burlap to remove all loose powder.
   f. All expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete.

6. Type V Textured: Use textured forms or textured form liners of plastic, wood, or sheet metal. Secure liner panels in forms by cementing or stapling, not by methods which will permit impressions of nail heads, screw heads, washers, or the like to be imparted to the surface of the concrete. Seal edges of textured panels to each other or to divider strips to prevent bleeding of cement paste. Use a sealant that will not stain the concrete surface.
7. Type VI Aggregate transfer: Produce aggregate transfer and other special finished that duplicate mock-ups or sample panels prepared in advance and accepted.
8. Type VII Exposed Aggregate: Expose aggregate using one of the following methods. Provide a concrete surface that will duplicate a mock-up or a sample panel prepared in advance and accepted

   a. For a scrubbed finish, cast concrete against form faces which have been coated with a chemical retarder used in accordance with the manufacturers recommendations. Wet the partially hardened concrete surface thoroughly and scrub with fiber or wire brushes, using water freely until the surface mortar is removed and the aggregate is uniformly exposed. Then rinse the surface with clear water. If portions of the surface have become too hard to permit uniform aggregate exposure, use dilute hydrochloric acid (one part commercial muriatic acid diluted with 4 to 10 parts water) to remove the excess surface mortar after the concrete is at least 2 weeks old. Remove the acid from the finished surface with clean water within 15 minutes after application.
   b. For a blast finish, sandblast or waterblast the concrete surface to a degree sufficient to expose fine aggregates with occasional exposure of coarse aggregate, and to produce a uniform color with a maximum reveal of 1/16 inch unless specified

otherwise in the Contract Documents. All surfaces with the same specified blast finish shall be done at approximately the same time after placing co concrete. Use stainless steel or plastic reinforcement supports and spacers near concrete surfaces to be blasted. Protect adjacent materials and inserts during blasting operations.

c. For a tooled finish, dress the thoroughly cured concrete surface with electric, air, or hand tools to a uniform texture removing surface mortar as specified in the Contract Documents. Then provide the surface with a hand tooled, rough or fine pointed, crandalled, or bush-hammered surface texture, as specified by Contract Documents.

9. Type VIII Applied: When finishes of stucco, cementitious coatings, or similar troweled materials are required or permitted, prepare the surface of the concrete to ensure permanent adhesion of the finish. If the concrete is less than 24 hours old, roughen it with a heavy wire brush or scoring too. If the concrete is older, roughen the surface mechanically or by acid etching. After roughening, wash the surface free of all dust, acid, chemical retarder, and other foreign material before any final finish is applied.

3.2 SLAB AND FLOOR FINISHES

A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Section 3.5 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.

1. Type “A” - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required.
2. Type “B” - Scratched: Following completion of Type “A” finish, roughen the surface with stiff brushes or rakes before final set.
3. Type “C” - Floated: Following completion of Type “A” finish, do not work the concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disc float as soon as the water sheen had disappeared, and the surface has stiffened sufficiently to permit the operation. During or after the first floating, check flatness of surface with a 10 ft straightedge applied in two or more directions. Eliminate high spots and low spots during this procedure to produce a conventional, straightedge finish, then refloat the slab immediately to a uniform texture.
4. Type “D” - Troweled: Following completion of a Type “C” finish and sufficient hardening of the concrete to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with a power trowel. Following the power trowel, hand trowel to provide a smooth, dense surface, free from defects, trowel marks, and blemishes. For surfaces exposed to wear as indicated in the Contract Documents, continue hand troweling until a ringing sound is produced as the floor is troweled.
5. Type “E” - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type “C” finish.
6. Type “F” - Liquid Hardened Finish: Liquid hardened finish shall be provided by application of a liquid floor hardener. Floors to receive this finish shall have previously received a Type “D” finish. Liquid hardener shall be applied between 30 to 60 days after concrete placement. Surface to be treated shall be dry, clean and free of all loose dust, dirt, oil, wax, sealers and curing compounds. Application procedure shall be in accordance with manufacturer's instructions and shall consist of a three-coat treatment.

7. Type “G” - Dry Shake Hardened Finish: Aggregate hardened finish shall be provided by applying an aggregate floor hardener concurrently with the application of a Type “D” finish. Application procedure shall be in accordance with manufacturer's instructions.
8. Type “H” - Non-Slip Finish: This finish shall be provided by applying a non-slip shake-on aggregate concurrently with the application of a Type “D” finish. Application procedure shall be in accordance with manufacturer's instructions.

3.3 SEALING OF CONCRETE

A. After installation of all equipment and piping, and after completion of other related construction activities, all floor slabs which are to remain unpainted and not intended to be immersed, and all equipment pads, shall be sealed with a floor sealer unless the slab has had liquid hardener applied or stated otherwise. Remove all dirt, droppage, oil, grease, asphalt or other foreign matter with caustics and detergents as required prior to application. Sealer shall be applied in accordance with the manufacturer's recommendations.

3.4 FINISHES ON EQUIPMENT PADS

A. Formed surfaces of equipment pads shall receive a Type IVC finish.

B. Top surfaces of equipment pads, except those surfaces subsequently required to receive non-shrink grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive non-shrink grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.5 CONCRETE FINISH SCHEDULE

A. The Type of finish to be used shall be as indicated or scheduled on the Contract Drawings. Where the type of finish is not shown or scheduled, the finish shall be as indicated below:

Item	Finish Type
All unexposed concrete surfaces	I
All exposed concrete surfaces: including utility and process areas unless otherwise noted.	IVB
Interior walls of tanks	IVB
Surfaces to be painted	III
Architectural finish	V, VI, VII, or VIII as indicated in the contract documents
Surfaces to receive bonded cementitious mixtures	B
Drives, interior stairs, surfaces to receive waterproofing, roofing insulation, or terrazzo,	C
Floors for walking surfaces in manufacturing,	D

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Item	Finish Type
storage, and warehousing areas, floors to receive coverings, floors of tanks, and bottoms of channels	
Sidewalks	E
Garage and storage area floors	F or G
Exterior stairs, platforms, landings and ramps and interior ramps	E or H

END OF SECTION 033500

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SECTION 033900 - CONCRETE CURING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete curing and protection during cold weather conditions.
2. Concrete curing and protection during hot weather conditions.
3. Wet curing and protection for all slabs and walls during normal weather conditions.

B. Related Sections:

1. Section 031113 “Structural Cast-in-Place Concrete Forming”
2. Section 033100 “Structural Concrete”
3. Section 031500 “Concrete Accessories”
4. Section 033500 “Concrete Finishing”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Concrete Institute:

1. ACI 301 – Specifications for Structural Concrete.
2. ACI 302 – Guide for Concrete Floor and Slab Construction
3. ACI 305R – Hot Weather Concreting
4. ACI 306R – Cold Weather Concreting
5. ACI-308.1 – Standard Specification for Curing Concrete
6. ACI-308R – Guide to Curing Concrete
7. ACI 318 – Building Code Requirements for Structural Concrete.
8. ACI 350.4R-04 – Design Considerations for Environmental Engineering Concrete
9. ACI 350.4R-04 – Design Considerations for Environmental Engineering Concrete
10. ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures

C. ASTM International:

1. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.

2. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Manufacturer’s specifications and other data required to demonstrate compliance with the specific requirements.

C. Manufacturer’s recommended instructions for:

1. Curing compound application.

D. Material Safety Data Sheets.

E. Test results from independent testing laboratories showing compliance with these specifications. Sworn affidavits or statements from suppliers are not acceptable.

F. Furnish manufacturer's certification or test results identifying physical characteristics.

G. Proposed curing methods and procedures.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, ACI 302, ACI 308.1, ACI 308R, ACI 318 and ACI 347.

B. Quality Control Data

1. Curing Compound:

a. Manufacturer’s Certification of Compliance, to include statement that product meets ASTM C 309.
b. Permeability requirement.
c. Coverage.

2. Curing method, procedures and method of application to be used shall be in compliance with the requirements of this Specification.

1.5 QUALIFICATIONS

A. Products used in the work of this section shall be produced by manufacturer’s who are regularly engaged in the manufacturer and/or supply of similar items for at least five (5) years and which have a history of successful production, acceptable to the Engineer.

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1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. Delivery:

1. Deliver materials to site in manufacturer’s original, unopened containers and packaging.
2. Packaging shall be provided, with labels clearly identifying product name and manufacturer.

C. Storage:

1. Store materials in a clean, dry area in accordance with manufacturer’s instructions
2. Keep containers sealed until ready for use.

D. Handling:

1. Protect materials during handling and application to prevent damage or contamination.

PART 2 - PRODUCTS

2.1 CURING AND SEALING COMPOUNDS

A. Characteristics:

1. Curing compounds shall be used only during cold weather conditions.
2. Curing compounds shall be dissipating, VOC-compliant, water-based, liquid membrane-forming, including a fugitive dye.
3. Compounds shall conform to ASTM C309, Type 1.
4. Compounds shall have a minimum thirty (30) percent solids content
5. Maximum moisture loss shall be 0.03 grams per square centimeter when applied at a coverage rate of 300 square feet per gallon

B. Acceptable Manufacturers

1. SYMONS Corporation Resi-Chem Clear Cure lD,
2. Tamms Industries Horncure WB 300,
3. Or Approved Equal.

PART 3 - EXECUTION

A. PREPARATION All freshly placed concrete shall be protected from adverse weather elements and from defacement. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for providing sufficient water for hydration and preventing loss of moisture from the concrete for at least a seven-day period.

B. The requirements of hot and cold weather concreting being taken into account.

3.2 HOT WEATHER CURING AND PROTECTION

A. The Contractor shall conform to ACI 305R when concreting during hot weather except as modified below.

B. Definition of Hot Weather - When air temperatures exceed 85 degrees F, or when extremely dry conditions exist even at moderate temperatures, particularly if accompanied by high winds, the Contractor and his concrete supplier shall exercise precautionary measures in preparing, delivering, placing, finishing, curing, and protecting the concrete.

C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation.

D. Wet curing shall be used for all slab and wall concrete.

E. Formwork may be left in place during the entire seven-day curing period, provided that the. forms remain tight and soaker hoses are placed on top of the exposed concrete surfaces. If the formwork is either loosened or removed prior to the end of the seven-day curing period, the concrete must be continuously wetted down and covered with white polyethylene.

3.3 COLD WEATHER CURING AND PROTECTION

A. The Contractor shall conform to ACI 306R when concreting during cold weather except as modified below.

B. Definition of Cold Weather - A period when for more than three consecutive days the mean daily temperature drops below 40 degrees F. When temperatures above 50 degrees F occur during more than half of any 24-hour period, the concrete shall no longer be regarded as cold weather concrete.

C. The methods of protecting the concrete shall be such as will prevent drying. Labor, equipment, and materials necessary for winter protection and heating shall be on the site in sufficient quantity before the work begins.

D. Definition of protection period. The length and intensity of the protection period for each type of structural member shall be as determined in the table below.

1. Cold Weather Concrete Protection Period

Type of Member	Service Category	Temperature Range	Type I or II Cement (Days)	Type III Cement (Days)
Fill Concrete	2	50°F - 70°F	3	2
Slab on Grade	3	50°F - 70°F	6	4
Slab on Deck	3	50°F - 70°F	6	4
Columns	3	50°F - 70°F	6	4
Walls	3	50°F - 70°F	6	4
Walls (note 1.)	4 (note 2.)	50°F - 70°F	21 (note 4.)	14 (note 4.)
Beams	4 (note 2.)	50°F - 70°F	21 (note 4.)	14 (note 4.)
Slabs(other)(note 4.)	4 (note 2.)	50°F - 70°F	21 (note 4.)	14 (note 4.)

(1) Refers to walls that are to be service loaded (water tested or backfilled) soon after concrete placement.

(2) Formwork shall remain in place until the end of the protection period for Service Category 4 structural members.
(3) All other structural slabs supported by temporary formwork.
(4) Protection period could be shortened based on concrete achieving at least 75 percent of the required design strength as determined by testing of field-cured cylinder.

E. Suitable means shall be provided for maintaining the deposited concrete within the temperature range as defined above. Heating may be provided by using a vented heating unit, insulated blankets, or a combination of both.

1. If blankets are to be used, they should be applied to the concrete as specified in ACI 306R, Chapter 7, Charts 7.3.1-7.3.4. Special attention should be given to corners and edges of concrete members which could require about three times the thickness of insulation to maintain concrete temperature, as might be required for interior spaces. Also note, that excessive amounts of blankets could raise the temperature of the concrete too high which could cause an increase of thermal shrinkage and cause cracking due to thermal shock.
2. Where heated enclosures are provided, vent flue gases from combustion heating units to the outside of the enclosure. Place and direct heaters to avoid areas of overheating or drying of the concrete surface. Exposed concrete surfaces must be protected and cured. Where continuous moist curing is not practical, tightly adhered polyethylene or curing compounds shall be used.

F. Interruptions to the Curing and Protection Period

1. Measures shall be taken to assure the concrete temperatures will not drop below 32 degrees F.
2. Interrupted time must be made up in accordance with ACI 306R-88, Section 7.7 on a degree-hour basis.

G. After the required protection period listed in the above table, concrete shall have curing coverings removed and be allowed to gradually dry out prior to lowering temperatures to freezing as described in the table below:

Maximum Concrete Temperature Drops at End of Protection Period

Least Dimension of Section, Inches	Minimum Gradual Decrease in Surface Temperature During any 24 hour Period of Protection, degrees F
Less than 12	50
12 to less than 36	40
36 to 72	30
Greater than 72	20

H. Complete removal of curing compounds will be required prior to application of coatings or other toppings. A light abrasive blast or other mechanical means will be required.

I. Monitoring of Concrete Temperatures

1. In order to better follow the Contractor's cold weather procedures, various thermometers (supplied and maintained by the Contractor) shall be placed along concrete members that are undergoing cold weather protection, particularly at corners and edges of concrete members where it is more difficult to maintain the required temperature.

2. Contractor monitoring of these temperatures must be done throughout the day so that the Contractor can make timely adjustments to maintain an even temperature.
3. Access to these thermometers must be made available for the inspector to perform spot-checking of the Contractor's effectiveness to achieve proper cold weather protection.
4. The Contractor shall provide the proper type and sufficient quantity of thermometers to determine the temperature of the concrete.

3.4 NORMAL WEATHER CURING AND PROTECTION

A. Definition of Normal Conditions - All conditions not defined as either hot or cold weather.

B. Slabs, Curbs, Sidewalks, Toppings, and other Flatwork:

1. After finishing and immediately after the concrete surface has hardened enough to prevent dilution of the cement paste, provide continuous moist curing for at least the first 24 hours.
2. After the initial 24-hour period, cover for an additional six days with waterproof paper or white polyethylene.
3. Wet burlap coverings may be used but must be kept wet by continuous sprinkling with water. Lap the cover material at least 12 inches, covering the top and sides of the concrete. The covering shall be weighted down to prevent it from blowing off.
4. If cover material is not used, the concrete surfaces shall be kept continuously wet by spraying or other approved methods.

C. Walls and Columns

1. Immediately after the concrete surface has hardened enough to prevent dilution of the cement paste, provide continuous moisture at the top of the formed surface for at least the first 24 hours.
2. If forms are left in place for the 7-day cure, the forms shall be loosened only after 24 hours to allow water to soak the sides of the concrete continuously over the next remaining 6 days.
3. If forms are removed in less than seven days, all vertical surfaces shall be:

    a. Sprayed with water and tightly sealed with white polyethylene or
    b. Covered with burlap combined with a continuous water spray.
    c. If forms are removed, either a. or b. shall be followed for the remainder of the seven-day period.

END OF SECTION 033900

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SECTION 036000 - GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portland cement grout.
2. Rapid curing epoxy grout.
3. Non-shrink grout.
4. Dry pack

B. Related Sections:

1. Section 031113 “Structural Cast-In-Place Concrete Forming”
2. Section 033100 “Structural Concrete”
3. Section 033900 “Concrete Curing”
4. Section 051200 “Structural Steel Framing”
5. Section 055000 “Metal Fabrications”

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Structural Concrete.
3. ACI 305.1-06 - Standard Specifications for Hot Weather Concreting
4. ACI 305 - Hot Weather Concreting.
5. ACI 306.1 - Standard Specification for Cold Weather Concreting
6. ACI 306R-88 – Cold Weather Concreting
7. ACI 350.4R-04 - Design Considerations for Environmental Engineering Concrete
8. ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures

B. American Society of Testing and Materials:

1. ASTM C33 - Standard Specification for Concrete Aggregates.
2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
3. ASTM C109 – Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50 mm Cube Specimens)
4. ASTM C150 - Standard Specification for Portland Cement.
5. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
6. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
7. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

8. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacings and Polymer Concretes.
9. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
10. ASTM C939 – Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow cone Method).
11. ASTM C1107 – Packaged Dry, Hydraulic Cement Grout (Non-Shrink)

C. U. S. Army Corps of Engineers Concrete Research Division (CRD):

1. CRD C621 - Non-Shrink Grout.

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Provide a complete materials list of items to be furnished under this Section.

C. For each type grout used submit the following:

1. Sufficient data to demonstrate compliance with the specified requirements, including product data, material certifications and technical data sheets.
2. Manufacturer’s instructions for mixing, handling, surface preparation, placement and appropriate uses.
3. Material Safety Data Sheets (MSDS).
4. Certified test results verifying the compressive strength, shrinkage and expansion requirements specified herein. Certifications or affidavits will not be acceptable.

1.4 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications.

    a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.
    b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.

B. Grout which has already been placed and which fails to meet the requirements of these Specifications, is subject to removal and replacement by the Contractor at no additional cost to the Owner.

C. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall instruct the Contractor's personnel in the mixing, proper use and application of the non-shrink grout and epoxy grout.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. Deliver grout in manufacturer's unopened containers with proper labels intact.

C. Store grout in a dry shelter, protect from moisture.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT GROUT

A. Portland cement grout shall be composed of Portland cement, sand and water. The sand to be used shall be selected to suit the spacing for placement. Where sand is not usable, the grout shall be composed of cement and water only.

B. The Alkali-Silica Reaction Potential of aggregates used in Portland cement grout shall be evaluated in conformance with the requirements of Specification Section 033100 Subsection 2.2 – Aggregate Evaluation for Alkali-Silica Reaction Potential. When aggregates are determined to be potentially reactive with alkalies, the aggregate shall not be used.

C. Portland Cement: ASTM C150, Type II.

D. Water:

1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:

    a. Corrosion of steel.
    b. Volume change increasing shrinkage cracking.
    c. Efflorescence.
    d. Excess air entraining.

E. Fine Aggregate:

1. Washed natural sand conforming to the requirements of ASTM C33
2. Free from injurious amounts of organic impurities as determined by ASTM C40.

F. Mix Design

1. Gradation of sand and mix proportioning shall be in accordance with the following table for grouts using natural sands and having a minimum 28-day compressive strength of 4,000 psi. For higher strength grouts or those using manufactured sands, strength shall be established by trial mixes.

a. Gradation for Natural Sand:

Sieve Size	Spaces less than one (1) inch	Spaces one (1) inch or more
Passing 3/8		100
Passing 4	100	95-100
Passing 8	95-100	80-100
Passing 16	70-100	50-85
Passing 30	40-75	25-60
Passing 50	10-35	10-30
Passing 100	2-15	2-10
Passing 200	--	--

b. Mix Proportioning:

By Weight	Non-Air Entrained Grouts (Maximum 4 Percent Entrapped Air)		Air Entrained Grouts (Air 8 Percent to 10 Percent)	
	Spaces less THAN ONE (1) inch	SPACES ONE (1) inch or more	Spaces less than one (1) inch	Spaces one (1) inch or more
Cement (bags)	10.8	10.5	11.3	11.0
Sand (lb)	2150	2240	1930	1990
Maximum water (gals)	59.5	57.8	57.5	55.8
Maximum water (gals per bag)	5.5	5.5	5.1	5.1
By Volume	Non-Air Entrained Grouts (Maximum 4 Percent Entrapped Air)		Air Entrained Grouts (Air 8 Percent to 10 Percent)	
	Spaces less THAN ONE (1) inch	SPACES ONE (1) inch or more	Spaces less than one (1) inch	Spaces one (1) inch or more
Cement	1	1	1	1
Sand (dry rodded)	1.85	2.10	1.6	1.7
Sand (damp & loose)	2.30	2.35	2.0	2.1

By Weight	Non-Air Entrained Grouts (Maximum 4 Percent Entrapped Air)		Air Entrained Grouts (Air 8 Percent to 10 Percent)	
	Spaces less THAN ONE (1) inch	SPACES ONE (1) inch or more	Spaces less than one (1) inch	Spaces one (1) inch or more
Maximum water (gals per bag)	5.5	5.5	5.1	5.1

2. Water shall be kept to a minimum, the amounts noted in the preceding table are the maximum for grout. Proportioning by volume shall be limited to small quantities mixed at the job site.
3. White Portland cement shall be mixed with the Portland cement as required to match the color of adjacent concrete
4. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 RAPID CURING EPOXY GROUT

A. High strength, three component epoxy grout formulated with thermosetting resins and inert fillers. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids and alkalies.

B. The Alkali-Silica Reaction Potential of aggregates used in epoxy grout shall be evaluated in conformance with the requirements of Specification Section 033100 Subsection 2.2 – Aggregate Evaluation for Alkali-Silica Reaction Potential. When aggregates are determined to be potentially reactive with alkalies, the aggregate shall not be used.

C. Epoxy grout shall conform to the following properties:

Property	Test	Result
Compressive Strength	ASTM C579	12,000 psi at 7 days
Tensile Strength	ASTM C307	2,000 psi minimum
Coefficient of Expansion	ASTM C531	30x10-6 in per degree F
Shrinkage	ASTM C827	None

D. Acceptable Products and Manufacturers:

1. Sikadur 42 Grout-Pak - Sika Chemical Co.
2. E^3-HP – Euclid Chemical Co.
3. Masterflow MP – Master Builders
4. Or Approved Equal

2.3 NON-SHRINK GROUT

A. General Requirements:

1. Non-shrink grout shall be non-metallic, non-shrink, non-gas forming, pre-mixed and ready-for-use requiring only the addition of water at the job site.
2. Grouts depending on oxidation to limit shrinkage shall not be used.
3. Grout shall contain no metals nor rust of corrosion promoting agents, or gypsum
4. The addition of set control agents or water reducers shall not be permitted
5. The grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under a 4' x 4' base plate.
6. When high fluidity and/or increased placing time is required use high flow grout. The highflow grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under a 18" x 36" base plate.

B. Non-shrink grout shall conform to the following properties

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	45 minutes (Min.)
		Final	3 hours (Approx.)
Shrinkage			
- Below Placement Volume	ASTM C827		0%
- Drying	CRD 588-76		0%
Expansion	CRD 588-76		0.4% (Max.)
Compressive Strength (Flowable Consistency)	CRD-C621	1 day	3,000 psi
		7 days	6,000 psi
		28 days	9,000 psi (Min.)
Pull-Out Strength	#5 bar grouted 6” deep in a 7/8” dia. Hole in saturated surface dried concrete		10,000 lb

C. Acceptable Products and Manufacturers:

1. Standard Non-Shrink Grout

   a. NS Grout – Euclid Chemical Co.
   b. Masterflow 713 Plus – Master Builders
   c. Sikagrout 212 – Sika Chemical Co.
   d. Or Approved Equal

2. High Flow Grout

   a. Hi-Flow Grout – Euclid Chemical co.
   b. Masterflow 928 – Master Builders
   c. Or Approved Equal

2.4 DRY PACK

A. Dry pack (to be packed or tamped in place) shall be made at no slump consistency

B. When mixing the batch, only enough water shall be added to the dry materials to produce a rather stiff mixture, then additions of water may be made in small increments until the desired consistency is obtained.

C. Dry pack grout shall conform to the following properties:

Property	Test	Time	Result
Expansion	CRD 588-76		0.4% (Max.)
Compressive Strength	CRD-C621	1 day	3,000 psi
		7 days	6,000 psi
		28 days	9,000 psi (Min.)

D. Acceptable Products and Manufacturers:

1. Dry Pack Grout – Euclid Chemical Co.
2. Sikagrout 212 – Sika Chemical Co.
3. L&M Dry Pack Grout – L&M Construction Chemicals
4. Or Approved Equal

2.5 FORMWORK

A. Refer to Section 031113 for formwork requirements.

2.6 CURING

A. Curing for cement grout shall be as specified in Section 033900.

B. Prevent rapid loss of water from grout in accordance with manufacturer’s written instructions.

PART 3 - EXECUTION

3.1 GROUT USES

A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Specifications or on the Contract Drawings. Where grout is called for in the Specifications or on the Contract Drawings which does not fall under any of the applications stated below, non-shrink grout shall be used.

1. Portland cement grout shall be used for grout toppings and for patching fresh concrete
2. Non-shrink grout shall be used for grouting beneath base plates of equipment and structural metal framing.

3.2 EXAMINATION

A. Verify areas to receive grout.

3.3 PREPARATION

A. Prepare all contact surfaces in accordance with manufacturer's recommendations.

B. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

C. Rough concrete lightly, but not enough to interfere with placement of grout.

D. Remove foreign materials from metal surfaces in contact with grout.

E. Align, level and maintain final positioning of components to be grouted.

F. Saturate concrete surfaces with clean water 12 to 24 hours prior to grouting. Before placing grout, remove all excess and free standing water.

3.4 INSTALLATION - FORMWORK

A. Construct leakproof forms anchored and shored to withstand grout pressures.

B. Install formwork with clearances to permit proper placement of grout.

3.5 MIXING

A. General Requirements

1. Measurements for grout shall be made accurately by weight or by volume using containers. All measurements shall be made in a manner satisfactory to the Engineer. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.
2. The amount of water used should be the minimum quantity to produce the grout of the desired consistency.
3. Mix grout components in proximity to work area and transport mixture quickly and in manner not permitting segregation of materials

B. Portland Cement Grout:

1. Prepare grout with water to obtain consistency to permit placing and packing.
2. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency.
3. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
4. Do not add additional water after grout has been mixed.

C. Rapid Curing Epoxy Grout

1. Mix and prepare rapid curing epoxy grout in accordance with manufacturer's instructions.

D. Non-Shrink Grout

1. Mix and prepare non-shrink grout in accordance with manufacturer's instructions.

3.6 PLACING GROUT

A. All work shall be done in strict accordance with manufacturer’s recommendations, including special procedures for hot and cold weather grouting.

B. At the request of the Engineer, the manufacturer’s representative shall be called to the job site for consultation regarding detailed use of the grout.

C. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency shall be such that the grout is plastic and moldable but will not flow.

D. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted, be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped.

E. For grouting beneath base plates, grout shall be poured from one side only and shall flow across to the open side to avoid air-entrapment.

F. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer.

G. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.

H. Thoroughly compact final installation and eliminate air pockets.

I. Do not remove forms until after the grout has taken an initial set and will not slump. After removal, cut off excess grout and finish to a smooth surface.

J. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.7 CURING

A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. After grout has attained its initial set, keep damp for minimum of 3 days.

END OF SECTION 036000

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SECTION 038100 - CONCRETE CUTTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall Sawing of Concrete
2. Flat Sawing or Concrete
3. Hand Sawing of Concrete

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American National Standards Institute (ANSI)

1. ANSI B7.1 – The Use, Care, and Protection of Abrasive Wheels
2. ANSI B175.4 – American National Standard for Outdoor Power Equipment - Portable, Handheld, Internal-Combustion-Engine-Driven Cut-Off Machines - Safety Requirements

C. Concrete Sawing & Drilling Association, Inc. (CSDA)

1. CSDA BP 001 – Slurry
2. CSDA BP 003 – Hazard Identification and Debris Removal
3. CSDA CS 109 – Chain Sawing
4. CSDA DB 112 – Diamond Blade
5. CSDA F 102 – Flat Sawing
6. CSDA HS 108 – Hand Sawing
7. CSDA W 104 – Track Mounted Wall Sawing
8. CSDA WS 106 – Wire Sawing.

D. International Association of Concrete Drillers and Sawyers (IASDS)

1. IASDS Standard 25007/1 – Basic Parameters for concrete Drilling and Sawing Equipment

E. Occupational Safety and Health Administration (OSHA)

F. All other applicable Federal, State and Municipal codes, rules and regulations

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Product Data for Concrete Cutting Equipment including:

1. Manufacturer
2. Type of Unit (i.e. Wall Saw, Flat Saw, Hand Saw with Circular Blade or Chain)
3. Size of Saw including maximum cutting depth, horsepower and weight
4. Power Source (i.e. electric, combustion engine, hydraulic)

C. Cutting Procedures

D. Health and Safety Plan

E. Temporary bracing plans for wall and elevated slab removals prepared under the direction of and signed by a Professional Engineer registered in the State of New York.

1.4 QUALITY ASSURANCE

A. Throughout the process of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills and who shall be present at the site and direct the work performed under this Section.

B. In the performance of the work of this Section, use an adequate number of trained workmen experienced in the cutting of concrete.

1.5 COORDINATION

A. Coordinate the work of this Section with other sections of work and trades.

PART 2 - PRODUCTS

2.1 SAW CUTTING EQUIPMENT

A. Use diamond saw blades capable of making straight cuts.

B. Saws shall be equipped with cutting guides, blade guards, water cooling systems, dust controls, and cut depth control.

C. Where beveled saw cuts are required, use a cutting or grinding device attached to the saw blade, or a separate device following the saw.

2.2 SAW CUTTING TOLERANCES

A. Tolerances for the cutting of concrete walls and elevated slabs shall not exceed the following:

Parameter	Wall or Elevated Slab Thickness	
	< 12 in	12 – 24 in
Alignment accuracy	0.4 in from target line	0.4 in from target line
Angle accuracy	± 0.42 in/ft	± 0.85 in/ft
Directional accuracy in relation to specified dimension in longitudinal direction	± 0.12 in/ft	± 0.25 in/ft
Vertical	± 0.42 in/ft	± 1 in/ft
Horizontal	± 0.42 in/ft	± 1 in/ft
Surface rouging of cut surface	± 0.2 in	± 0.4 in
Cut width, deviation from specified dimension	± 10% from target value	± 10% from target value
Specified depth	± 0.4 in	± 0.6 in
* Tolerances are only valid for elevated slabs cuts if cuts are made from above.		

B. Tolerances for the cutting of concrete slabs on grade shall not exceed the following:

Parameter	Slab Thickness	
	< 4 in	4 – 24 in
Alignment accuracy	0.4 in from target line	0.4 in from target line
Angle accuracy	± 1 in/ft	± 1 in/ft
Directional accuracy in relation to specified dimension in longitudinal direction	± 0.18 in/ft	± 0.3 in/ft
Vertical	± 0.7 in/ft	± 1 in/ft

Parameter	Slab Thickness	
	< 4 in	4 – 24 in
Horizontal	-	-
Surface rouging of cut surface	± 0.2 in	± 0.4 in
Cut width, deviation from specified dimension	± 10% from target value	± 10% from target value
Specified depth	± 0.4 in	± 0.6 in

PART 3 - EXECUTION

3.1 SAFETY

A. Silica Dust

1. Saw cutting concrete produces silica dust.
2. The Contractor shall provide protection to all workers from exposure to hazardous levels of silica in accordance with 29 CFR 1926.55.
3. The Contractor shall identify and address silica health and safety in the written Project Health and Safety Plan.
4. The Contractor hall identify and implement worker training, engineering controls, and workplace practice controls to reduce worker exposure to silica prior to instituting a program based on respirators or protective clothing to protect workers.
5. Engineering controls shall include, but not be limited to dust suppression through the application of water or other methods, use of general or local ventilation, and containment/isolation.
6. Workplace practice controls shall include proper use and implementation of supervision, task procedures, employee training, signing, protective clothing, housekeeping, and personal hygiene.
7. If engineering controls and work practice controls cannot reduce exposures below the personal exposure limit, the contractor shall institute a respirator program.

B. Combustion Engine Driven Equipment

1. When sawing interior walls or slabs with internal combustion powered saws, provide adequate ventilation, air circulation that meets OSHA standards.

C. Work Zone Access Control

1. Define a safe work zone prior to the start of cutting operations
2. Provide barricades, cones, caution tape or other devices as appropriate to keep unauthorized personnel out of the work zone.

D. Cutting Operations

1. Do not cut with personnel directly in line with the blade or chain.
2. Plan the cutting sequence of wall cuts so that the bottom horizontal cut is not the last one to be completed.
3. Wall and elevated slab concrete sections to be removed shall be adequately braced to hold them in place prior to the start of cutting operations.
4. Areas below elevated slabs being cut shall be barricaded to keep personnel from entering the area.
5. Do not operate any cutting equipment without manufacturer supplied guards, covers, and other safeguards.
6. Do not operate any cutting equipment with damaged blades.

3.2 PROTECTION

A. The Contractor shall protect the work of other trades, Contractors and Subcontractors from damage during concrete cutting and removal operations.

B. The Contractor shall make provision for the protection of all existing and new structures, utilities, piping, equipment, and other objects that might be damaged in the course of concrete cutting and removal operations.

C. When cutting and removing concrete, every precaution shall be taken to ensure the continuous safe operation of the wastewater treatment facility. No interruption will be permitted and only such changes in the normal operating procedure as are approved by the Engineer will be permitted.

D. Care shall be taken to protect all utility lines, piping and conduit that are in the concrete cutting and removal area. The Contractor shall inform the Engineer of their location and notify the Engineer of any breaks immediately. In the event of break or other damage caused by concrete cutting and removal operations, the Contractor shall responsible to either immediately repair the lines at his own cost, or arrange for the appropriate utiity to make such repair at the Contractor’s cost.

3.3 EXAMINATION

A. Examine areas where concrete is to be cut and removed:

1. Determine scaffolding and work platform requirements
2. Determine and investigate hazards in and in close proximity to the area.
3. Identify and locate buried, embedded and surface mounted piping, conduit, utilities ductwork, and other items that may be damages or interfere with concrete cutting and removal operations.
4. Locate embedded items.
5. Locate cold joints.
6. Review reinforcing steel patterns and determine size, location and orientation of rebar; locate rebar where possible.
7. Determine method of slurry management and disposal.
8. Verify cutting operations will not impact structural integrity of the structure or slab.

9. Determine methods for protection of area below elevated slabs into which openings are to be cut.
10. Determine method for supporting the concrete to be removed during cutting operations.
11. Determine methods for lifting and removing concrete sections.
12. Determine the path for removing concrete sections for the work area.
13. Determine the weight limitations along the proposed removal path, adjust concrete section size as required.
14. Determine work zone safety requirements.

B. PREPARATION

1. Verify area to be cut
2. Verify cut depth
3. Layout cut lines.
4. If proposed cuts will cut through embedded objects, split rebar or lie adjacent to a cold joint; review the proposed cut location with the Engineer. Adjust cut location as permitted by the Engineer.
5. Verify all buried, embedded and surface mounted piping, conduit, utilities ductwork, and other items that may be damages or interfere with concrete cutting and removal operations have been removed or decommissioned.
6. Install required shoring and bracing.
7. Erect required work platforms and scaffolding.
8. Set-up slurry management.
9. Implements work zone safety requirements
10. Inspect concrete saw equipment, do not operate any cutting equipment without manufacturer supplied guards, covers, and other safeguards. Do not operate any cutting equipment with damaged blades.

C. CUTTING

1. Observe all safety requirements.
2. If chipping or spalling of concrete at the sawcut occurs, the Contractor shall stop the work and adjust cutting operations as required. If the chipping or spalling occurs in new concrete being cut, the Contractor shall stop the work until the concrete has cured sufficiently to be able to withstand damage from cutting operations
3. Unless otherwise noted, sawcuts shall be made normal to the concrete surface.
4. The Contractor shall be responsible for the collection and disposal of concrete slurry.
5. The Contractor shall repair any chips or spalls in the concrete surface.

END OF SECTION 038100

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SECTION 038200 - CONCRETE BORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Smooth Bore Drilling
2. Rotary Impact Drilling
3. Core Drilling

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American National Standards Institute (ANSI)

1. ANSI B7.1 – The Use, Care, and Protection of Abrasive Wheels
2. ANSI B175.4 – American National Standard for Outdoor Power Equipment - Portable, Handheld, Internal-Combustion-Engine-Driven Cut-Off Machines - Safety Requirements

C. Concrete Sawing & Drilling Association, Inc. (CSDA)

1. CSDA BP 001 – Slurry
2. CSDA BP 003 – Hazard Identification and Debris Removal
3. CSDA C 101 – Core Drilling

D. International Association of Concrete Drillers and Sawyers (IASDS)

1. IASDS Standard 25007/1 – Basic Parameters for Concrete Drilling and Sawing Equipment

E. Occupational Safety and Health Administration (OSHA)

F. All other applicable Federal, State and Municipal codes, rules and regulations

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1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Product Data for Concrete Cutting Equipment including:

1. Manufacturer
2. Type of Unit
3. Size of Drill or Boring Machine including maximum drilling/boring diameter, maximum depth, horsepower and weight
4. Power Source (i.e. electric, combustion engine, hydraulic)

C. Drilling/Boring Procedures

D. Health and Safety Plan

E. Method for catching elevated slab cores. Where temporary bracing is proposed, bracing plans/procedures shall be prepared under the direction of, and signed by a Professional Engineer registered in the State of New York.

1.4 QUALITY ASSURANCE

A. Throughout the process of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills and who shall be present at the site and direct the work performed under this Section.

B. In the performance of the work of this Section, use an adequate number of trained workmen experienced in the cutting of concrete.

1.5 COORDINATION

A. Coordinate the work of this Section with other sections of work and trades.

PART 2 - PRODUCTS

2.1 DRILLING EQUIPMENT

A. Smooth Bore Drilling Equipment

1. Smooth bore drilling equipment shall be utilized for drilling small diameter holes in concrete, typically < 2-inches in diameter.
2. Use diamond or carbide tipped drill bits to provide a smooth bore hole.
3. Drill shall not require lubricant for drilling operations. Water is not considered a lubricant.

4. Drills shall be equipped with guides and guards.

B. Rotary Impact Drill

1. Rotary impact drills shall be used to provide a "rough" walled hole in concrete as required for doweling rebar into existing concrete and bonded anchor systems. Rotary impact drills shall not be used for work closer than 6 inches from a concrete edge. For work closer than 6 inch, core drill and subsequently roughen hole wall.
2. Rotary impact drills shall not require lubricant for drilling operations. Water is not considered a lubricant.
3. Drills shall be equipped with guides and guards.

C. Core Drilling Equipment

1. Core drilling equipment shall be utilized to provide large diameter smooth bore circular holes in concrete, typically from ½-inch to 60-inches in diameter.
2. Use diamond core drilling bits capable of making smooth, straight cored holes in concrete.
3. Core drillings machines shall not require lubricant for drilling operations. Water is not considered a lubricant.
4. Core drilling machines shall be equipped with guides, guards, and depth control.
5. Machines used for large diameter drilling shall be equipped with water cooling systems and dust control.

2.2 DRILLING TOLERANCES

A. Holes less than 12-inches in Diameter: Tolerances for the drilling of holes less than 12-inches in diameter in concrete walls and slabs shall not exceed the following:

Parameter	Hole Depth	
	< 40 in	≥ 40 in
Alignment accuracy	±0.2 in from target center plus 2.5% of hole diameter	
Angle accuracy	± 1 in/ft	
Directional accuracy in oblique drilling	± 0.7 in/ft	
Vertical	± 0.7 in/ft	
Horizontal	± 0.7 in/ft	
Surface rouging drilled hole (eveness)	± 0.2 in	± 0.6 in
Diameter deviation from specified dimension	± 0.12 in	± 0.6 in
Specified depth for pocket hole	± 0.4 in	± 0.6 in

B. Holes between 12-inches and 40-inches in Diameter: Tolerances for the drilling of holes between 12-inches and 40-inches in diameter in concrete walls and slabs shall not exceed the following:

Parameter	Hole Depth	
	< 40 in	≥ 40 in
Alignment accuracy	±0.2 in from target center plus 2.5% of hole diameter	
Angle accuracy	± 1 in/ft	
Directional accuracy in oblique drilling	± 0.7 in/ft	
Vertical	± 0.7 in/ft	
Horizontal	± 0.7 in/ft	
Surface rouging drilled hole (eveness)	± 0.4 in	± 0.8 in
Diameter deviation from specified dimension	± 0.4 in	± 0.8 in
Specified depth for pocket hole	± 0.4 in	± 0.8 in

PART 3 - EXECUTION

3.1 SAFETY

A. Silica Dust

1. Drilling/coring holes in concrete produces silica dust.
2. The Contractor shall provide protection to all workers from exposure to hazardous levels of silica in accordance with 29 CFR 1926.55.
3. The Contractor shall identify and address silica health and safety in the written Project Health and Safety Plan.
4. The Contractor hall identify and implement worker training, engineering controls, and workplace practice controls to reduce worker exposure to silica prior to instituting a program based on respirators or protective clothing to protect workers.
5. Engineering controls shall include, but not be limited to dust suppression through the application of water or other methods, use of general or local ventilation, and containment/isolation.
6. Workplace practice controls shall include proper use and implementation of supervision, task procedures, employee training, signing, protective clothing, housekeeping, and personal hygiene.
7. If engineering controls and work practice controls cannot reduce exposures below the personal exposure limit, the contractor shall institute a respirator program.

B. Combustion Engine Driven Equipment

1. When drilling/coring interior walls or slabs with internal combustion powered saws, provide adequate ventilation, air circulation that meets OSHA standards.

C. Work Zone Access Control

1. Define a safe work zone prior to the start of cutting operations
2. Provide barricades, cones, caution tape or other devices as appropriate to keep unauthorized personnel out of the work zone.

D. Drilling/Coring Operations

1. Drilling/coring equipment requiring water coolant shall not be operated without water.
2. Never permit drilling/coring equipment to operate unattended
3. Plan the cutting sequence of wall cuts so that the bottom horizontal cut is not the last one to be completed.
4. Provide a means to catch/retain cores from dropping though when coring elevated slabs.
5. Areas below elevated slabs being drilled/cored shall be barricaded to keep personnel from entering the area.
6. Do not operate any drilling/coring equipment without manufacturer supplied guards, covers, and other safeguards.
7. Do not operate any drilling/coring equipment with damaged birs/blades.

3.2 PROTECTION

A. The Contractor shall protect the work of other trades, Contractors and Subcontractors from damage during concrete drilling/coring operations.

B. The Contractor shall make provision for the protection of all existing and new structures, utilities, piping, equipment, and other objects that might be damaged in the course of concrete drilling/coring operations.

C. When drilling/coring concrete, every precaution shall be taken to ensure the continuous safe operation of the wastewater treatment facility. No interruption will be permitted and only such changes in the normal operating procedure as are approved by the Engineer will be permitted.

D. Care shall be taken to protect all utility lines, piping and conduit that are in the concrete drilling/coring area. The Contractor shall inform the Engineer of their location and notify the Engineer of any breaks immediately. In the event of break or other damage caused by concrete drilling/coring operations, the Contractor shall responsible to either immediately repair the lines at his own cost, or arrange for the appropriate utility to make such repair at the Contractor’s cost.

3.3 EXAMINATION

A. Examine areas where concrete is to be cut and removed:

1. Determine scaffolding and work platform requirements

2. Determine and investigate hazards in and in close proximity to the area.
3. Identify and locate buried, embedded and surface mounted piping, conduit, utilities ductwork, and other items that may be damages or interfere with concrete cutting and removal operations.
4. Locate embedded items.
5. Locate cold joints
6. Review reinforcing steel patterns and determine size, location and orientation of rebar; locate rebar where possible.
7. Determine method of slurry management and disposal.
8. Verify cutting operations will not impact structural integrity of the structure or slab.
9. Determine methods for protection of area below elevated slabs into which openings are to be cut.
10. Determine method for supporting the concrete to be removed during cutting operations.
11. Determine methods for lifting and removing concrete sections.
12. Determine the path for removing concrete sections for the work area.
13. Determine the weight limitations along the proposed removal path, adjust concrete section size as required.
14. Determine work zone safety requirements.

B. Preparation

1. Verify location to be drilled/cored.
2. Verify drill/core diameter and depth.
3. Layout hole.
4. If proposed hole will cut through embedded objects, split rebar or lie adjacent to a cold joint; review the proposed cut location with the Engineer. Adjust hole location as permitted by the Engineer.
5. Verify all buried, embedded and surface mounted piping, conduit, utilities ductwork, and other items that may be damages or interfere with concrete drilling/coring operations have been removed or decommissioned.
6. Install required means to catch or retain cores in elevated slabs
7. Erect required work platforms and scaffolding.
8. Set-up slurry management.
9. Implements work zone safety requirements.
10. Inspect concrete drilling/coring equipment, do not operate any equipment without manufacturer supplied guards, covers, and other safeguards. Do not operate any requiring cooling water without water, or with damaged bits or blades.

C. Drilling/Coring

1. Observe all safety requirements.
2. If chipping or spalling of concrete at the drilling/coring occurs, the Contractor shall stop the work and adjust drill/coring machine operations as required. If the chipping or spalling occurs in new concrete being cut, the Contractor shall stop the work until the concrete has cured sufficiently to be able to withstand damage from drilling/coring operations.
3. Unless otherwise noted, holes shall be made normal to the concrete surface.
4. The Contractor shall be responsible for the collection and disposal of cooling water/concrete slurry.

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5. The Contractor shall repair any chips or spalls in the concrete surface.
6. When reinforcing steel is encountered drilling a hole with a rotary impact drill, the reinforcing steel shall be cut with and removed by means of a core drill, and the remainder of the drilling done by rotary impact drill.

END OF SECTION 038200

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SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural shapes.
2. Channels and angles.
3. Hollow structural sections.
4. Structural pipe.
5. Structural plates and bars.
6. Fasteners, connectors, and anchors.

B. Related Sections:

1. Section 036000 “Grout”
2. Section 055000 “Metal Fabrications and Anchorage”
3. Section 099123 “Interior Painting”
4. Section 099679 “Atmospheric Protection and Plant Service Areas Coatings”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. The duties and responsibilities of the Owner, Engineer and Contractor shall not be altered by any standard referenced.
4. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

B. American Institute of Steel Construction:

1. Design, Fabrication, and Erection: “Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design”, June 1, 1989, by the American Institute of Steel Construction (AISC Specification).
2. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
3. AISC 341 - Seismic Provisions for Structural Steel Buildings.
4. AISC 360 - Specification for Structural Steel Buildings.

C. ASTM International:

1. ASTM A6 – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
2. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
3. ASTM A572, Grade 50 Standard Specification for High-Strenght Low-Alloy Columbium-Vanadium Structural Steel
4. ASTM A992, Grade 50 Standard specification for Structural Steel Shapes
5. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated, Welded and Seamless
6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
8. ASTM A501 – Standard Specification for hot-formed Welded and Seamless Carbon Steel Structural Tubing.
9. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
10. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

D. American Welding Society:

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.

E. Research Council on Structural Connections:

1. RCSC - Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

F. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.

G. New York State Department of Transportation, Office of Structures:

1. Steel Construction Manual

1.3 REQUIREMENTS FOR CONNECTIONS

A. General:

1. Except where Type 1 (rigid-frame) or Type 3 (semi-rigid framing) connections are indicated, the design has been prepared on the basis of Type 2 (simple or unrestrained) connections, complying with the provisions of Section A2.2 of the AISC Specification.
2. Do not use connection details which depend upon sharing the stress between any combination of high-strength bolts in bearing-type connections and welds.
3. Size connections for the loads indicated on the Drawings. If the loads are not indicated, use a connection whose capacity is half the total uniform load capacity shown in the “Allowable uniform loads in kips for beams laterally supported” tables in the AISC Manual for the given shape, span, and steel specification of the beam in question, unless otherwise indicated.
4. All bolted connections shall have a minimum of two bolts.

B. Shop Connections: Unless otherwise indicated, all shop connections shall be welded or high strength bolted. Field connections required to be welded or fully-tensioned high-strength bolted shall meet the same requirements when fabricated in the shop.

C. Field Connections:

1. The following field connections shall be welded or fully-tensioned high-strength bolted.

   a. Column splices.
   b. Column bracing.
   c. Connections for supports of machinery.
   d. All connections of eave struts, eave purlins, first interior purlins, ridge beams, and ridge purlins to rigid frames and trusses.

2. All other bolted field connections need only be tightened to the snug tight condition.
3. When steel members of any cross section are to be spliced by welding in the field, a detailed welding procedure shall be submitted to the Engineer for approval. The procedure shall be detailed on shop drawings, submitted and approved prior to the fabrication of structural steel. The detailed field welding procedure shall include the method of supporting members during welding. All field welded splices shall be subject to non-destructive testing, Radiographic Testing (RT), or Ultrasonic Testing (UT), as determined by the Engineer. Field splice locations, when specifically shown on contract documents, shall not be relocated nor shall splices be added without written approval of the Director.

D. Standard Beam Connections:

1. Unless otherwise shown on the Drawings or required in the Specifications, all beam connections shall be framed in accordance with Part 4 of the AISC Manual, with sizes and lengths of angles and welds and with fastener spacings as shown therein.
2. Standard beam connections shown on the Drawings shall be fabricated as detailed. Substitutions will not be approved.

E. Special Beam Connections:

1. Where special conditions make it impracticable to provide connections complying with Paragraphs A thru D, and no details for such connections are shown on the Drawings, special connections shall be used. Such special connections shall, in general, comply with the provisions of the AISC Manual.
2. Typical details of proposed special connections shall be shown on the job standards.
3. Special connections shown on the Drawings shall be fabricated as detailed. Substitutions will not be approved.

1.4 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Product Data:

1. Producers or manufacturer’s specifications and installation instructions for all products supplied including but not limited to the following. Include laboratory test reports and other data to show compliance with specified requirements.

    a. Structural steel shapes, channels, angles, hollow structural sections, structural pipe, structural plates, structural bars and related fabrications.(each type).
    b. Bolts (each type), including nuts and washers.
    c. Surface Preparation and Shop Paint
    d. Reports of ladle analysis for all steel.
    e. Reports of tensile properties and bend tests.
    f. Certificates of conformance.
    g. Reports of tensile properties.
    h. Reports of mechanical properties of headed stud type shear connectors.
    i. Reports of mechanical tests.
    j. Bolts (each type), including nuts and washers.
    k. Description of each type of welding stud and arc shield.
    l. Field Paint

C. Shop Drawings:

1. Submit shop drawings and bills of materials including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erection. Information to be provided includes:

    a. Details of the location, type, size, etc., of bolts and welds.
    b. Details of cuts, connections, camber, holes, and other pertinent data.
    c. Indicate welds by standard AWS A2.4 welding symbols. Show size, length, and type of each weld.
    d. Setting drawing templates and directions for installation of anchor bolts and other anchorages
    e. Identify details to sheet and detail number on the drawings.
    f. Structural calculations

2. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the shop drawings.
3. Drawings which accompany the Contract Documents are designated Contract Drawings. Contract Drawings shall not serve as shop drawings. The Contractor shall draw and originate his own erection plans, anchor bolt plans, details and any other drawings necessary for his work. The Engineer's drawings shall not be reproduced, copied, traced or reused for erection or detail shop drawings.
4. Match Marks: Provide a diagram showing the match marks for connecting structural parts assembled in the shop for the purpose of erecting structures true and plumb, and/or for connections.
5. Design of details and connections, calculations shall be signed, stamped, and sealed by a Professional Engineer registered in the State of New York.
6. Architectural Clearances: No part of the steel work, such as seat stiffeners, brackets, bracing, etc. shall be permitted to interfere with architectural clearances.

D. Erection Procedures:

1. Accompanying the Shop Drawings, submit descriptive data to illustrate the structural steel erection procedure, including the sequence of erection and temporary staying and bracing.
2. Erection drawings shall show the identifying marks of all members.

E. Welding Procedure: Submit written description as required to illustrate each welding procedure to be performed in the specified work.

F. Field Welding Equipment: Submit descriptive data for field welding equipment, including type, voltage and amperage.

G. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

H. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis,

I. Alignment Certificate: Submit certification and survey data attesting that alignment requirements have been complied with following erection.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following:

1. Structural Steel: AISC 303.
2. High Strength Bolted Connections: RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.

1.6 QUALIFICATIONS

A. Fabricator: Company specializing in performing Work of this section with minimum 5 years documented experience.

B. Erector: Company specializing in performing Work of this section with minimum 5 years experience.

C. Shop Painter: Company specializing in performing Work of this section with minimum 5 years experience.

D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. General Requirements

1. Deliver materials to site at such intervals to insure uninterrupted progress of work.

2. Deliver anchor rods and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time not to delay that work.

C. Delivery of Materials to be Installed Under Other Sections

1. Anchors bolts and other anchorage devices which are embedded in cast-in-place concrete or masonry construction shall be delivered to the project site in time to be installed before the start of cast-in-place concrete operations or masonry work.
2. Provide setting drawings, templates, and directions for the installation of the anchor bolts and other devices.

D. Storage of Materials

1. Store materials to permit easy access for inspection and identification.
2. Structural steel members which are stored at the project site shall be above ground on platforms, skids or other supports.
3. Steel shall be protected from corrosion.
4. Other materials shall be stored in a weathertight and dry place, until ready for use in the work.
5. Packaged materials shall be stored in their original unbroken package or container.

E. Materials which fail to comply with specified requirements, either at the shop or project site, shall be promptly removed from the site and replaced with acceptable material, without additional cost to the Owner, and without causing delay in work.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural steel members, except for angles, shall comply with ASTM A572 or ASTM A992, Grade 50, high strength steel, new and unused, except where other type of steel is indicated.

B. Steel angles shall comply with ASTM A36/A36M, new and unused, except where other type of steel is indicated.

C. Round Hollow Structural Sections: ASTM A500/A500M, Grade C.

D. Square and Rectangular Hollow Structural Sections: ASTM A500/A500M, Grade C.

E. Structural Pipe: ASTM A53/A53M, Type E or S, Grade B.

1. Finish: Black except where indicated to be galvanized.

F. Stainless Steel: ASTM A276 Type 316

2.2 FASTENERS, CONNECTORS, AND ANCHORS

A. Anchor Bolts: ASTM A307; Grade A or ASTM A36.

1. Finish: Unfinished.

B. High Strength Bolts and Nuts: ASTM A325; Type 1.

1. Finish: Unfinished.

C. Nuts: ASTM A563 heavy hex type.

1. Finish: Unfinished.

D. Washers: ASTM F436; Type 1, circular.

1. Finish: Unfinished.

E. Anchor Rods: ASTM F1554; Grade 36.

2.3 WELDING MATERIALS

A. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 ACCESSORIES

A. Shop Primer: Compatible with Finish Paint. See Section 099123 and Section 099679.

B. Touch-Up Primer: Match shop primer.

2.5 FABRICATION

A. Shop Fabrication and Assembly:

1. Fabricate and assemble structural assemblies in shop to greatest extent possible.
2. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings.
3. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
4. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
5. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of member exposed in final structure free of markings, burrs, and other defect.
6. Develop required camber for members.

B. Connections:

1. All connections that are not specifically detailed on the drawings shall be properly designed for the standard end loads of the members to be connected, as tabulated for uniform load in the AISC Steel Construction Manual.
2. Fabricate connections for bolt, nut, and washer connectors.
3. All shop connections shall be welded.

4. All field connections shall be bolted using A325 hexagonal bolts and nuts except where welding may be required or as otherwise noted on the drawings.

    a. All thread area shall be excluded from shear planes.
    b. Minimum size bolt shall be 3/4-inch diameter.
    c. High strength bolted connections shall conform to the AISC Specifications

C. Welded Construction

1. Welding shall conform to AWS "Code for Welding in Building Construction" and to the AISC specifications.
2. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.
3. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
4. Complete visual inspection shall be provided by the Contractor prior to welding, during welding and on completed weldments.
5. Necessary equipment, tools and gauges to be used for quality control of fabrication, construction and erection shall be made available for use by the Engineer during inspection.

D. Bolts:

1. Anchor bolts shall be provided with double nuts and washers for leveling.
2. All unfinished bolts shall be provided with lock washers.

E. Bearing Plates:

1. Provide bearing plates for all open web joists, beams or girders bearing on concrete piers or walls.
2. Bearing plates shall be loose or attached as applicable.

F. Holes for Other Work:

1. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
2. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.
3. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.6 FINISH

A. Shop Painting

1. Shop prime structural steel members in accordance with the requirements of Section 099123 and Section 099679.
2. Shop coat shall be omitted in areas to be field welded, on contact surfaces of high strength bolted connections, on all surfaces to be permanently embedded in concrete, fireproofed, or galvanized.
3. Do not omit shop paint at piece marks on otherwise painted pieces.

B. Galvanizing:

1. In addition to members indicated on the Drawings and/or specified; all exterior exposed steel, all loose lintels in exterior walls; and all nuts, washers and the top 12 inches of exterior anchor bolts shall be hot-dip galvanized, after fabrication, in accordance with the requirements of the applicable specifications and other requirements listed below
2. ASTM A123/A123M; hot dip galvanize after fabrication.
3. Galvanizing for Fasteners, Connectors, and Anchors:

    a. Hot-Dipped Galvanizing: ASTM A153/A153M.
    b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

2.7 SOURCE QUALITY CONTROL AND TESTS

A. General: The fabricator shall perform the following inspection and testing:

1. Inspect high-strength bolted connections, visually inspect welded connections, perform required tests and inspections and prepare test reports.
2. Submit test reports to the Engineer
3. Review mill test reports, verify identity of steel with respect to mill test reports and, if found to comply with the specification requirements, so certify to the Engineer.
4. If steel is not accompanied by test reports, or test reports fail to verify compliance, perform additional tests in compliance with procedures specified in the appropriate ASTM Specifications and prepare test reports.
5. Conduct and interpret the tests and state in each report whether the test specimens comply with specification requirements.
6. Inspect structural steel at the plant before shipment, however, the engineer reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.
7. Verify dry mil thickness of shop prime coat.
8. Perform any additional tests as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work.

B. Shop Bolted Connections:

1. Inspect in accordance with AISC 303.
2. Visually inspect all bolted connections.

C. Shop Welding:

1. Inspect and test during fabrication of structural steel assemblies as follows:

    a. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
    b. Visually inspect all welds.

D. Access:

1. Provide access for the Engineer to the place where structural steel work is being fabricated or produced so that the required inspection and testing can be witnessed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erector must examine areas and conditions under which structural steel work is to be installed, and notify the Engineer in writing of conditions detrimental to proper and timely completion of work.

1. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
2. Execution of the work under this section constitutes acceptance of the base or adjoining work and other conditions as satisfactory in every respect.

B. Verify bearing surfaces are at correct elevation.

C. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

3.2 PREPARATION

A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

3.3 ERECTION

A. All structural steel shall be erected in accordance with the AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" and the "Code of Standard Practice for Steel Buildings and Bridges".

B. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.

C. Erecting equipment shall be adequate for the work and safety and no existing work shall be damaged or defaced.

D. Any members damaged during the erection of steel shall be repaired in the shop or replaced at the expense of the Contractor as directed by the Engineer.

E. Plumbing and Leveling:

1. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening.

2. All work shall be set level and plumb with individual members of structure within specified AISC tolerances. All work shall be within a tolerance of 1:500 for design slope, level or plumb except elevator shafts which shall conform to manufacturers requirements.
3. Level and/or plumb shall be checked to the satisfaction of the Engineer using leveling instrument and plumb-bob, or other acceptable means before permanent connections are made.
4. Base and bearing plates which require grouting with a non shrinking material shall be supported at the designated level by means of adjusting nuts on the anchor bolts
5. All discrepancies in plumbs and levels shall be reported to the Engineer and corrected.

F. Field Holes, Reaming and Drifting

1. No burning of holes for any purpose will be allowed.
2. Field holes shall be drilled.
3. Light drifting will be permitted to draw the parts together by drift pinning to enlarge holes or to match unfair holes will not be permitted.
4. Any enlargement of holes shall be done by reaming with twist drills.
5. After steel work is erected, the Contractor shall see that no one is allowed to burn holes in the steel members, except as approved in writing by the Engineer.

G. Temporary Bracing

1. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guide lines to achieve proper alignment of structures as erection proceeds.
2. During erections, steel cables with turnbuckles shall be installed in sufficient number to prevent distortion or damage to the framework due to wind or erection forces.
3. These cables shall be used to plumb and line columns before final bolting and shall be left in place until sufficient masonry bracing has been placed to insure the lateral stability of the structure.

H. Anchor Bolts and Column Base Plates

1. Anchor bolts and other required anchorage items shall be verified for proper size and accurate location prior to erection of structural steel work.
2. Column baseplates shall be supported and aligned on steel wedges or shims. After supported members have been plumbed and positioned and the anchor nuts tightened, the entire bearing area under each base plate shall be packed solidly with grout as specified under Section 036000 “Grout”.
3. Wedges and shims shall be cut-off flush with edges of plate and shall be left in place.
4. Moist cure grout.
5. Remove forms after grout is set. Trim grout edges to from smooth surface, splayed 45 degrees.
6. Tighten anchor bolts after grout has cured for a minimum of 3 days.

I. Field Connections

1. Installation, tension control and wrenches used for high strength bolting shall conform to the SISC "Specifications for Structural Joints using ASTM A325 Bolts" as approved by the Research Council on Riveted and Bolted Structural Joints

2. Tightening of nuts shall be accomplished with properly calibrated wrenches or by the "Turn-of-Nuts" method, at the Contractor's option.
3. Calibrated wrenches shall be checked for accuracy at least once daily.
4. Bolts completely tightened shall be marked with an identifying symbol.
5. Common bolts shall be drawn up tight and the threads set after the work has been plumbed and leveled.
6. Field welding shall be performed in accordance with AWS D1.1 - Structural Welding Code – Steel.

J. Exposed erection bolt holes shall be plug welded and ground smooth.

K. Steel members exposed to the exterior view shall have all integrally raised letters ground off smooth.

L. Do not field cut or alter structural members without approval of Architect/Engineer.

M. After erection, touch up welds and abrasions to match shop finishes.

3.4 FIELD PAINTING

A. Field painting shall include painting of bolts, field welds, abrasions and places where the shop coat has been broken or omitted.

B. Paint shall be the same as used for the shop coat and shall be supplied by the steel fabricator.

C. Before the touch-up paint is applied, the area to be coated shall be sandblasted to a commercial finish in accordance with SSPC-SP6.

D. At welds, all flux and scale shall be removed.

E. Final full field coat shall be as specified in Section 099123 and Section 099679.

3.5 FIELD QUALITY CONTROL

A. Bolted Connections: Inspect in accordance with AISC 303.

1. Visually inspect all bolted connections.

B. Welding: Inspect welds in accordance with AWS D1.1.

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
2. Visually inspect all welds.

C. Correct defective bolted connections and welds.

END OF SECTION 051200

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SECTION 051400 - STRUCTURAL ALUMINUM

PART 1 - PART 1 GENERAL

1.1 DESCRIPTION

A. Furnish all equipment, labor, materials, and services required to provide all structural aluminum work in accordance with the Contract Documents. The term "structural aluminum" shall include items as defined in the Aluminum Association "Specifications for Aluminum Structures".

1.2 REFERENCES

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid.

1. 2006 Maryland Building Performance Standards
2. Aluminum Association "Specifications for Aluminum Structures"
3. AWS D1.2 - "Structural Welding Code".

B. Related Sections

1. Section 036000 – Grout
2. Section 055000 - Metal Fabrications and Anchorage

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittals, of the Standard Specifications.

1. Certified Mill Test Reports
2. Affidavit of Compliance with grade specified
3. Shop Drawings which include the following:

    a. Layout drawings indicating all structural shapes, sizes, and dimensions.
    b. Beam and column schedules.
    c. Detailed drawings indicating jointing, anchoring and connection details.

1.4 QUALITY ASSURANCE

A. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no

way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural aluminum shall comply with Section 05 12 00, Structural Steel Framing.

B. Fasteners for structural aluminum shall be in accordance with Section 05 12 00, Structural Steel Framing.

C. Electrodes for welding shall be in accordance with Section 05 12 00, Structural Steel Framing.

PART 3 - INSTALLATION

3.1 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.2 FABRICATION

A. Fabrication shall be in accordance with the Aluminum Association "Specifications for Aluminum Structures". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural aluminum members required for anchors, anchor bolts, bolt holes, or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

3.3 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural aluminum members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or

damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.4 ERECTION

A. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened.

C. No cutting of structural aluminum members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05 05 23, Metal Fastening.

F. All bolted connections shall comply with Section 05 05 23, Metal Fastening.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.
2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.
3. Where misalignment between anchor bolts and bolt holes in aluminum members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.
2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.
3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03 60 00 – Grout.

4. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.5 PAINTING

A. Painting shall be performed according to Section 099679 Atmospheric Protection and Plant Service Areas Coatings.

B. Aluminum surfaces in contact with concrete or dissimilar metals shall be thoroughly protected with two coats of epoxy paint with a minimum total thickness of 16 mils or other approved isolating material in accordance with the requirements of Section 099679 Atmospheric Protection and Plant Service Areas Coatings.

END OF SECTION 051400

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SECTION 055000 - METAL FABRICATIONS AND ANCHORAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. All metal fabrications and miscellaneous metal items which are not included on the drawings, in the specifications or in other areas of the Contract Documents.
2. Shop fabricated ferrous and non-ferrous metal items which, in general, includes bollards, lintels, shelf angles, bearing plates, overhead door frames, ladders, access hatches, checkered floor plate, wall brackets, specialty pipe supports, crane support columns and beams, trash racks, etc.
3. Anchorage

B. Related Sections:

1. Section 036000 “Grout”
2. Section 051200 “Structural Steel Framing”

1.2 REFERENCES

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements are specified herein:

1. ANSI A14.3 – Ladders, Fixed, Safety Requirement
2. ASTM A992 – Grade 50 Structural Steel
3. ASTM A572 – Grade 50 Structural Steel
4. ASTM A53 – Pipe, steel, black and hot-dipped, zinc-coated welded and seamless
5. ASTM A123 – Zinc (Hot-Galvanized) Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip
6. ASTM A153 – Zinc (Hot-Galvanized) Coatings on Iron and Steel Hardware
7. ASTM A276 – Stainless and Heat-Resistant Steel Bars and Shapes
8. ASTM A283 – Low and Intermediate Tensile Strength Carbon Steel Plates
9. ASTM A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
10. ASTM A325 – Structural Bolts, Heat Treated, 120/105 ksi Tensile Strength
11. ASTM A489 – Carbon Steel Eyebolts
12. ASTM A500 – Cold-Formed welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
13. ASTM A501 – Structural Tubing
14. ASTM A536 – Ductile Iron Castings
15. ASTM B209 – Aluminum-Alloy Sheet and Plate
16. ASTM B221 – Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
17. ASTM B308 – Aluminum-Alloy 6061-T6 Standard Structural Shapes
18. ASTM B632 – Aluminum Tread Plate
19. American Welding Society (AWS)

a. AWS A2.0 – Standard Welding Symbols.
b. AWS D1.1 – Structural Welding Code - Steel.
c. AWS D1.2 – Structural Welding Code - Aluminum.

20. Steel Structures Painting Council (SSPC)
21. "Construction Manual Series, Section 1, Specifications for Aluminum Structures, December, 1986", by the Aluminum Association, Incorporated (AAI Specification).

1.3 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of holes and fasteners, and all accessories. Include detailed fabrication and erection drawings, elevations, bill of materials, finishes, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

B. Shop drawings shall be signed and sealed by the licensed in State of New York Professional Engineer who performed the design.

C. Manufacturer’s product data, samples for selection of finish, color, texture, and other properties.

D. Anchorage:

1. Sizing Calculations
2. Load Ratings
3. Material Schedule
4. Performance Specifications
5. Installation procedures.

1.4 QUALITY ASSURANCE

A. Finish joints in accordance with NOMMA Guideline 1.

B. Design of all load supporting systems shall be performed under the direct supervision of a Professional Engineer experienced in design of the Work and licensed in State of New York.

C. Weld procedures and welder personnel shall be AWS certified. Certifications shall be submitted prior to performing the related work.

D. All anchors shall be a product from a manufacturer regularly engaged in the manufacture and supply of similar items for at least 5 years.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Sections: ASTM A992 or A572; Grade 50.

B. Steel Channel, Angle and Plate: ASTM A36.

C. Steel Plates to be Bent or Cold-Formed: ASTM A 283, Grade C.

D. Steel Bars and Bar-Size Shapes: ASTM A 675, Grade 70; or ASTM A 36.

E. Merchant Quality Steel Bars: ASTM A 575, grade as selected by fabricator.

F. Cold-Finished Steel Bars: ASTM A 108, grade as selected by fabricator.

G. Hot-Rolled Carbon Steel Sheet and Strip: ASTM A 569, pickled and oiled.

H. Cold-Rolled Carbon Steel Sheet: ASTM A 366, oiled.

I. Galvanized Steel Sheet: ASTM A 526, with G90 hot-dip process zinc coating complying with ASTM A 525.

J. Hollow Structural Sections: ASTM A500/A501, Grade C.

K. Cold-Drawn Steel Tubing: ASTM A 512, buttwelded, cold-finished carbon steel tubing, sink drawn and stress relieved.

L. Cast Iron Castings: ASTM A 48, gray iron castings, Class 30.

M. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.

N. Steel Castings: ASTM A 27, grade and class as required by use of item.

O. Steel Pipe: ASTM A53, Grade B, Schedule 40.

P. Rolled Steel Floor Plate, Raised Pattern: ASTM A 786; raised herringbone pattern unless otherwise indicated.

Q. Aluminum Pipe: Aluminum Alloy 6061-T6.

R. Aluminum Sections: ASTM B308, Alloy 6061-T6. Use Aluminum Association Shapes.

S. Aluminum Checkered Floor Plate: ASTM B632, Alloy 6061-T6.

T. Stainless Steel Angles and Plates: ASTM A276. Type 316.

U. Stainless Steel: Type 302/304; ASTM A 666 for plate, sheet and strip; ASTM A 276 for bars and shapes; ASTM A 269 for tubing.

V. Fasteners: Except where shown or specified, select fasteners of type, size, style, grade, and class required for secure installation of metal fabrications. For exterior use and where built into exterior walls, fasteners shall be galvanized.

1. Standard Bolts and Nuts: ASTM A 307, Grade A, regular hexagon head.
2. Machine Bolts: ASME B18.5 or ASME B18.9, Type, Class, and Form as required.
3. Machine Screws: ASME B18.6.3.
4. Lag Screws: ASME B18.2.1.

5. Wood Screws: Flat head, ASME B18.6.1.
6. Plain Washers: Round, ASME B18.22.1.
7. Lock Washers: Helical, spring type, ASME B18.21.1.
8. Toggle Bolts: Spring Wing Type; Wing AISI 1010, Trunion Nut AISI1010 or Zamac Alloy, Bolt Carbon Steel ANSI B18.6.3.

W. Bolts, Nuts and Washers

1. Stainless Steel: ASTM A276 Type 316 Stainless Steel, With Raised Letter Indicating Manufacturer.
2. Steel Bolts: ASTM A325 galvanized to ASTM A153.
3. Steel Anchor Bolts: ASTM A36 or ASTM A307 galvanized to ASTM A153.
4. Steel Eyebolts: ASTM A489

X. Sheet Steel: ASTM A653/A653M, Grade 33 Structural Quality galvanized to ASTM A153

Y. Galvanized Items: ASTM A 36; or ASTM A 675, Grade 70.

Z. High-Strength Bolts: ASTM A 325, galvanized.

AA. Common Bolts: ASTM A 307, galvanized.

BB. Stainless Steel Fasteners:

1. Bolts: 316 alloy, ASTM F 593.
2. Nuts: 316 alloy, ASTM F 594.
3. Plain Washers: 316 alloy, FS FF-W-92, round, general assembly grade, Class B.
4. Lock Washers: 316 alloy, FS FF-W-84, helical spring type, Class C, Style 2.

CC. Weld Filler Metal: ER5356 filler metal complying with AWS Specification A5.10.

DD. Shielding Gas: Argon.

EE. Cold Galvanizing Compound: Single component compound giving 93 percent pure zinc in the dried film, and meeting the requirements of DOD-P-21035A (NAVY).

FF. Shop Paint for Galvanized Steel: FS TT-P-641, Type II.

GG. Shop Paint (General): Primer selected from the following:

1. TNEMEC Series 15 (color as selected by the Director's Representative).
2. Rust-Oleum 5781 (Gray) or 5769 (Red).
3. Valspar 13-W-11.

HH. Surface Etching Solution for Shop Paint (General):

1. As recommended by the manufacturer of the paint selected.

II. Bituminous Mastic: Cold applied asphalt mastic; SSPC - Paint 12.

JJ. Shrink-Resistant Grout (Non-Staining): Factory-packaged, non-ferrous mortar grouting compound selected from the following:

1. Masterflow 713 by Master Builders.
2. Sonogrout by Sonneborn.
3. Five Star Grout by U.S. Grout Corporation.
4. Crystex by L&M Construction Chemicals.
5. Non-Corrosive, Non-Shrink Grout by A.C. Horn.

2.2 GENERAL REQUIREMENTS FOR ANCHORAGE

A. Anchorage specified herein is for anchorage of hangers, brackets, equipment, piping, electrical, HVAC, plumbing, and miscellaneous metals.

B. Provide anchorage suitable for the design loadings times a minimum safety factor of 4.

C. Existing concrete shall be assumed to have a compressive strength of 3000 psi.

D. Install all anchorage in strict accordance with manufacturer's installation instructions.

E. Anchors, washers, and nuts to be installed in wet, corrosive, or exterior locations shall be Type 316 stainless steel.

F. Anchors, washers, and nuts to be installed in interior, enclosed, dry, temperature controlled, humidity controlled environments shall be carbon steel hot dipped galvanized, in accordance with ASTM A153.

G. Anchors, washers, and nuts shall not be used to resist vibratory loads in tension zones of concrete members.

H. Anchors not shown or indicated on the drawings shall be adhesive anchors, unless otherwise specified herein.

I. Testing of anchorage shall be as specified herein.

2.3 ANCHOR BOLTS

A. Anchor bolts shall be used for structural anchoring and anchoring items to new concrete floors and equipment pads.

B. All anchor bolts shall be solidly cast-in-place anchors.

C. Provide equipment anchorage utilizing anchor bolts per equipment manufacturer's recommendations.

2.4 UNDERCUT ANCHORS

A. Undercut anchors shall be used for overhead support into existing concrete, and all installations in cracked concrete.

B. Undercut anchors shall be of an undercut style with brazed tungsten carbides on the embedded end that perform the self undercutting process.

C. Undercut portion of anchor shall have a minimum projected bearing area equal to or greater than 2.5 times the nominal bolt area.

D. The bolt shall conform to ISO 898 class 8.8 strength requirements.

E. Product: HDA as manufacturered by Hilti, or approved equal.

2.5 ADHESIVE ANCHORS

A. Adhesive anchors shall not be used to support overhead piping larger than 4 inch diameter, or in cracked concrete.

B. Adhesive anchors shall be used to anchor items to new and existing walls.

C. All adhesive anchors shall be made of Type 316 stainless steel.

D. Injectable adhesive shall be used for installation of all reinforcing steel dowels or threaded anchor rods and inserts into new or existing concrete.

E. Adhesive shall be furnished in containers which keep the two components separate.

F. Injection adhesive shall be formulated to include resin and hardener to provide optimal curing speed as well as high strength and stiffness.

G. Injection adhesive shall be HIT-HY 150 or HIT-ICE, as manufactured by Hilti, or approved equal.

H. Anchor rods shall be furnished with chamfered ends so that either end will accept a nut and washer.

I. Anchor rods shall be in accordance with the following:

1. ISO 898 Class5.8
2. ASTM A193, Grade B7 (High strength carbon steel)
3. AISI 316 stainless steel, ASTM F 593, Condition CW

J. Use only manufacturer recommended injection tools and mixing nozzles

2.6 EXPANSION ANCHORS

A. Expansion anchors shall not be used to support overhead piping larger than 2 inch diameter, or in cracked concrete. Expansion anchors shall only be used overhead when anchoring to interior new concrete.

B. Expansion anchors shall not be used to anchor items to new or existing walls, unless otherwise approved by the Engineer.

C. Expansion anchors shall be in accordance with Federal specification A-A 1923A, Type 4.

D. The anchor shall bear a length identification mark embossed into the impact section or dog point, of the anchor identifying the anchor.

E. Product: Kwik Bolt 3, as manufactured by Hilti, or approved equal.

2.7 ACCESSORIES

A. Welding Materials: AWS D1.1 and AWS D1.2: type required for materials being welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Backpaint aluminum surfaces in contact with concrete or masonry with bituminous paint. Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Fasten aluminum with Type 316 stainless steel bolts.

E. Bollards: 6 Inch ASTM A53, Schedule 40 Steel Pipe, Concrete Filled. Cover with Safety Yellow PVC sleeve and cap.

F. Galvanized Steel Shelf Angles: For support of masonry, prime paint before installation and finish paint exposed surfaces per paint specification.

G. Shop Primer: Conform to Paint Specification.

H. Touch-Up Primer: Match shop primer.

2.8 FABRICATION

A. General:

1. All dimensions shall be field verified prior to fabrication.
2. Fit and shop assemble items in largest practical sections, for delivery to site.
3. Continuously seal joined members by continuous welds.
4. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
5. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, consistent with design of component.
6. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication.

B. Miscellaneous Framing and Supports

1. Fabricate metal framing and supports, which are not a part of the structural steel framework, to support related items required by the Work.
2. Fabricate units to the sizes, shapes, and profiles indicated or, if not indicated, of required dimensions to receive adjacent Work to be retained by the framing. Except as otherwise indicated, fabricate from structural steel shapes, plates, and bars, of all welded construction, with mitered corners, necessary brackets and splice plates, and a minimum

number of joints for field connection. Punch, drill, and tap units to receive hardware and similar items to be anchored to the Work.

3. When required to be built into masonry or cast-in-place concrete, equip units with integrally welded anchor straps. Unless otherwise indicated, anchors shall be minimum 1-1/4 x 1/4 x 8 inch steel straps, spaced 2 feet oc.
4. Galvanize exterior steel framing and supports.

C. Miscellaneous Steel Trim

1. Fabricate trim of shapes, sizes, and profiles shown. Fabricate units from steel shapes, plates, and bars, with continuously welded joints and smooth exposed edges, unless otherwise indicated. Use concealed field splices wherever possible. Furnish cutouts, fittings, and anchorages as required for assembly and installation.
2. Galvanize exterior steel trim.

D. Fixed Ladders

1. Fabricate ladders to span between elevations at locations indicated. Comply with the requirements of ANSI A 14.3 unless otherwise shown or specified.

    a. Side Rails: Continuous, structural steel, flat solid bars with eased edges.

2. Rungs: Structural steel, round solid bars, spaced 12 inches oc.
3. Non-slip Surface: The top of each rung shall have a non-slip surface, achieved either by coating the rung with aluminum oxide grit set in epoxy resin adhesive or by use of manufactured rung filled with aluminum oxide grout.
4. Fit rungs into punched holes in centerline of side rails, plug weld and grind welds smooth on outer face of rails.
5. Supports: Locate supports for each side rail near top rung, at bottom of ladder, and at intermediate points spaced not more than 5’-0” oc. Use welded or bolted steel brackets or straps for wall anchors, designed for adequate support and anchorage to hold the ladder 6 inches clear of the wall surface and other obstructing construction.
6. Except for ladders terminating at a hatch, extend side rails 3’-6” minimum above top rung and return rails to wall or structure; if construction does not extend above the top rung, goose-neck the extended rails back to the structure. Flare out side rails for through ladder extensions. For side-step ladders, continue the rungs also in the extension.
7. Galvanize exterior ladders and supports.
8. Safety Chain: ASTM A 666; Type 316 stainless steel, straight link individually welded, 3/8 inch trade size.
9. Eye Bolts: Drop forged stainless steel, shoulder pattern, threaded, 1/4 inch diameter.
10. Snap Eye Bolts: Chrome plated, 5/8 inch swivel loop, 3/8 inch snap opening.

E. Loose Bearing Plates

1. Steel plates fabricated flat, free from warp or twist, and of required thickness and bearing area. Drill plates as required for anchor bolts and for grouting access. Furnish bearing plates where shown and where required for steel items bearing on masonry or concrete construction.

F. Loose Lintels

1. Structural steel shape lintels, fabricated for openings and recesses in masonry walls and partitions as indicated. Loose lintels bearing on masonry or concrete shall have a minimum end bearing length of 6 inches at each end, unless otherwise shown. Galvanize lintels to be installed in exterior walls.

G. Shelf Angles

1. Galvanized structural steel shelf angles of sizes shown, fabricated for attachment to concrete framing. Angles shall have slotted holes, to receive 3/4 inch bolts, spaced not more than 6 inches from ends and not more than 24 inches oc, unless otherwise shown. Furnish wedge-type concrete inserts and fasteners for attachment of shelf angles to cast-in-place concrete.

2.9 FINISHES

A. Prepare surfaces in accordance with the Paint Specification. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Shop prime items in accordance with the Paint Specification and the reviewed paint shop drawings.

C. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.

D. Galvanizing for Fasteners, Connectors, and Anchors:

1. Hot-Dipped Galvanizing: ASTM A153/A153M.
2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads and provide temporary bracing to maintain indicated alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on Drawings and/or reviewed shop drawings. Perform field welding in accordance with AWS D1.1 and AWS D1.2.

D. Obtain approval prior to site cutting.

E. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

3.4 INSTALLATION OF ANCHORAGE

A. Install all anchorage in strict accordance with Manufacturer's installation procedures.

B. Finish paint anchors in accordance with Section 099123.

3.5 ANCHORAGE TESTING

A. Field test random selection of minimum 10% of installed anchorage of each type for floor and wall anchorage, and 20% of installed anchorage of each type for ceiling anchorage. Testing shall be performed at 100% of the minimum pullout loadings for the anchor. Testing shall be performed by an independent testing agency.

B. The Engineer shall determine if the results of the testing reveals unsatisfactory results. If the results are unsatisfactory, the Contractor shall provide a full scale pullout testing program.

C. Pullout Testing Program: Contractor shall perform full scale pullout testing program if the results of anchorage testing are unsatisfactory to the Engineer. The program shall serve to ascertain the cause of the unsatisfactory strength test results and verify the suitability of the anchoring system. The pullout test –to rated capacity- shall be performed on a selection of minimum 50% of installed anchorage of each type. Pullout testing shall be performed by an independent testing agency. Testing shall conform to the requirements of ASTM E488

3.6 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1 and AWS D1.2.

END OF SECTION 055000

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SECTION 055117 - PRE-ENGINEERED ALUMINUM STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install pre-engineered aluminum stairs including surface preparation and shop priming.
2. The extent of pre-engineered aluminum stairs shall be as shown.
3. The Work also includes:

    a. Providing openings in and attachments to pre-engineered aluminum stairs to accommodate the Work under this and other Sections and providing for the pre-engineered aluminum stairs all items such as anchor bolts, studs and all items required for which provision is not specifically included under other Sections.
    b. Providing openings in and attachments to pre-engineered aluminum stairs to accommodate the work under other contracts, and assisting other contractors in building on or attaching to the pre-engineered aluminum stairs all items such as anchor bolts, studs and all items required for which provision is not specifically included under other contracts.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the pre-engineered aluminum stairs Work.
2. Notify other contractors in advance of the installation of the pre-engineered aluminum stairs to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the pre-engineered aluminum stairs Work.

C. Related Sections:

1. Section 05 50 00 – Metal Fabrication and Anchorage
2. Section 05 52 15 – Aluminum Handrails and Railings
3. Section 05 53 00 – Metal Grating.
4. Section 05 54 00 – Metal Floor Plates
5. Section 09 91 00 – Painting.

1.2 REFERENCES

A. Aluminum Association (AA), Specification for Aluminum Structures.

B. American Society for Testing and Materials, (ASTM).

1. ASTM B 209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM B 211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.

3. ASTM B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
4. ASTM B 308/B 308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
5. ASTM B 429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
6. ASTM F 593, Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
7. ASTM F 594, Specification for Stainless Steel Nuts.

C. American Welding Society, (AWS).

1. AWS D1.2/D1.2M, Structural Welding Code-Aluminum.

D. National Association of Architectural Metal Manufacturers, (NAAMM).

1. NAAMM, Metal Stairs Manual and Metal Finishes Manual.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Samples: Submit the following:

1. Representative samples of materials including nosings, tread material, and others items as requested by the Engineer. Review will be for type only. Compliance with all other requirements is exclusive responsibility of Contractor.

C. Shop Drawings and Calculations: Submit the following:

1. Erection and detailed Shop Drawings, which show the plan location, elevation and details for the fabrication and erection of the pre-engineered aluminum stair Work. Show anchorage and accessory items. Include details of all connections between all materials.
2. Provide signed and sealed Shop Drawings and calculations, which are prepared by a Registered Professional Engineer licensed in the State in which the pre-engineered aluminum stairs will be installed.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:

1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of the component manufacturer from a single pre-engineered aluminum stair manufacturer.
2. The pre-engineered aluminum stair manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pre-engineered aluminum stair manufacturer.

C. Codes: Comply with the applicable requirements of the New York State Building Codes.

D. Source Quality Control: Contractor shall be responsible for entire design, fabrication and installation of pre-engineered aluminum stair Work.

E. The Shop Drawings and calculations shall be prepared by a Registered Professional Engineer licensed in the State in which the pre-engineered aluminum stairs will be installed and is a recognized expert in the type of Work shown and specified.

1.5 DELIVERY, STORAGE AND HANDLING

A. Section 01 65 00 – Product Delivery, Storage and Handling Requirements: Requirements for transporting, handling, storing and protection products.

1.1 JOB CONDITIONS

B. Conform to applicable OSHA and the New York State Building Codes.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Pre-engineered aluminum stairs shall comply with the requirements of the NAAMM, "Metal Stairs Manual".

B. Sizes of miscellaneous items such as carrier angles and platform stiffeners, and design stresses shall be as recommended in Section 4 of the "Metal Stairs Manual", unless otherwise shown.

C. All required stair loadings and other stair related requirements shall comply with the governing building code in which the pre-engineered aluminum stairs will be installed.

2.2 FABRICATION

A. General:

1. Use welding for joining pieces together, unless otherwise shown or specified. Welding to comply with the applicable provisions of AWS D1.2/D1.2M. Fabricate units so that bolts and other fastenings do not appear on finish surfaces. Make joints true and tight, and make connections between parts light-proof tight. Provide continuous welds, ground smooth where exposed.
2. Construct stair units to conform to sizes and arrangements as shown. Provide pre-engineered aluminum framing, hangers, columns, struts, clips, brackets, bearing plates and other components for the support of pre-engineered aluminum stairs and platforms. Erect pre-

engineered aluminum stair Work to line, plumb, square, and true with runs registering level with floor and platform levels.

3. Provide brackets and bearing surfaces as detailed and as required to anchor and contain the pre-engineered aluminum stairs on the supporting structure.
4. Where masonry walls support the pre-engineered aluminum stair Work, provide temporary supporting struts, designed for the erection of stair components before installation of masonry.
5. Finish: Provide Architectural mill finish as specified in the NAAMM Manual.
6. Protection of Aluminum from Dissimilar Materials: Coat all surfaces of aluminum in contact with dissimilar materials, such as concrete, masonry and steel as specified in Section 09 91 00.

B. Stair Framing:

1. Fabricate stringers of structural aluminum channels, or plates, or a combination thereof, as shown. Provide closures for exposed ends of stringers.
2. Construct platforms of structural aluminum channel headers and miscellaneous framing members, as shown. Bolt or weld headers to stringers. Bolt or weld framing members to strings and headers.

C. Aluminum Floor Plate, Treads and Platforms:

1. Provide raised pattern aluminum floor plate. Provide pattern shown or, if not shown, as selected from manufacturer's standard patterns.
2. Form treads of 3/8-inch thick aluminum floor plate with integral nosing and back edge stiffener. Weld aluminum supporting brackets to stringers and bolt treads to brackets. Provide closed tread and riser at egress stairs.
3. Fabricate platforms of aluminum floor plate of thickness shown. Provide nosing matching that on treads at all landings. Secure floor plates to platform framing members with bolts.

D. Aluminum Grating Treads and Platforms:

1. For aluminum grating and treads, refer to Section 05 53 00 and Section 05 54 00.
2. Fabricate grating treads with abrasive nosing on one edge and with aluminum angle or aluminum plate carrier at each end for stringer connections. Secure treads to stringers with bolts. Provide grating treads at non-egress stairs only.
3. Fabricate grating platforms, with nosing matching that on grating treads, at all landings. Provide toe-plates at open-sided edges of floor grating fastened to platform framing members.
4. Provide platforms 3/8-inch minimum thick with solid abrasive surface matching that on treads. Secure platforms to platform framing members with bolts.

E. Stair Aluminum Railing:

1. Aluminum railings shall conform to the requirements of Section 05 52 15.

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PART 3 - EXECUTION

3.1 INSPECTION

A. Contractor shall examine the conditions under which the Work is to be installed and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction.

3.3 INSTALLATION

A. Fastening to In-Place Construction:

1. Provide anchorage devices and fasteners where necessary for securing pre-engineered aluminum stairs to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts and other connectors as required. The anchorage devices and fasteners shall be Type 316 stainless steel.

B. Cutting, Fitting and Placement:

1. Perform cutting, drilling and fitting required for the installation of the pre-engineered aluminum stairs. Set the pre-engineered aluminum stairs accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry or similar construction.
2. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

END OF SECTION 055117

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SECTION 055215 - ALUMINUM HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install aluminum handrail and railing systems. The Work also includes:

   a. Providing openings in, and attachments to, aluminum handrail and railing systems to accommodate the Work under this and other Specification Sections. Provide all items for aluminum handrails and railings, including anchorages, fasteners, studs, and other items required for which provision for is not specifically included under other Sections.
   b. Provide openings in and attachments to aluminum handrails and railings to accommodate work under other contracts. Assist other contractors in building on or attaching to aluminum handrails and railings all items such as fasteners and other items required for which provision is not specifically included under other contracts.

2. Aluminum handrails and railings Work shall include components and features shown and specified, and all components and features available from specified manufacturers required for providing complete aluminum handrail and railing system in accordance with the Contract Documents.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum handrails and railings Work.
2. Notify other contractors in advance of installing aluminum handrail and railings to provide them with sufficient time to install items included in their contracts that are to be installed with or before aluminum handrails and railings Work.
3. Aluminum handrail and railing locations shall conform with Laws and Regulations.

C. Related Sections:

1. Section 036000 “Grout”
2. Section 055000 “Metal Fabrication and Anchorage”

1.2 REFERENCES

A. Aluminum Association (AA), Aluminum Design Manual.

B. American Society for Testing and Materials, (ASTM).

1. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.

2. ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
3. ASTM B136, Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.
4. ASTM B137, Standard Test Method for Measurement of Coating Mass per Unit Area on Anodically Coated Aluminum.
5. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
6. ASTM B241/B241M, Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
7. ASTM B244, Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
8. ASTM B247, Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and rolled Ring Forgings.
9. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
10. ASTM E 935, Standard Test Methods for Permanent Metal Railing Systems and Rails for Buildings.

C. National Association of Architectural Metal Manufacturers, (NAAMM).

1. NAAMM/Architectural Metal Products Division (AMP), Pipe Railing Manual.
2. NAAMM/AMP AMP 501 Finishes for Aluminum.

1.3 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Action Submittals: Submit the following:

1. Shop Drawings:

a. Drawings for fabrication and installation of aluminum handrail and railing systems with sizes of members, pipe wall thickness, information on components, and anchorage devices. Show all anchorages. Provide details drawn at scale of 1.5-inch equal to one foot.
b. Indicate required location of posts.
c. Indicate locations and details of all expansion joints, if any.
d. Indicate locations and details of gaps across seismic joints, if any.
e. Profile drawings of aluminum handrail and railing system components.
f. Custom detail drawings. Details of forming, jointing, sections, connections, internal supports, trim and accessories. Provide details drawn at scale of 1.5-inch equal to one foot.

2. Product Data:

a. Manufacturer’s specifications, standard detail drawings, and installation instructions for aluminum handrail and railing systems.
b. Manufacturer’s catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by Engineer.

3. Delegated Design Submittals:

    a. Design Data:

        1) Design computations or complete structural analysis of handrail and railing systems, signed and sealed by professional engineer. Professional engineer's seal shall be clearly legible, including state of registration, registration number, and name on seal.
        2) Certification by professional engineer that professional engineer has performed design of aluminum handrail and railing systems in accordance with performance and design criteria stated in the Contract Documents, and that design conforms to all local, state, and federal Laws and Regulations, and to prevailing standards of practice.

4. Samples:

    a. Full-size Sample, 2.0 feet long, of assembled railing system at post and rail intersections. Sample shall have all associated components including typical connections, mounted toeboard and sleeve, and handrail at wall return, complete with mounting brackets, all with specified controlled uniform metal finish.
    b. Color Samples: Maximum range of clear anodized aluminum that shall appear in finished Work. Prepare range Samples, to show highest level of color control feasible for actual handrail and railing systems, as determined by licensor of finishing process specified, on actual extrusions and castings of the Work.
    c. Samples will be reviewed for finish, color, joint tolerances, workmanship, and general component assembly only. Compliance with other requirements is the responsibility of the Contractor.

5. Test Procedure: Submit detailed description of proposed shop testing procedures. Do not perform shop testing until Engineer approves shop test procedure:

C. Informational Submittals: Submit the following:

1. Certificates:

    a. Certification on source of supply, as specified in Article 1.3 of this Section.
    b. Manufacturer certification specified in Article 1.3 of this Section.

2. Source Quality Control Submittals:

    a. Manufacturer's load testing report in accordance with ASTM E935 for completed aluminum handrail and railing systems, demonstrating compliance with applicable requirements of building codes, safety codes, and other Laws and Regulations.

3. Qualifications Statements: Submit qualifications for the following:

    a. Manufacturer, when requested by Engineer.
    b. Professional engineer.
    c. Installer, when requested by Engineer. Qualifications statement shall include record of experience with references specified.

D. Closeout Submittals: Submit the following:

1. Maintenance Manuals: Furnish detailed maintenance manuals that include the following:

a. Product name and number.
b. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions in use of products that may be detrimental to finish when improperly applied.
c. Handrail and railings systems manufacturer's current catalog including individual parts.

2. Guarantee: Provide in maintenance manual the guarantee specified.

E. Maintenance Material Submittals: Submit the following:

1. Extra Stock Materials:

a. After completing installation, deliver to Owner 5 percent of actual quantity of each handrail and railing system component used in the Work.
b. Label each piece or sealed container with name and product number.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

a. Manufacturer shall be able to document at least five years successful experience in fabricating aluminum handrail and railing systems of scope and type similar to that required.
b. Manufacturer shall be able to capable of providing custom detail drawings for the products required.

2. Professional Engineer:

a. Contractor or handrail and railing manufacturer shall retain a registered professional engineer legally qualified to practice in same state as the Site. Professional engineer shall have at least five years experience designing aluminum handrails and railings.
b. Responsibilities include:

1) Reviewing aluminum handrail and railing system performance and design criteria stated in the Contract Documents.
2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
3) Preparing or supervising preparation of design calculations verifying compliance of aluminum handrail and railing system with requirements of the Contract Documents.
4) Signing and sealing all calculations.
5) Certifying that:

a) Design of aluminum handrail and railing system was performed in accordance with performance and design criteria stated in the Contract Documents, and
b) Design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.

3. Installer Qualifications:

a. Retain a single installer trained and with record of successful experience in installing aluminum handrail and railing systems.
b. Installer shall have record of successfully installing aluminum handrail and railing systems in accordance with recommendations and requirements of manufacturer, or shall provide evidence of being acceptable to the manufacturer.
c. Installer shall employ only tradesmen with specific skill and successful experience in the type of Work required.
d. When requested by Engineer, submit name and qualifications of installer with the following information for at least three successful, completed projects:

1) Names and telephone numbers of owner and architect or engineer responsible for each project.
2) Approximate contract cost of the aluminum handrail and railing systems for which installer was responsible.
3) Amount (linear feet) of aluminum handrail and railing installed.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of component manufacturer, from a single aluminum handrail and railing system manufacturer.
2. Aluminum handrail and railing system manufacturer shall review and approve or prepare all Shop Drawings and other submittals (except for delegated design submittals, when professional engineer is retained by other than handrail and railing manufacturer) for all components furnished under this Section.
3. Components shall be specifically constructed for specified service conditions and shall be integrated into overall assembly by aluminum handrails and railings manufacturer.

C. Regulatory Requirements: Conform to Laws and Regulations including:

1. OSHA Part 1910.23, Guarding Floor and Wall Openings and Holes.

D. Certifications:

1. Furnish certification, signed by authorized officer of manufacturer and notarized, stating that handrail and railing systems conform to the design prepared by the professional engineer.
2. Furnish certification, signed by authorized officer of Contractor and notarized, stating that all components and fittings are furnished by the same manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing and protection products.

B. Handling of Products:

1. Do not subject handrail and railing products to bending or stress.
2. Do not damage edges or handle products in a manner that will cause scratches, warping, or dents.
3. Protect handrails and railings by paper or coating as acceptable to handrail and railing manufacturer, against scratching, splashes of mortar, paint, and other marring during transportation, handling, and erection. Protect until completion of adjacent work.

C. Coordinate deliveries to avoid conflict with the Work and conditions at Site, and to accommodate the following:

1. Work of other contractors, or Owner.
2. Limitations of storage space.
3. Availability of equipment and personnel for handling products.
4. Owner's use of premises.

D. Have products delivered to Site in manufacturer's original, unopened, labeled containers. Keep Engineer informed of delivery of all products to be incorporated in the Work.

E. Clearly mark partial deliveries of component parts of equipment to identify the equipment, to permit easy accumulation of parts and to facilitate assembly.

F. Immediately on delivery, inspect shipment to ensure:

1. Product complies with requirements of Contract Documents and reviewed submittals.
2. Quantities are correct.
3. Containers and packages are intact, labels are legible.
4. Products are properly protected and undamaged.

G. Promptly remove damaged products from the Site and expedite delivery of new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.6 JOB CONDITIONS

A. Conform to applicable OSHA and the New York State Building Codes.

1.7 WARRANTY

A. Section 016000 "Product Requirements": Requirements for warranties.

B. Guarantee: Manufacturer shall provide written warranty of availability of replacement parts and components for period of at least five years after completion of the Project.

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PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description: Aluminum handrail and railing system shall consist of equally spaced horizontal rails with totally concealed mechanical fasteners, internally threaded tubular rivets and components fastened to posts spaced no more than 5.0 feet on centers and system of handrails supported from adjacent construction by mounting brackets spaced at no more than 5.0 feet on centers.

B. Design Criteria and Performance Criteria:

1. Design, fabricate, and install aluminum handrail and railing systems to withstand the most critical effects resulting from the following loads (loads listed below do not act concurrently):

a. Uniform Load: 50 pounds per foot, applied at top in any direction.
b. Concentrated Load: 200 pounds single load, applied at any point along the top in any direction.
c. Components: Intermediate rails (all rails except the handrail), balusters, and panel fillers, if any, shall withstand horizontally-applied normal load of 50 pounds on an area equal to one square foot, including openings and space between rails. Reactions due to this loading are not required to be superimposed to loading specified for main supporting members of handrails and railings.
d. Conform to requirements of AA Aluminum Design Manual for determining allowable stresses and safety factors for aluminum structural components.
e. Limit deflection in each single span of railing and handrail to 1.5-inch maximum, and to 1.4-inch maximum on railing posts. Applied loads shall not produce permanent deflection in the completed Work when loads are removed.

2. Thermal Control: Provide adequate expansion within fabricated systems that allows for thermal expansion and contraction caused by material temperature change of 140 degrees F to -20 degrees F without warp or bow of system components. Distance between expansion joints shall be based on providing 1/4-inch wide joint at 70 degrees F, which accommodates movement of 150 percent of calculated amount of movement for specified temperature range.
3. Where handrail and railing systems cross expansion joints in the building or structure, provide expansion joints in handrail and railings systems.
4. For posts located at or near end of runs as shown, uniformly space intermediate posts as required to conform to loading and deflection criteria specified, at intervals no greater than maximum post spacing specified. Where posts are shown for handrails along both sides of walkways and other similar locations, locate posts opposite each other; do not stagger post locations.

2.2 MANUFACTURERS

A. Provide the following railing system at all locations except as defined below:

1. Products and Manufacturers: Provide one of the following:

a. Custom Fabricated Series 500 Non-Welded Aluminum Pipe Aluminum handrails and railing systems by Superior Aluminum Products, Inc.
b. Or Approved Equal.

B. Provide the following railing system at Outfall Chamber deck and Sludge Processing Building roof locations:

1. Products and Manufacturers: Provide one of the following:

a. Custom Fabricated Connectorail System Non-Welded Aluminum Pipe Aluminum handrails and railing systems by Julius Blum & Co., Inc.
b. Or Approved Equal.

2.3 MATERIALS

A. Extruded Aluminum Architectural and Ornamental Shapes: ASTM B221, Alloy 6063-T52.

B. Aluminum Forgings: ASTM B247.

C. Extruded or Drawn Aluminum Pipe and Tube:

1. ASTM B429 or ASTM B241/B241M, Alloy 6063-T5, 6063-T52, or 6063-T832 as required by loadings, deflections, and post spacing specified.
2. Provide Schedule 40 pipe, minimum, unless conditions of detail and fabrication require extra-heavy pipe to comply with Specifications. Rails and posts shall have minimum outside diameter of 1.90 inches.

D. Reinforcing Bars: Solid, circular profile, 24 inches long, 6061-T6 aluminum reinforcing bars with same outside diameter as inside diameter of post.

E. Anchors and Fastenings:

1. For anchors and fasteners, use Type 316 stainless steel; minimum 0.5-inch diameter.
2. Provide minimum of four bolt fasteners per post where surface-mounted posts are shown. Components shall be in accordance with manufacturer's recommendations and as approved or accepted (as applicable) by Engineer on submittals.
3. Anchors: As specified in Section 054500.

F. Castings:

1. Provide high-strength aluminum alloy brackets, flanges, and fittings suitable for anodizing as specified.
2. Aluminum alloy sand castings: ASTM B26/B26M.

G. Connector Sleeves: Schedule 40, 5.0-inch long by 1.610-inch diameter.

H. Perforated Panel: Provide ¼-inch perforated round hole aluminum panels at railings, as shown on drawings. Panel shall be .050 gauge aluminum, 3/8-inch staggered pattern, and 'U' edges. Finish to match railing system.

1. Panels shall be attached to the lowest horizontal rail, vertical post and second highest railing. Attachment shall be by tapping the railing and providing stainless steel screws with 1-inch spacer, gaskets and washers.
2. Products and Manufacturers: Provide one of the following:

    a. McNichols Perforated Panel
    b. Or Approved Equal.

I. Sockets: Provide six-inch deep by 2.5-inch outside diameter aluminum sockets with 3.5-inch wide socket cover on bottom of each socket and on top and bottom of removable post sockets.

J. Chain, Snaps, and Eye Bolts: Provide oblong 0.250-inch welded link, Type 316 stainless steel chain weighing 57 pounds per cubic foot, each link 1.25-inch by 7/16-inch. Provide Type 316 stainless steel eyebolts, 1/4-inch stainless steel threaded quick links and heavy-duty swivel snaps with spring loaded latch.

K. Gates: For each gate in handrail or railing system, provide the following:

1. Hinges: Two-self closing aluminum hinges.
2. Latches and Stops: One latch and stop with rubber bumper and one-inch diameter plastic knobs.

L. Custom Cover Flanges: 1/4-inch high by 4.0-inch diameter, aluminum.

M. Adhesive: Two-part waterproof epoxy-type as recommended by handrail and railing systems manufacturer.

N. Non-shrink Grout: Refer to Section 036213.

O. Toeboards:

1. Provide extruded Alloy 6063-T5 or T52 aluminum alloy toeboards, unless railing is mounted on curbs or other construction of sufficient height and type to conform to OSHA 1910.23. Bars or plates are not acceptable.
2. Unless otherwise specified, toeboards shall conform to requirements of OSHA 1910.23, Section (e).

P. System Components and Miscellaneous Accessories: Provide complete selection of manufacturer's standard and custom aluminum handrail and railing systems components and miscellaneous accessories required. Show type and location of all such items on Shop Drawings and other submittals as applicable.

2.4 FABRICATION

A. General: Unless otherwise shown or specified, provide typical non-welded construction details and fabrication techniques recommended in NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501.

B. Fabricate handrail and railing systems true to line and level, with accurate angles surfaces and straight edges. Fabricate corners without using fittings. Provide bent-metal corners to smallest

radius possible without causing grain separation or otherwise impairing the Work. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends. Provide not less than four-inch outside radius.

C. Provide chains across openings in railings where shown. Attach one end of each chain to an eyebolt in post and other end attached by means of swivel eye snap hook to similar eyebolt in opposite post.

D. Remove burrs from exposed edges.

E. Close aluminum pipe ends by using prefabricated fittings.

F. Weep Holes:

1. Fabricate joints that will be exposed to weather to exclude water.
2. Provide 15/64-inch diameter weep holes at lowest possible point on each post in handrail and railing systems.
3. Provide pressure relief holes at closed ends of handrail and railing systems.

G. Toeboards:

1. Provide manufacturer's standard toeboard, which accommodates movement caused by thermal change specified without warping or bowing toeboards.
2. Provide manufacturer's standard toeboard, which accommodates storage for removable socket covers.
3. Coordinate and cope toeboard as required to accommodate cover flanges at posts.
4. Toeboards shall follow curvature of railing. Where railing is shown to have curved contours at corners, or other locations, toeboard shall likewise be curved to follow line of railing system.

H. Reinforcing Bars: Provide reinforcing bar friction-fitted at each post in railing system. Extend reinforcing bars of tubes six inches into cast-in-place sleeves or other types of supporting brackets.

I. At all locations except at noted in Section 2.2 B. - Mechanically Fitted Component Pipe Handrail and Railing System:

1. Use non-welded pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.
2. Provide top and one intermediate horizontal rail(s), equally spaced.
3. Do not use blind rivets, pop rivets, or other exposed fastening devices in the Work. Fasteners used for side-mounting fascia flanges where shown or specified may be exposed in the Work. Provide internal threaded aluminum rivets, stainless steel through-bolts with lock nuts, stainless steel sheet metal screws with lock washers, and epoxy adhesive for fastening components of the Work.

J. At locations indicated in Section 2.2 B. - Mechanically Fitted Component Pipe Handrail and Railing System:

1. Use non-welded pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.

2. Provide top and five intermediate horizontal rail(s), equally spaced. Intermediate rails shall be 1.66 inch outside diameter. Top rail shall be 1.9 inch outside diameter.
3. Do not use blind rivets, pop rivets, or other exposed fastening devices in the Work. Fasteners used for side-mounting fascia flanges where shown or specified may be exposed in the Work. Provide internal threaded aluminum rivets, stainless steel through-bolts with lock nuts, stainless steel sheet metal screws with lock washers, and epoxy adhesive for fastening components of the Work.

2.5 FINISHES

A. General:

1. Prepare surfaces for finishing in accordance with recommendation of aluminum producer and the finisher or processor.
2. Adjust and control direction of mechanical finishes specified to achieve best overall visual effect in the Work.
3. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for aluminum components. Engineer reserves the right to reject aluminum materials because of color or texture variations that are visually objectionable, but only where variation exceed range of variations established by manufacturer prior to fabrication, by means of range of Samples approved by Engineer.
4. Anodize aluminum components.

B. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; AA Designation - M32 Medium Satin Directional Texture.

1. Hand Rubbed Finish: Where required to complete the Work and provide uniform, continuous texture, provide hand-rubbed finish to match medium satin directional texture specified to even out and blend satin finishes produced by other means.

C. Provide non-etching chemical cleaning by immersing aluminum in inhibited chemical solution, as recommended by coating applicator, to remove lard oil, fats, mineral grease, and other contamination detrimental to providing specified finishes.

1. Clean and rinse with water between steps as recommended by aluminum manufacturer.

D. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified that do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density, and acid electrolytes to obtain specified colors in compliance with designation system and requirements of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501. Comply with the following:

1. Provide Architectural Class I high density anodic treatment by immersing the components in tank containing solution of 15 percent sulfuric acid at 70 degrees F with 12 amperes per square foot of direct current for minimum of sixty minutes; AA Designation A41 Clear.
2. Physical Properties:

    a. Anodic Coating Thickness, ASTM B244: Minimum of 0.7-mils thick.
    b. Anodic Coating Weight, ASTM B137: Minimum of 32 mg/sq. in.

c. Resistance to Staining, ASTM B136: No stain after five minutes dye solution exposure.
d. Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.

3. Seal finished anodized coatings using deionized boiling water to seal pores and prevent further absorption.
4. Products and Manufacturers: Provide one of the following:

a. Alumilite 215 Clear by Aluminum Company of America, Inc.
b. Or Approved Equal.

2.6 SOURCE QUALITY CONTROL

A. Allowable Tolerances:

1. Limit variation of cast-in-place inserts, sleeves and field-drilled anchor and fastener holes to the following:

a. Spacing: Plus-or-minus 3/8-inch.
b. Alignment: Plus-or-minus 1/4-inch.
c. Plumbness: Plus-or-minus 1/8-inch.

2. Minimum Handrails and Railings Systems Plumb Criteria:

a. Limit variation of completed handrail and railing system alignment to 1/4-inch in 12.0 feet with posts set plumb to within 1/16-inch in 3.0 feet.
b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4-inch in 12.0 feet.

3. Provide “pencil-line” thin butt joints.

B. Factory Testing:

1. Perform load test on completed handrail and railing systems. Extent of handrail and railing systems to be factory-tested shall be as shown and specified.
2. Load test completed handrail and railing systems in accordance with requirements of ASTM E935. Provide written report to Engineer identifying and documenting testing methods used, magnitude and location of loads superimposed, and results of such tests on actual completed handrail and railing systems, including all anchors and fasteners to be used in the Work. Testing setup shall simulate actual conditions of installation to be used in the Work.
3. Do not ship products from factory until Engineer accepts load testing report.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work is to be performed and notify Engineer, in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Verify to Engineer gauge of aluminum pipe railing posts and rails brought to the Site by actual measurement of on-Site material in presence of Engineer.

3.2 INSTALLATION

A. Section 017000 “Execution and Closeout”: Requirements for installation.

B. General:

1. Do not erect components that have become scarred, dented, chipped, discolored, otherwise damaged or defaced. Remove from Site railing and handrail system components that have holes, cuts, gouges, deep scratches, or dents of any kind. Repairs to correct such Work will not be accepted. Remove and replace with new material.
2. Comply with installation and anchorage recommendations of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501 in addition to requirements specified and approved or accepted (as applicable) submittals.

C. Fastening to In-Place Construction:

1. Remove protective plastic immediately before installing.
2. Adjust handrails and railings prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building or structure as follows:

    a. Anchor posts in concrete by means of sockets set and anchored into concrete floor slab. Provide closure secured to bottom of sleeve. Before installing posts, remove debris and water from sleeves. Verify that reinforcing bars or tubes have been inserted into posts before installation. Do not install posts without reinforcing bar. For all non-removable handrail and railing systems sections, after posts have been inserted into sockets, fill annular space between posts and sockets solid with grout as specified in Section 03 62 0. Crown the grout and slope grout to drain away from posts.
    b. Anchor posts to stair stringers with stringer or support flanges, angle type or floor type as required by conditions, shop-connected to posts and bolted to steel supporting members. Flanges shall be as recommended by manufacturer. Verify that reinforcing bars have been inserted into posts before installation. Do not install posts without reinforcing bar.
    c. Side-mount posts by fastening them securely in brackets attached to steel or concrete fascia as shown and in accordance with approved or accepted (as applicable) submittals.
    d. Provide removable railing sections where shown. Removable railing system posts shall be provided with friction fitted reinforcing bar in each post. Provide sockets with socket covers stored in extruded toeboard. Provide aluminum pipe collars for all removable posts. Accurately locate sleeves to match post spacing.
    e. Posts set in concrete shall be provided with an aluminum floor cover flange.

3. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

D. Cutting, Fitting and Placement:

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.
2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade surfaces of units that have been finished after fabrication, and are intended for field connections.
3. Make permanent field splice connections using manufacturer's recommended epoxy adhesive and 5.0-inch minimum length connector sleeves. Tight press-fit field splice connectors and install in accordance with manufacturer's written instructions. Follow epoxy manufacturer's recommendations for requirements of installation and conditions of use.
4. Make splices as near as possible to posts, but not exceeding 12.0 inches from nearest post.
5. Field welding is not allowed. Make splices using pipe splice lock employing a single allen screw to lock joint.
6. Provide hinged gates as shown.
7. Provide chain sections as shown. Provide one chain length with fastening accessories for top and each intermediate rail.
8. Secure handrails to walls with wall brackets and end fittings as shown. Drill wall plate portion of the bracket to receive one bolt, unless otherwise shown for concealed anchorage. Locate brackets as shown or, if not shown, at no more than 5.0 feet on centers. Provide flush type wall return fittings with same projection shown for wall brackets. Secure wall brackets and wall return fittings to building or structure. Refer to Section 054500.
9. Securely fasten toeboards in place with not more than 1/4-inch clearance above floor level.
10. Drill one 15/64-inch diameter weep hole not more than 1/4-inch above top of location of solid reinforcing bar or tube in each post.

E. Fastening to Existing Construction:

1. Provide heavy-duty floor flange and anchorage devices and fasteners where necessary for securing handrail and railing systems components to existing construction; including stainless steel threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required. Refer to Section 054500.
2. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

F. Expansion Joints:

1. Provide slip joint with internal sleeve extending 2.0-inch minimum, beyond joint on each side.
2. Construct expansion joints as for field splices, except fasten internal sleeve securely to one side of rail only.
3. Locate joints within six inches of posts.

G. Seismic Joints:

1. Discontinue handrails and railings on each side of seismic joints where handrails and railings cross over seismic joints in structure.
2. Comply with details shown.

H. Protection from Dissimilar Materials:

1. Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, and steel, in accordance with Section 099123.
2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.3 FIELD QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Requirements for manufacturer’s field services.

3.4 CLEANING AND REPAIRING

A. Cleaning: Installer shall clean exposed surfaces of handrail and railing systems after completing installation. Comply with recommendations of both handrail and railing system manufacturer and finish manufacturer. Do not use abrasives or unacceptable solvent cleaners. Test cleaning techniques on an unused section of railing before employing cleaning technique.

1. Remove stains, dirt, grease, and other substances by washing handrails and railings systems thoroughly using clean water and soap; rinse with clean water.
2. Do not use acid solution, steel wool, or other harsh abrasives.
3. If stain remains after washing, remove defective sections and replace with new material meeting requirements of this Section.

B. Handrails and railings shall be free from dents, burrs, scratches, holes, and other blemishes. Replace damaged or otherwise defective Work with new material that conforms with this Section at no additional cost to Owner.

C. At Substantial Completion, replace adjacent work marred by the Work of this Section.

END OF SECTION 055215

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SECTION 055300 - METAL GRATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum Gratings
2. Galvanized Steel Gratings
3. Stainless Steel Gratings
4. Grating Frames
5. Structural Supports

B. Related Sections:

1. Section 051200 “Structural Steel Framing”
2. Section 055000 “Metal Fabrications”
3. Section 055117 “Pre-Engineered Aluminum Stairs”
4. Section 055215 “Aluminum Handrails and Railings”

1.2 REFERENCES

A. General Requirements:

1. Except as modified by governing codes and by this Specification, comply with the applicable provisions and recommendations of latest editions of the following.
2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract unless otherwise directed by the Engineer.
3. Conflicts: Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.
4. All exterior gratings, gratings in wash down areas and gratings in process & pumping areas shall have a non slip abrasive surface.

B. American Society for Testing and Materials (ASTM):

1. ASTM 6 - 09 Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
2. ASTM A36 - Standard Specification for Carbon Structural Steel
3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
5. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes

6. ASTM307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
8. ASTM A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
9. ASTM A502 - Standard Specification for Rivets, Steel, Structural
10. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
11. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
12. ASTM A675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
13. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
14. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
15. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
16. ASTM F594 - Standard Specification for Stainless Steel Nuts

C. Aluminum Association, Inc. (AA)

D. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code – Steel
2. AWS D1.2 – Structural Code - Aluminum

E. US Dept. of Labor - Occupational Safety & Health Administration (OSHA):

1. 29 CFR 1910.23 Guarding Floor and Wall Openings and Holes

F. The National Association of Architectural Metal Manufacturers (NAAMM)

1. MBG 531-00 Metal Bar Grating Manual
2. MBG 532-00 Heavy Duty Metal Bar Grating Manual
3. MBG 533-89 Welding Specifications for Fabrication of Steel, Aluminum and Stainless Steel Bar Grating
4. MBG 534-94 Metal Bar Grating Engineering Design Manual

G. The Society for Protective Coatings (SSPC)

1. SSPC – Steel Structures Painting Manual
2. SSPC SP1 – Solvent Cleaning
3. SSPC SP 10 – Near White Blast Cleaning

1.3 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated on the Contract Drawings, gratings, grating frames and grating supports shall conform to the following minimum requirements:

GRATING TYPES AND DESIGN REQUIREMENTS

	Description	Design Conditions		Fabrication	Material
A	Light Duty	Uniform Load	150 psf	P, W or R	Aluminum, Galvanized Steel, or Stainless Steel
		Concentrated Load	300 lb		
		Maximum Deflection (Grating and Grating Supports)	1/240 span, ¼-inch max.		
		ANSI/NAAMM Design Standard		MBG 531	
B	Medium Duty	Uniform Load	300 psf	W or R	Galvanized Steel, or Stainless Steel
		Concentrated Load	2000 lb		
		Maximum Deflection (Grating and Grating supports)	1/240 span, ¼-inch max.		
		ANSI/NAAMM Design Standard		MBG 532	
C	Heavy Duty I (5 Ton Forklift)	Vehicle Wt	14,400 lb	W or R	Galvanized Steel, or Stainless Steel
		Loading	10,000 lb		
		Total Load	24,400 lb		
		Wheel Load	13,480		
		Load Distribution Area			
		- Parallel to Axle	11”		
		- Perpendicular to Axle	11” + 2s		
		Maximum Deflection Grating and Grating Supports)	1/240 span, ¼-inch max.		
		ANSI/NAAMM Design Standard		MBG 532	
D	Heavy Duty II (AASHTO H20)	Axle Load (Dual Wheel)	32,000 lb	W or R	Galvanized Steel, or Stainless Steel
		Wheel Load	20,800 lb		
		Load Distribution Area			
		- Parallel to Axle	20”		
		- Perpendicular to Axle	20” + 2s		
		Maximum Deflection (Grating and Grating Supports)	1/240 span, ¼-inch max.		
		ANSI/NAAMM Design Standard		MBG 532	

Notes:
1. Grating Types: W = Welded (Steel Only), P = Pressure Locked, R = Riveted
2. Wheel Load = ½ of Axle Load + 30% Impact
   Forklifts assume 85% drive axle load.
3. Load Distribution: s = bearing bar spacing, center-to-center

B. Unless otherwise indicated, the design load for gratings shall be equivalent to or greater than that of the adjacent floor area, but not less than a uniform load of 150 pounds per square foot (psf) or a concentrated load pounds distributed over a 12-inch square area at the center of the grating span, whichever produces the greatest stress.

C. Gratings in areas subject to vehicular traffic shall be designed for the maximum vehicle weight that can access the area. Forklifts or other similar wheeled vehicles shall have maximum wheel loads as defined by the vehicle manufacturer but not less than those specified in 1.3.A above.

D. The maximum allowable deflection due to dead plus live load shall not exceed 1/240th to the grating span, but shall not be more than ¼ inch.

E. Gratings shall be designed in accordance with the design criteria specified herein and NAAMM specifications unless otherwise noted on the Contract Drawings or required by Code.

1.4 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Manufacturer's specifications and product data demonstrating compliance with specific requirements. Including:

1. Span and Deflection Tables

C. Complete fully dimensioned and detailed layout drawings of all gratings showing:

1. Area to be covered.
2. Location and dimensions of all cutouts and openings.
3. Direction of bearing bars.
4. Layouts, sizes, materials and fabrication details of supports and framing.
5. Location of all welded anchorages, saddle clips and weld lugs.
6. Sizes and types of gratings.
7. Location, size and type of all grating banding
8. All critical dimensions and clearances including:

a. Grating panel dimensions.
b. Clearance between ends of cross bars of adjacent rectangular grating panels.
c. Clearance between rivet heads of adjacent riveted grating panels.
d. Clearance between bearing bars of adjacent grating panels.
e. All other applicable standards installation clearances as defined in the NAAMM publications “MBG 531-00 Metal Bar Grating Manual” and “MBG 532-00 Heavy Duty Metal Bar Grating Manual”.

D. Details of fastening system for attachment of grating to supports.

E. Submit calculations certified by a Professional Engineer registered in the State of New York for all gratings and supports.

F. Welding:

1. All welds, both shop and field shall be indicated by AWS “Welding Symbols” A2.0
2. Welding Procedure: Submit written description as required to illustrate each welding procedure to be performed in the specified work.
3. Field Welding Equipment: Submit descriptive data for field welding equipment, including type, voltage and amperage.

4. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months

G. Samples of each size and type grating and fastening device shall be submitted to the Engineer for review.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with all applicable Federal, State and Municipal codes and regulations including revisions to date of contract.

1.6 QUALIFICATIONS

A. Manufacturer: Products used in the work of this Section shall be produced by those who are regularly engaged in the manufacture and/or supply of similar items for at least five (5) years and which has a history of successful production, acceptable to the Engineer.

B. Installers: Use adequate number of skilled workmen who are thoroughly trained and experienced in the specified requirements and the methods needed for proper performance of the work of this Section.

C. Grating and grating support design shall be under the direct supervision of a Professional engineer registered in the State of New York.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication after all piping and equipment are set in place.

B. Prepare templates were required for location and size of openings and cutouts.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. Use all means necessary to protect the materials of this Section before, during and after installation and to protect installed work and materials of all other trades.

C. Gratings stored at the jobsite shall be covered or under roof.

D. In the event of damage, immediately make all repairs and replacement necessary to the approval of the Engineer and at no additional cost to the Owner.

1.9 WARRANTY

A. Section 016000 “Product Requirements”: Requirements for warranties.

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1.10 COORDINATION

A. Coordinate the work of this Section with the work of other Sections, Contractors and subcontractors.

PART 2 - PRODUCTS

2.1 TYPES OF GRATINGS

A. Type of Gratings

1. Unless otherwise shown or specified, gratings shall be one of the four (4) types as specified in Subsection 1.3.A above.
2. Type A Grating shall consist of metal bar grating consisting of an open grid of metal bars. The bearing bars shall be held in place at regular spacing by either:

a. Straight, sinuous or corrugated bars having their longitudinal axes perpendicular to the bearing bars and being connected to them by welding, forging or mechanical locking, or by
b. Bent connecting bars alternately contacting adjacent bearing bars and riveted to them at regular intervals.

3. Types B, C and D Grating shall consist of metal bar grating consisting of an open grid of metal bars. The bearing bars shall have a cross-sectional depth of not less than two times their width. The bearing bars shall be held at regular parallel spacing, either by:

a. Straight, sinuous or corrugated bars having their longitudinal axes perpendicular to the bearing bar and being connected to them by welding, or by
b. Reticuline bars alternately contacting adjacent bearing bars and riveted to them at regular intervals.

2.2 MATERIALS AND COMPONENTS

A. Manufacturer:

1. Gratings shall be the product of one manufacturer unless otherwise permitted by the Engineer.
2. Acceptable Manufacturers

a. IKG Industries
b. Borden Metal Products
c. Ohio Gratings, Inc.
d. Approved Equal

B. Materials

1. General Requirements

a. All grating shall be constructed of bars smooth and free of surface blemishes, including pitting, seam marks, trade names, and roughness.
b. Grating components shall comply with applicable ASTM, AA, NAAM, and other applicable standards and requirements.

2. Aluminum Gratings

a. Bearing bars shall be either alloy 6061-T6 or alloy 6063-T6, conforming to ASTM B 221.
b. Cross bars and bent connecting bars shall be of alloy 6061 or 6063 conforming to ASTM B221 or alloy 3003 conforming to ASTM B210.
c. Rivets shall be made of aluminum wire or alloy 6053-T61 conforming to ASTM B316.

3. Steel Gratings

a. Type A Steel Gratings

1) Steel used in bearing bars, cross bars and connecting bars of rectangular section shall conform to ASTM A110 Co0mmercial Steel (Type 2) for hot rolled carbon steel sheet and strip.
2) Cross bars made of wire shall conform to ASTM A510 for carbon steel wire rods and coarse round wire, except permissible tolerance on diameter of coarse round wire shall be ± 0.005 in.
3) Rivets shall be of steel, ¼ inch minimum diameter, flat head type.

b. Types B, C and D Steel Gratings.

1) Steel used in bearing bars, cross bars and reticuline bars of rectangular section shall conform to ASTM A1011, Commercial Steel (SC Type 2) for hot rolled carbon steel sheet and strip and ASTM A36 for structural steel bars.
2) Cross bars made of wire rod shall conform to ASTM 510 for carbon steel wire rods and coarse round wire, except permissible tolerance on diameter of coarse round wire shall be ± 0.005 in.
3) Rivets shall be of a steel as prescribed in ASTM A575, ¼ inch minimum diameter, flat head type.

4. Stainless Steel Gratings

a. Type A Stainless Steel Grating

1) Bearing bars, cross bars, and connecting bars shall be Type 316L alloy conforming to ASTM A666.
2) Rivets shall be Type 300 series alloy as prescribed in ASTM A493.

b. Types B, C and D Gratings

1) Stainless steel used in bearing bars, cross bars and reticuline bars shall be Type 316L alloy confirming to ASTM A666.
2) Rivets shall be Type 300 series alloy as prescribed in ASTM A493.

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2.3 MINIMUM SIZE OF MEMBERS

A. Type A Grating:

1. Bearing Bars: Size of bearing bars shall conform to the tolerances shown in the Minimum Standard Section of the Metal Bar Grating Manual (NAAMM MBG 531-00), but not less than 1-1/4 inch x 3/16 inch.
2. Cross Bars: Minimum dimensions of cross bars shall be in conformance with the Minimum Standard Section of the Metal Bar Grating Manual (NAAMM MBG 531-00) but shall not be less than 3/16 inch for welded members and 1/8 inch for mechanically interlocked members
3. Banding Bars: Banding bars shall have a minimum thickness equivalent to the bearing bars to which they are attached.
4. All banding bars shall be the full depth of the grating except where banding bars will bear on a grating support. The bottom of banding bars at grating supports shall be ¼ inch above the bottom of the bearing bars to permit drainage.

B. Type B, C and D Grating

1. Bearing Bars: All bearing bars shall be of a minimum nominal size as shown in the Load Tables of the Heavy duty Metal Bar Grating Manual (NAAMM MBG 532-00), but not less than 1 ¼ inch x ¼ inch.
2. All materials shall be in accordance with ASTM A6 tolerances.
3. Banding Bars: Banding bars shall have a minimum thickness equivalent to the bearing bars to which they are attached.
4. All banding bars shall be the full depth of the grating except where banding bars will bear on a grating support. The bottom of banding bars at grating supports shall be ¼ inch above the bottom of the bearing bars to permit drainage.

2.4 GRATING FABRICATION

A. General:

1. Gratings shall be accurately fabricated, free from warps, twists or other defects that affect appearance and serviceability.
2. The tops of grating bearing, cross and reticuline bars shall be in the same plane.
3. All welds shall be ground smooth and conform to the requirements of NAAMM MBG 533 - Welding Specifications for Fabrication of Steel, Aluminum and Stainless Steel Bar Grating, and Section 051200.

B. Grating Depth

1. Minimum: 1-1/4 inches.
2. Maximum 3 inches.

C. Bar and Rivet Spacing

1. Type A Grating:

a. Bearing Bars: Not more than 1 3/16 inches on center

b. Cross Bar or Rivets: Not more than 4 inches on center.

2. Type B, C and D Grating

a. Bearing Bars: Not more than 1 ½ inches on center.
b. Cross Bar or Rivets: Not more than 4 inches on center.

D. Serrated Grating:

1. Serrated grating shall be provided where shown on the Contract Drawings.
2. Depth of serrated grating shall not be less than ¼ inch greater than required for standard bar grating

E. Grating Panel Weight

1. Grating panels shall be sized to conform the following grating panel weight limitations unless otherwise indicated on the Contract Drawings, specified or otherwise permitted by the Engineer:

a. Type A Grating: Shall not exceed 50 pounds.
b. Type B Grating: Shall not exceed 50 pounds.
c. Type C Grating: Shall not exceed 100 pounds
d. Type D Grating: Shall not exceed 100 pounds

F. Cutouts and Openings:

1. Cutouts and openings shall be provided in grating for the passage of pipes, valve stems, columns and similar work.
2. All cutouts and openings shall be banded.

a. Where more than 4 bearing bars are included in the cutout or opening, banding bars shall be of the same dimensions as the bearing bars and welded to the components of the grating.
b. Banding for Type C and D grating shall be designed for the effects of impact and fatigue from vehicular loading.

3. Structural support shall be provided for all cutout and openings in Type C and D gratings.
4. Two separate section of grating, each with a banded hole of the proper size shall be provided for the passage of each pipe, valve stem, column, etc. passing through the grating unless otherwise directed by the Engineer.
5. Openings and cutouts shall be at least 2 inches larger than the obstruction.

G. Grating Supports

1. The grating supports shall be Type 316L stainless steel.
2. The maximum deflection of grating and the grating supports shall not exceed those specified in subsection 1.3A above.

H. Grating Embedded Frames.

1. Grating frames embedded in concrete shall be of the same material as the grating.

I. Grating Bearing

1. All grating bearing bars shall be provided with the minimum bearing surface:

   a. Bearing Bars ≤ 2-1/4 inches: 1 inch
   b. Bearing Bars > 2-1/4 inches: 2 inches

J. Grating Anchorage

1. All grating panels shall be provided with weld lugs for bolting grating in place, saddle clips shall not be permitted.
2. Weld lug locations shall be in conformance with the recommendations of NAAMM MBG 531 – Metal Bar Grating Manual and NAAMM MBG 532 – Heavy Duty Metal Bar Grating Manual, and the following:

   a. All grating panels shall be provided with a minimum of one (1) weld lug at each corner
   b. A minimum of four (4) weld lugs shall be provided for each grating panel.
   c. Where grating panels exceed six (6) feet in length, additional weld lugs shall be provided at the midpoint of the sides in excess of six (6) feet.
   d. Where grating panel lengths exceed eight (8) feet in length, additional weld lugs shall be provided to limit spacing between weld lugs to four (4) feet.
   e. A minimum of one (1) weld lug shall be provided at the center of each intermediate support.
   f. Weld lugs shall be a minimum of ¼ inch thick and provided with a hole as required for accepting the anchor bolts or studs.

3. The final grating installation shall be free of any unnecessary movement.

K. Hinged Panels

1. Hinged panels of grating shall be provided where shown on the Drawings
2. All hinged grating shall conform to the requirements listed above, and shall be provided with extra heavy duty 316L stainless steel hinges, hinged pins and fastenings attached to the grating frame, forming a flush surface. A minimum of two (2) hinges shall be provided for each hinged panel.
3. Exterior hinged panels shall have a recessed hasp to accept a padlock.

L. Fabrication Tolerances

1. Grating fabrication tolerances shall be within the limits set by:

   a. Type A Grating: NAAMM MBG 531 – Metal Bar Grating Manual
   b. Type B,C and D Grating: NAAMM MBG 532 – Heavy Duty Metal Bar Grating Manual

2.5 FINISHES

A. Aluminum and stainless steel gratings and frames shall be provided with a mill finish unless otherwise noted on the Contract Drawings or specified.

B. Steel gratings shall be hot dipped galvanized after fabrication with a coating of not less than 1.8 oz/sq ft of coated surface

C. All aluminum in contact with concrete, masonry or dissimilar metals shall be catholically protected by painting, according to the methods outlined in Section 099123.

PART 3 - EXECUTION

3.1 GRATING TYPE AND MATERIAL

A. Design Criteria: Unless otherwise shown on the Contract Drawings or specified, grating type and design criteria shall be as specified in subsection 1.3 Performance Requirements above.

B. Material:

1. General Service: Aluminum or Steel
2. Corrosive and Chemical Handling Areas: Stainless Steel.

3.2 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be installed. Conditions detrimental to the proper and timely completion of the work shall be corrected. Do not proceed until unsatisfactory conditions have been corrected

3.3 PREPARATION

A. Furnish setting drawings, diagrams, templates, instructions and other directions for the installation of anchorages, such as concrete inserts, anchor bolts, and other miscellaneous items having integral anchors, which are to be embedded in concrete construction.

B. Coordinate delivery of such items to the project site.

3.4 INSTALLATION

A. Install grating and supports in strict accordance with the manufacturer’s detailed instructions and the reviewed shop drawings.

B. Perform all cutting, fitting, and drilling required for the installation of the grating.

C. Set the grating accurately in their proper location.

D. Gratings shall be installed with each section readily removable and replaceable.

E. Adjacent grating panels shall be neatly fitted together

F. The maximum installed gratings clearances shall be as specified in:

1. Type A Grating: NAAMM MBG 531 – Metal Bar Grating Manual
2. Type B, C and D Grating: NAAMM MBG 532 – Heavy Duty Metal Bar Grating Manual

G. Tops of gratings shall be set flush with surrounding construction

H. Gratings shall be set with a full and uniform end bearing on the frame and grating supports to preclude rocking movement. Wedges or similar shimming devices shall not be used. The final grating installation shall be free of any unnecessary movement.

I. Anchorage

1. Gratings shall be anchored in place using the provided weld lugs.
2. Gratings panels shall be used as a template for locating hoes or studs.
3. Bolts, studs or nuts shall not protrude above the surface of the grating
4. Anchor bolts and studs shall be installed in accordance with manufacturer's instructions.

J. All aluminum grating shall be isolated from contact dissimilar metals with a HDPE or neoprene pad between grating and underlying steel.

3.5 FIELD WELDING

A. Comply with the latest revision of the AWS code for any necessary field welding.

END OF SECTION 055300

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SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Dimension lumber framing.
5. Miscellaneous lumber.
6. Plywood backing panels.

B. Related Requirements:

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Not Used

2.2 MATERIALS / EQUIPMENT

A. General: All natural wood lumber used in the Work shall be verified as obtained from a certified sustainable natural wood lumber source using sustainable forest management practices.

B. Rough Carpentry: Lumber for rough carpentry such as nailers, grounds, blocking and framing shall be of Sustainably Managed Construction Grade, thoroughly seasoned dry No. 1 white fir, ponderosa pine, spruce or hem-fir.

C. Preservative Treatment: All lumber for rough carpentry which is incorporated into the finished structures shall be pressure-treated lumber complying with the requirements as shown on the Contract Drawings, specified in Section 06 05 73.33 - Preservation Wood Treatment or required for the Work. All lumber shall be seasoned lumber with a maximum moisture content of 19 percent at time of dressing. Water-borne preservative shall be as specified in Section 06 05 73.33 - Preservation Wood Treatment. All lumber shall be branded accordingly.

D. Fire Retardant Treatment: All wood designated on the Contract Drawings or specified to be fire-retardant treated shall be pressure impregnated with flame-proofing as specified in Section 06 05 73.33 - Preservation Wood Treatment.

E. Code Conformance: Materials shall conform to the requirements of the National Design Specification for Wood Construction as recommended by the American Wood Council, unless otherwise indicated.

F. Plywood Standards: Plywood shall conform to the requirements of the American Plywood Association.

G. Grading: Each panel of plywood shall be identified with the appropriate DFPA grade mark of the American Plywood Association.

H. Exterior Plywood Uses: Exterior type plywood shall be installed where plywood is used for roof sheathing or decking, or in areas where it may be exposed to moisture.

I. Temporary Protection: Exterior type southern yellow pine plywood, APA Grade C, plugged fir shall be used for temporary protection.

J. Accessories

1. Anchors, connectors, and fastenings, not indicated or specified otherwise, shall be provided and installed and shall be of the type, size and spacing necessary to suit the conditions encountered and as recommended by National Forest Products Association. Sizes, types, and spacing of nails, screws, or bolts for installation of manufactured building materials shall be as recommended by the product manufacturer, unless indicated or specified otherwise.
2. Steel rough hardware exposed to the weather shall be zinc-electroplated unless indicated otherwise. Zinc-electroplated steel bolts, nuts, washers, hangers, and straps, and all other rough hardware embedded in, or in contact with exterior walls or slabs, and located in humid areas, shall be provided and installed, except as indicated otherwise.
3. Rough hardware shall be formed and punched before coating. Common steel wire nails, bright finish, shall be used, unless specified otherwise.
4. Bolt heads and nuts bearing on wood shall be provided with standard steel washers.
5. Galvanized fasteners for treated wood shall be in accordance with the requirements contained in Section 05 05 13.01 - Galvanizing.

2.3 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.4 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

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PART 3 - EXECUTION

3.1 EXAMINATION / PREPARATION

A. The Contractor shall verify that areas to receive rough carpentry which is to be incorporated into the finished Work are properly prepared and completed to final elevations.

3.2 INSTALLATION

A. General: Rough carpentry shall be installed in accordance with the manufacturer's recommendations and approved shop drawings.

B. Erection: All carpentry shall be correctly laid out. All items of woodwork, hardware, and any other work in connection with carpentry shall be carefully fit and erected, accurately located, and shall be plumb, level, and properly aligned, and rigidly secured in place.

C. Blocking: Blocking shall be furnished and installed where required for the attachment of copings, roof ventilators, ducts and other sheet metal work. Wood grounds for other work shall be provided and installed and as shown and required.

D. Securing Finished Work: Wood blocks, strips, plugs and similar items shall be provided and installed as required to secure finished work to concrete and masonry.

E. Centers: Centers shall be provided, where required, for brick and other masonry at the exterior and interior openings.

F. Protection of other Work: Jambs of finished door frames and finished masonry openings shall be protected to a height of 6 feet above the floor. Protection shall be erected in a manner to facilitate cleaning, painting and similar work without damage to finished work.

G. Preservative Coating: All field-cut edges and surfaces of treated lumber shall be liberally coated with a concentrated solution of preservative.

3.3 FIELD TESTING / QUALITY CONTROL

A. Not Used

3.4 STARTUP / DEMONSTRATION

A. Not Used

3.5 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting

1. System components which are dislodged, damaged, expanded, broken, penetrated or crushed by subsequent installation operations or by detrimental weather shall be

immediately replaced with undamaged material in compliance with the Sections and properly protected as specified.

B. Protection

1. All components of the work shall be protected from detrimental weather and damage until construction operations are completed.
2. Work which cannot be covered with complete construction systems before the onset of weather detrimental to the work shall be completely covered and protected in such a manner as to deflect water and weather from the installation without damaging adjacent work.
3. Rough carpentry shall be protected from all damage and abuse until Final Acceptance by the City.

END OF SECTION 061000

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SECTION 066100 - FIBERGLASS REINFORCED PLASTICS (FRP) FABRICATIONS PULTRUDED TUBE GUARDRAIL AND HANDRAIL

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This specification is for a pultruded fiberglass railing system in compliance with 2012 IBC, and OSHA 1910.23.

1.2 REFERENCES

A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.
   1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:
   2. ASTM D-638-Tensile Properties of Plastics
   3. ASTM D-790-Flexural Properties of Unreinforced and Reinforced Plastics
   4. ASTM D-2344-Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method
   5. ASTM D-495-High Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
   6. ASTM D-696-Coefficient of Linear Thermal Expansion for Plastics
   7. ASTM E-84-Surface Burning Characteristics of Building Materials
   8. INTERNATIONAL CODE COUNCIL, INC.
   9. The International Building Code, 2012
   10. THE OCCUPATIONAL HEALTH AND SAFETY ADMINISTRATION
   11. Code of Federal Regulations (CFR), Title 29, Section 1910.23

1.3 SUBMITTALS

A. The CONTRACTOR shall furnish shop drawings of all fabricated railings and accessories in accordance with the provisions of this Section.

B. The CONTRACTOR shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication of and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.

C. The CONTRACTOR shall submit the manufacturer’s published literature including structural design data, structural properties data, corrosion resistance tables, certificates of compliance, test reports as applicable, and design calculations for systems not sized or designed in the contract documents, sealed by a Professional Engineer.

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D. The CONTRACTOR may be requested to submit sample pieces of each item specified herein for acceptance by the ENGINEER as to quality and color. Sample pieces shall be manufactured by the method to be used in the WORK.

1.4 QUALITY ASSURANCE

A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.

B. Manufacturer shall offer a 3 year limited warranty on all FRP products against defects in materials and workmanship.

C. Manufacturer shall be certified to the ISO 9001 standard.

D. Manufacturer shall provide proof of certification from at least two other quality assurance programs for its facilities or products (DNV, ABS, USCG, AARR).

1.5 PRODUCT DELIVERY AND STORAGE

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Guardrail and/or Handrail system to be Dynarail® as manufactured by

1. Fibergrate Composite Structures Inc.
   5151 Belt Line Road, Suite 1212
   Dallas, Texas 75254-7028 USA
   (800) 527-4043 Phone (972) 250-1530 Fax

   Website: fibergrate.com
   E-mail: info@fibergrate.com

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2.2 GENERAL

A. All posts and rails are to be DYNAFORM® FRP structural shapes manufactured by the pultrusion process. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions specified in the Contract Documents.

B. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

C. Resins shall be {DYNAFORM® *ISOFR, fire retardant isophthalic polyester used to produce NSF Standard 61 certified shapes, or VEFR, fire retardant vinyl ester used to produce NSF Standard 61 certified shapes*, (*choose one*)} with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.

D. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

E. All pultruded structural shapes shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin, 2) a synthetic surfacing veil to help produce a resin rich surface, and 3) an appropriate UV resistant coating for outdoor exposures.

F. All FRP products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test, (except for non-fire retardant isophthalic polyester and vinyl ester NSF Standard 61 certified shapes).

G. Top and bottom rails for guards are to be 1.75" x 0.125" (44.4 mm x 3.2 mm) wall square tube, the posts are to be 2.125" x 0.1875" (53.9 mm x 4.8 mm) wall square tube and kick plate is to be ½" deep x 4" wide with two reinforcing ribs. Offset rail used as handrail to be 1.5” x 0.25” (38.1 mm x 6.4 mm) wall round tube.

H. The completed railing installation shall meet the following load requirements with a minimum factor of safety of 2.0:

1. Concentrated Load: 200 lb (891 N) applied in any direction at any point on the rail.
2. Uniform Load: 50 lb/lf (730.5 N/m) applied in any direction on the rail.
3. Loads are assumed not to act concurrently.

I. All rails, posts, and kick plates are to be integrally pigmented yellow.

J. Pultruded structural shapes used in the railing systems are to have the minimum longitudinal mechanical properties listed below:

Property	**ASTM Method**	**Value**	**Units**
Tensile Strength	D-638	30,000 (206)	psi (MPa)
Tensile Modulus	D-638	2.5 x 10^6 (17.2)	psi (GPa)
Flexural Strength	D-790	30,000 (206)	psi (MPa)

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Property	ASTM Method	Value	Units
Flexural Modulus	D-790	1.8×10^6 (12.4)	psi (GPa)
Flexural Modulus (Full Section)	N/A	2.8×10^6 (19.3)	psi (GPa)
Short Beam Shear (Transverse)	D-2344	4,500 (31)	psi (MPa)
Shear Modulus (Transverse)	N/A	4.5×10^5 (3.1)	psi (GPa)
Coefficient of Thermal Expansion	D-696	4.1×10^{-6} (7.4×10^{-6})	in/in/°F (cm/cm/°C)
Flame Spread	E-84	25 or less	N/A

K. All fasteners used in the railing system are to be 316 SS. Rivets to be 18-8 SS.

PART 3 - EXECUTION

3.1 FABRICATION

A. The post/rail connection for guards is to be fabricated such that the rails are unbroken and continuous through the post without the use of packs or splices. The bottom rail is to be installed through the post at a prepared hole made to fit the outside dimensions of the rail. The top rail is to fit into a machined, u-shaped pocket formed into top of the post such that the rail is located at the center of the post. All exposed post corners are to be radiused to eliminate sharp edges. The rails are to be joined to the post through a combination of bonding and riveting. The offset handrail is to be fabricated such that the rail is continuous with the use of connectors and splices. No sharp, protruding edges are to remain after assembly of the railing system. Spacing of the posts and offset handrail supports shall not exceed 6'-0" (1.83 m).

B. The bases of the posts are to be attached according to the contract drawings. The bases of the posts are to be reinforced to a height of 8.5" (254 mm). The offset handrails are to be attached to guards or walls with brackets.

C. When required, rails for guards are to be spliced using a 10" (152.4 mm) length of 1.5" x 1/8" (38.1 mm x 3.2 mm) FRP square tube bonded and riveted into place using epoxy adhesive. Rail for offset handrail to be spliced using a 5” (127 mm) length of 1” (25.4 mm) FRP round rod.

D. To avoid embrittlement at cold temperatures and loss of strength at high temperatures, PVC or CPVC connectors should not be used as a load carrying component of the railing system.

E. All shop fabricated cuts are to be sealed to provide maximum corrosion resistance. Field cuts are to be similarly coated by the contractor in accordance with the manufacturer’s instructions.

END OF SECTION 066100

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Molded (expanded) polystyrene foam-plastic board insulation.
3. Graphite-polystyrene foam-plastic board insulation.
4. Polyisocyanurate foam-plastic board insulation.

B. Related Requirements:

1. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
2. Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

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1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Provide one of the following:

1. FOAMULAR NGX as manufactured by:

a. Owens Corning Foam Insulation LLC, Toledo OH.
b. Or approved equal.

2.2 Materials / Equipment

A. Fire Safing Insulation: Provide the following:

1. Mineral Fiber Insulation: Un-faced, semi-rigid, non-asbestos, non-combustible blankets composed of compounds of spun mineral fiber felt, complying with ASTM C665, Type I, and FS HH-I-558B, Type 1 and 2.
2. Physical Properties: Provide the following:

a. Thermal Conductivity (k), ASTM C518: 0.25 Btu/in./hr./sf/°F.
b. Density, Manufacturer's Certified Test: 4 pcf.
c. Flame Spread, ASTM E84: 15 maximum.
d. Smoke Developed, ASTM E84: 0.
e. Fire Resistance Rating, ASTM E119: 3 hours.
f. Thickness: 4-inches
g. Width: 24-inches

B. Fire-Stop Sealants and Other Fire-Stop System Components: Provide the following:

1. Complete selection of fire stop manufacturer's recommended silicone rubber fire stop systems. Provide complete systems complying with UL 1479 with a two or three hour fire rating. Provide equal fire protection as provided by fire-rating of construction penetrated.

2. Provide multiple component systems coordinated to meet actual conditions encountered in the Work and as recommended by the fire stop manufacturer. In addition to providing fire-resistance the fire stop systems shall also be gas and watertight.

C. Miscellaneous Materials and Accessories: Provide the following:

1. Adhesive for Bonding Insulation: The type recommended by the insulation manufacturer, and complying with fire-resistance requirements.
2. Mechanical Anchors: Type and size shown or, if not shown, as recommended by the insulation manufacturer for the type of application shown and condition of substrate.
3. Protection Board: Fiberboard sheathing or heavy duty asphaltic panels as recommended by the insulation manufacturer.
4. Adhesive Tapes: Complete selection of insulation manufacturer's recommended taping materials.
5. Bitumen: Asphalt, ASTM D449

2.3 Fabrication / Assembling / Finishes

1. Contractor shall verify that foamed-in-place cementitious insulation shall be mixed using the quantities, proportions and the pressures required in the manufacturer’s written specifications and comply with the intended use.

2.4 Source Quality Control / Shop Tests

1. Not Used

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or those that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF BOARD INSULATION

A. Install board insulation in accordance with manufacturer's written instructions per project applications and conditions.

3.4 INSTALLATION OF REFLECTIVE AND RADIANT BARRIERS INSULATION

A. Install sheet reflective insulation in accordance with ASTM C727.

B. Install sheet radiant barriers in accordance with ASTM C1744.

C. Install interior radiation control coating system in accordance with ASTM C1321.

3.5 INSTALLATION OF VACUUM INSULATION

A. Install vacuum insulation panels in accordance with manufacturer's written instructions.

3.6 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

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SECTION 075216 – STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
2. Hybrid roofing system that combines built-up ply sheets with styrene-butadiene-styrene (SBS)-modified bituminous cap sheet.
3. Substrate board.
4. Vapor retarder.
5. Roof insulation.
6. Cover board.
7. Walkways.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Section 077100 "Roof Specialties" for counterflashings.
5. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.

3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Crickets, saddles, and tapered edge strips, including slopes.
7. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
8. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Cap Sheet: Samples of manufacturer's standard colors for selection by Architect
2. Flashing Sheet: Samples of manufacturer's standard colors for selection by Architect
3. Aggregate surfacing material in gradation and color required.
4. Walkway Pads or Rolls: Samples of Manufacturer's standard colors for selection by Architect

D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of membrane roofing system, from ICC-ES.

E. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

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1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, and other components of roofing system.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 UL CLASS

A. UL Class A, 20 year build-up type, four or more plies to match existing or approved equal.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

2.3 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from approved by roof membrane manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.

1. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft., and allow primer to dry.

D. Perform fastener-pullout tests according to roof system manufacturer's recommendations.

1. Submit test result within 24 hours of performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

1. Locate end joints over crests of steel roof deck.
2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Loosely lay substrate board over roof deck.

3.5 INSTALLATION OF VAPOR RETARDER

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of the insulation and cover board.
2. Continuously seal side and end laps with tape adhesive.

B. Laminate Sheet: Loosely lay laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of the insulation and cover board.
2. Continuously seal side and end laps with tape.

C. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of the insulation and cover board.
2. Seal laps by rolling.

D. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F.

D. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

    a. Staggered end joints within each layer not less than 24 inches in adjacent rows.

E. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
c. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation, so that water flow is unrestricted.

d. Fill gaps exceeding 1/4 inch with insulation.
e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

3.7 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board, so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to manufacturer’s written instructions and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3.8 INSTALLATION OF ROOFING MEMBRANE, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.9 INSTALLATION OF BASE SHEET

A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.

B. Installation of SBS-Modified Bitumen Polyester and Fiberglass-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Adhere to substrate in a uniform coating of cold-applied adhesive.

5. Install base sheet without wrinkles, rears, and free from air pockets.
6. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

    a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches.
    b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches.
    c. Stagger end laps not less than 18 inches.
    d. Completely bond and seal laps, leaving no voids.
    e. Roll laps with a 20-pound roller.

7. Repair tears and voids in laps and lapped seams not completely sealed.
8. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

C. Installation of Vented Base Sheet:

1. Spot or strip mop to substrate with hot roofing asphalt vented base sheet with vented side down.

    a. Fasten vented base sheet according to manufacturer’s written requirements
    b. Fasten vented base sheet to resist uplift pressure at corners, perimeter, and field of roof.

3.10 INSTALLATION OF INTERPLY SHEETS

A. Install two ply sheets, starting at low point of roofing.

1. Align ply sheets without stretching.
2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

    a. Shingle in direction to shed water.

3. Extend ply sheets over and terminate above cants.

3.11 INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET

A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.

B. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

1. Extend cap sheet over and terminate above cants.
2. Install cap sheet in a shingle fashion.
3. Install cap sheet as follows:

    a. Adhere to substrate in cold-applied adhesive.

4. Install cap sheet without wrinkles or tears, and free from air pockets.
5. Install cap sheet, so side and end laps shed water.

C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches.
2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches.
3. Stagger end laps not less than 18 inches.
4. Heat weld laps, leaving no voids.
5. Roll laps with a 20-pound roller.
6. Repair tears and voids in laps and lapped seams not completely sealed.

D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

E. Aggregate Surfacing: After installing and testing roofing, base flashing, and stripping, promptly apply flood coat to roof surface with 60 lb/100 sq. ft. of hot roofing asphalt. While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

3.12 INSTALLATION OF FLASHING AND STRIPPING

A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application:

    a. Mechanically fasten backer sheet to walls or parapets.
    b. Adhere backer sheet over roofing membrane at cants in cold-applied adhesive.

3. Backer Sheet Application:

a. Adhere backer sheet to substrate in cold-applied adhesive.

4. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.

a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches in all directions from edges of item being flashed.
2. Embed granules, matching color of roof membrane, into wet compound.

3.13 INSTALLATION OF WALKWAYS

A. Walkway Cap Sheet Strips: Install walkway cap sheet strips over roofing membrane, using same application method as used for roofing cap sheet.

1. Install walkways strips at the following locations:

a. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
b. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
c. Top and bottom of each roof access ladder.
d. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
e. Locations indicated on Drawings.
f. As required by roof membrane manufacturer’s warranty requirements.

2. Provide 3-inch clearance between adjoining strips.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Engineer.

B. Perform the following tests:

1. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

    a. Perform tests before overlying construction is placed.
    b. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches .
    c. Maintain 2 inches of clearance from top of base flashing.
    d. Flood each area for 48 hours.
    e. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is the responsibility of the Contractor.

    f. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.

2. Infrared Thermography: Testing agency shall survey entire roof area using infrared color thermography according to ASTM C1153.

    a. Perform tests before overlying construction is placed.
    b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing, or by nuclear hydrogen detection testing.
    c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is Contractor's responsibility.

    d. Testing agency shall prepare survey report of initial scan indicating locations of entrapped moisture if any.

3. Electrical Capacitance/Impedance Testing: Testing agency shall survey entire roof area for entrapped water within roof assembly according to ASTM D7954/D7954M.

    a. Perform tests before overlying construction is placed.
    b. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is Contractor's responsibility.

    c. Testing agency shall prepare survey report indicating locations of entrapped moisture, if any.

4. Nuclear Hydrogen Detection Testing: Testing agency shall survey entire roof area for entrapped water within roof assembly according to ANSI/SPRI/RCI NT-1.

    a. Perform tests before overlying construction is placed.
    b. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

c. Testing agency shall prepare survey report indicating locations of entrapped moisture, if any.

5. Low-Voltage Electrical Conductance Testing: Testing agency shall survey entire roof area and flashings to locate discontinuity in the roof membrane using an exposed metal electrical loop to create an electrical field tested with hand-held probes or a scanning platform having integral perimeter electrical loops creating a complete electrical field.

a. Perform tests before overlying construction is placed.
b. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

1) Cost of retesting is Contractor's responsibility.

c. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

6. High-Voltage Spark Testing: Testing agency shall survey entire roof area, flashings, and parapet walls to locate discontinuity in the roof membrane using an electrically charged metal "broom head."

a. Perform tests before overlying construction is placed.
b. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

1) Cost of retesting is Contractor's responsibility.

7. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

C. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

1. Determine approximate quantities of components within roofing membrane according to ASTM D3617/D3617M.
2. Examine test specimens for interply voids according to ASTM D3617/D3617M and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.

D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Engineer, and to prepare inspection report.

1. Notify Engineer and Owner 48 hours in advance of date and time of inspection.

E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

F. Roofing system will be considered defective if it does not pass tests and inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.15 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Engineer and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.16 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: _____.
7. Warranty Period: <Insert time>.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

a. lightning;
b. peak gust wind speed exceeding 90-120 mph;
c. fire;
d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
f. vapor condensation on bottom of roofing; and
g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075216

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SECTION 076200 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section describes the general requirements for sheet metal flashing and trim for a complete water- and weather-tight installation complying with all governing codes and standards.

B. The Contractor shall provide all labor, materials, equipment and incidentals necessary to perform the work of this Section as shown on the Contract Drawings, specified herein or required otherwise for a complete installation.

C. The Contractor shall implement practices and procedures to meet the project's sustainability goals as identified in the Contract Documents. The Contractor shall ensure that the sustainability requirements of this Section are implemented to the fullest extent.

D. The following index of this Section is presented for convenience:

E.

Article	Title	Section Page
PART 1 - GENERAL		1
1.1	Summary	1
1.2	Payment	2
1.3	Related Sections	2
1.4	References	2
1.5	Description	2
1.6	Quality Assurance	3
1.7	Submittals	4
1.8	Delivery, Storage, and Handling	5
1.9	Spare Parts, Special Tools, and Supplies	5
1.10	Special Warranty Provisions / Guarantee Periods	5
PART 2 - PRODUCTS		5
2.1	Manufacturers	5
2.2	Materials / Equipment	6
2.3	Fabrication / Assembling / Finishes	6
2.4	Source Quality Control / Shop Tests	6
PART 3 - EXECUTION		7
3.1	Examination / Preparation	7
3.2	Installation	7
3.3	Field Testing / Quality Control	8
3.4	Startup / Demonstration	8
3.5	Adjusting / Protection / Cleanup	9

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1.2 PAYMENT

A. No separate payment shall be made for performing any Work required under this section. All costs for work required by this Section shall be included in the applicable lump sum, unit price(s), or allowance(s) as set forth in Section 01 27 00 – Measurements and Payments.

1.3 RELATED SECTIONS

A. Section 075216 “Styrene-Butadiene Styrene (SBS) Modified Bituminous Membrane Roofing”.

B. Section 079200 “Joint Sealants”.

1.4 REFERENCES

A. BCNY - Building Code of New York

B. ASTM A666 - Specification for Annealed or Cold-Worked Austenitic

1. Stainless Steel Sheet, Strip, Plate and Flat Bar

C. ASTM B32 - Standard Specification for Solder Metal

D. FM 1-49 FM - Global Property Loss Prevention Data Sheet,

1. Perimeter Flashing

E. SMACNA - Sheet Metal and Air Conditioning Contractors National

1. Association, Incorporated, Architectural Sheet Metal Manual

1.5 DESCRIPTION

A. Sheet metal flashing and trim to be provided under this Section shall include complete systems of flashing and counterflashing at penetrations in roofing; interlocking, mechanically-keyed, 3-way ribbed stainless steel metal masonry cavity wall flashing and miscellaneous system components such as cast-in-place and built-in-place reglets and other accessory components; miscellaneous flashings not supplied under the work of other Sections; miscellaneous accessories, fasteners and incidental system components.

B. Installation of the systems shall meet the requirements of FM Approval Rating Class 1-90 construction, without relying upon sealants or other non-metallic detailing and fabricating techniques to achieve weather- and water tightness.

C. Performance Criteria:

1. Sheet metal flashing and trim shall be permanently watertight, and not deteriorate in excess of manufacturers’ published limitations.
2. Comply with fabrication details recommended by SMACNA and the sheet metal flashing and trim manufacturers, as approved by Engineer at time of Shop Drawing submission.

3. Provide completely weather- and watertight wall and single-ply roofing metal flashing systems. Contractor shall provide only the highest quality materials and methods of construction and installation as recommended by sheet metal flashing and trim manufacturers in compliance with governing authorities and as approved by Engineer at time of Shop Drawing submission.
4. Provide Working Drawings showing the coordination of the Work with Paragraph 1.03, Related Sections, of this Section. Provide detailed Working Drawings showing all profiles of sheet metal flashing and trim systems to be used in the Work, fully dimensioned, located, quantified, and presented such that sequence of installation is acceptable to each interfacing material supplier

D. Sustainable Design Requirements

1. Recycled Content of Steel-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content shall not be less than 25 percent.
2. Low Emitting Materials: All adhesives and sealants used onsite and within the building's weatherproofing system shall meet the VOC content limits for the work as specified in the Contract Documents.

E. Project-specific system/design requirements will be provided (if necessary) in the Contract in order to update the requirements given herein or to supplement other requirements given in the Contract Drawings.

F. Scheduling:

1. Coordinate ribbed metal cavity wall flashings with other Work to ensure secure anchorage and watertight seals, and to minimize exposure to puncture or other damage from the work of other trades. Refer to Sections 04 22 23.23 – Prefaced Concrete Unit Masonry and 07 55 56.13 – Hot-Applied Rubberized Asphalt Protected Membrane Roofing.
2. Deliver materials to the site in sufficient quantities to ensure uninterrupted progress of the Work.
3. Do not proceed with the sheet metal flashing and trim Work until curb and substrate construction, blocking, and other construction to receive the Work is completed.
4. Schedule the installation of sheet metal flashing and trim Work to coincide with the installation of roofing, waterproofing, drains, piping, blocking, nailers, framing at openings, curbs, Concrete Unit Masonry and other adjoining and substrate work.
5. Proceed with and complete the work only when materials, equipment and knowledgeable tradesmen required for the installation of sheet metal flashing and trim systems are at the site and are ready to follow and integrate the work of this Section with work requiring the installation of sheet metal flashing and trim.

1.6 QUALITY ASSURANCE

A. Engage installers skilled, trained and with successful experience in the detailing, fabrication and installation of each type of sheet metal flashing and trim work required who are recognized sheet metal contractors, equipped to perform workmanship in accordance with the Contract Documents and approved Shop Drawings so that there will be undivided responsibility for the performance of each flashing and trim component of the work.

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1.7 SUBMITTALS

A. The Contractor shall submit the following to the Engineer for review and approval:

1. Installer Qualifications: Submit names and qualifications to Engineer along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owners, architects or engineers, responsible for the projects.
b. Approximate contract prices for sheet metal flashing and trim.
c. Size of area installed

2. Samples:

a. Typical examples of sheet metal flashing and trim profiles, 12-inches long with all fasteners, clips, and supports required for the Work. 12-inch by 12-inch sheet of each item specified and 6-inch long pieces of each required system component to be used in the work.
b. Each fastener type required marked as to type of material and with their intended purpose in the work.

3. Shop Drawings:

a. Copies of manufacturers' specifications, installation instructions and recommendations for sheet metal flashing and trim requirements.
b. Manufacturer's data substantiating that the materials comply with the requirements.
c. Shop Drawings showing the coordination of the Work with Sections 04 22 23.23 – Prefaced Concrete Unit Masonry and 07 55 56.13 – Hot-Applied Rubberized Asphalt Protected Membrane Roofing.
d. Detailed Shop Drawings showing all profiles of sheet metal flashing and trim systems to be used in the work, fully dimensioned, located, quantified and presented such that sequence of installation is acceptable to each interfacing material supplier.
e. Large scale isometric drawings of all sheet metal and trim intersections and transitions, include all fastener locations and materials, cleats and other miscellaneous accessories necessary to complete the Work as specified.

B. Sustainable Design Submittals:

1. The Contractor shall report information pertaining to the sustainable procurement, regional sourcing, and/or recycled content of new materials to be procured during the Work, in accordance with Section 01 35 63 – Sustainability Certification Report Requirements. The Contractor shall coordinate with their vendor on sustainable product requirements as stipulated by the Contractor's approved New Materials Sustainable Implementation Plan, in accordance with Section 01 35 63 – Sustainability Certification Report Requirements . The Contractor shall submit vendor shop drawings for review by the Engineer that clearly illustrate the vendor is meeting the requirements as approved in the Contractor's New Materials Sustainable Implementation Plan.

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1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver materials in manufacturers' original, unopened and undamaged containers and rolls, with labels intact and legible and with information accurately representing container contents as approved by Engineer at time of Shop Drawing submission.
2. Items delivered in broken, damaged, rusted, or unlabeled condition shall immediately be removed from project site and not offered again for approval by Engineer.

B. Storage of Materials:

1. Store materials in an area protected from all construction traffic not associated with the work of this Section.
2. Store materials off the ground and in same package in which they were shipped, and on platforms protected from dirt and other contamination.
3. Store under cover and in a manner which does not permit water to remain on units.

C. Handling of Materials:

1. Protect all sheet metal flashing and trim work from dents, scratches, warps and bends.
2. Immediately after installation of each system component, remove all strippable protective films.
3. Comply with manufacturer's instructions for handling and installation of the ribbed metal cavity wall flashing materials, except where more stringent requirements are shown or specified.

1.9 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

A. Not Used

1.10 SPECIAL WARRANTY PROVISIONS / GUARANTEE PERIODS

A. The Contractor shall obtain from the manufacturer and provide to DEP the manufacturer's standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Stainless Steel Flashing and Counter Flashing System

1. Cheney Flashing Company, Inc.; Cheney Flashing – Trenton, NJ.
2. Or approved equal.

B. Reglets:

1. Cheney Flashing Company, Inc., Trenton, NJ.
2. Or approved equal

2.2 MATERIALS / EQUIPMENT

A. Stainless Steel Flashing & Counterflashing System Associated with work of this Section:

1. Provide deformed sheet, stainless steel, Type 316 complying with ASTM A666 for all Work with No. 2D finish.
2. Stainless Steel Flashing & Counterflashing System Associated with wok of this Section: Provide deformed sheet, stainless steel, Type 316 complying with ASTM A666 for all Work with No. 2D finish.
3. Provide thickness of twenty-six (26) gage. Termination bar units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory- mitered and -welded corners and junctions.
4. Material: Stainless steel, one-eighth (1/8)-inch thick.
5. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
6. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
7. Solder for Stainless Steel: ASTM B32, Lead-free; 96.5% Sn, 3.45% Cu, 1% Sb, 0.05% Ag used with an acid flux of the type recommended by the stainless steel manufacturer. Use a non-corrosive rosin flux over tinned surfaces.
8. Stainless Welding Rods: Type recommended by stainless steel sheet manufacturer for the type of metal sheets furnished.
9. Nails, Screws and Rivets: Same material as flashing sheet, or as recommended by manufacturer of flashing sheet.
10. Cleats: Same metal and gage as sheet being anchored, two (2) inches wide, punched for two (2) anchors.

2.3 FABRICATION / ASSEMBLING / FINISHES

A. Fabricated Metal Flashing and Trim: Shop fabricate sheet metal flashing and trim to comply with profiles and sizes shown, and to comply with manufacturer's recommended details. Except as otherwise shown or specified, provide soldered flat-lock seams, and fold back metal to form a hem on the concealed side of exposed edges. Comply with metal producers' recommendations for tinning, soldering and cleaning flux from metal.

B. On all metal base and counterflashing, and trim provide completely shop-fabricated corners and special flashings; arc welded to insure watertight joints. Grind welds smooth so as to be indistinguishable from adjacent surfaces

2.4 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

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PART 3 - EXECUTION

3.1 EXAMINATION / PREPARATION

A. Examination

1. The Contractor shall examine the substrate and the conditions under which the sheet metal flashing and trim work is to be performed, and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Preparation

1. Clean the substrate of dust, debris, substances and interferences detrimental to the Work and prepare substrates as recommended by the sheet metal manufacturer.
2. Before installing flashing and trim, verify shapes, and dimensions to be covered.

3.2 INSTALLATION

A. General:

1. Separate dissimilar metals from substrates and from each other by painting each metal surface in the area of contact with a 15-mil thick application of bituminous coating, as recommended by the manufacturers of the dissimilar metals. Comply with manufacturer's recommendations for other forms of protection of the stainless steel and aluminum against corrosion.
2. Provide thermal expansion for running trim, flashing and other items exposed for more than 15 feet - 0 inch continuous length. Maintain a watertight installation at expansion seams. Locate expansion seams at 15 feet - 0 inch intervals, and 2 feet - 0 inch each side of corners and intersections.
3. Fabricate and install the work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves and avoidable tool marks, considering the temper and reflectivity of the metal. Provide uniform, neat double-locked seams with cleats rolled into the seam and with minimum exposure of solder, welds and sealant. Except as otherwise shown, fold back the sheet metal to form a hem on the concealed side of exposed edges. All exposed edges of all sheet metal flashing shall be hemmed not less than 1/2-inch wide.
4. Conceal fasteners and expansion provisions wherever possible in exposed work, and locate so as to minimize the possibility of leakage. Cover and seal work as required for a watertight installation.
5. Provide cleat-type anchorages for metal flashings and trim wherever practical, arranged to relieve stresses from building movement, and thermal expansion and contraction.
6. On vertical surfaces lap 2-piece flashings a minimum of 4 inches.
7. On sloping surfaces, for slopes of not less than 6 inches in 12 inches, lap unsealed flashings a minimum of 6 inches. For slopes less than 6 inches in 12 inches, use soldered flat-locked seams.
8. For embedment of metal flashing flanges in single ply roofing or flashing or stripping, extend flanges for a minimum of 6 inches embedment.

9. Flashing to be inserted into reglets shall be installed to the full depth of the reglet with the top flange of the flashing edge turned forward to form a hook. Caulk flashing into reglets using stainless steel wedges. Fill reglet with sealant specified in Section 07 90 00 - Joint Protection.

B. Installation of Stainless Steel Flashing and Trim:

1. Tin the edges of plain stainless steel to be soldered, for a width of 1-1/2 inches, using solder for stainless steel and acid flux. Remove every trace of acid flux residue from the metal promptly after tinning or soldering.
2. Provide welded joints. Provide upturned, 1/2-inch wide hooked flanges, and weld between adjoining sheets; lay seam flat.

C. Installation of Ribbed Metal Cavity Wall Flashing:

1. Build ribbed metal through-wall masonry flashing work into Concrete Unit Masonry construction as construction work progresses. Work performed without built-in flashings shall be stopped, removed and rebuilt at no additional expense to DEP, even if discovered only after walls and other materials are in-place and completed.
2. Install all flashings in a split bed of mortar, increasing the thickness of the bed if required to achieve full mortar coverage on top and bottom of flashings.
3. Coordinate the installation of flashing materials and associated work so as to provide a complete system complying with the combined recommendations of manufacturers and installers involved in the work.
4. Use only installation techniques approved by the ribbed metal cavity wall flashing manufacturer

3.3 FIELD TESTING / QUALITY CONTROL

A. Field Quality Control for Cavity Wall Flashing

1. Field test ribbed metal cavity wall flashing after installation. After building three courses of concrete unit masonry above area of ribbed cavity wall flashing, tape weep vents closed and fill cavity with water.
2. Water leaking from the wall below the area of the ribbed metal cavity wall flashing shall be evidence that the ribbed metal cavity wall flashing was improperly installed.
3. Remove concrete unit masonry and improperly installed ribbed cavity wall flashing and install new ribbed cavity wall flashing. Repeat this process until the wall does not shown evidence of leakage beneath ribbed cavity wall flashing. All such remedial work shall be at no additional expense to DEP.
4. Remove tape from weep vents and all mortar and other debris from cavity and demonstrate free flow of water from the cavity at conclusion of test

3.4 STARTUP / DEMONSTRATION

A. Not Used

3.5 ADJUSTING / PROTECTION / CLEANUP

A. Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from all construction traffic.

B. Do not permit workmen, or others, to step directly on flashing sheets in place, or to place or move equipment over flashing and trim surfaces. Protect surfaces during installation of permanent covering work and adjoining work.

C. Coordinate metal wall flashings with other Work to ensure secure anchorage and watertight seals, and to minimize exposure to puncture or other damage from the Work of other trades.

D. Neutralize excess flux as work progresses with five percent to ten percent washing soda solution and rinse thoroughly.

E. Clean exposed surfaces of every substance which is visible or might cause corrosion or prevent uniform oxidation of the metal surfaces. Exercise extreme care to remove fluxes and ferrous metal particles, including welding splatter and grinding dust.

F. Do not leave metal debris and discarded materials at the site of the work. Clean each site of the work as the work progresses on a daily basis.

END OF SECTION 076200

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SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.3 SUBMITTALS

A. Contractor shall submit Shop Drawings for approval of the Engineer. Submittals shall include, but not be limited to:

1. Samples of each material listed
2. Manufacturers Literature

B. Each submittal shall be identified by the Specification Section Number.

C. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed materials compliance with the Contract Documents.

D. Partial, incomplete or illegible submissions will be returned to the Contractor without review for resubmission.

E. Samples shall include finish and color samples for all items.

F. Shop Drawings shall include, but not be limited to:

1. Complete layout and installation drawings with clearly marked dimensions and schedules including sizes, weights, gages of metal and spacing.
2. Details of all attachments.

G. Design Test Reports:

1. Submit copies of design test reports for each of the performance testing standards listed in Article 1.05 herein.
2. Test reports shall be performed by independent, International Accreditation Service, Inc. (IAS) accredited testing laboratory, and shall bear the seal of a licensed and registered professional engineer in New York.

H. Engineering Calculations:

1. Submit engineering wind pressure calculations specific to this Project.
2. Calculations shall be prepared and sealed by a professional engineer that is a full time employee of the system manufacturer.
3. Calculations shall clearly demonstrate that the system is capable of resisting the calculated design wind pressure(s) after the application of the safety factor specified herein in accordance with the requirements of ANSI/SPRI ES-1 and the building code.

I. Installer Qualifications:

1. Engage a single installer skilled, trained and with successful experience in the installation of roof specialties systems and with successful experience in the erection of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of work. Submit names and qualifications to the Engineer for approval along with the following information on a minimum of three successful projects:

    a. Names and telephone numbers of owners, architects or engineers responsible for projects.
    b. Approximate contract cost of the system.
    c. Amount of area installed.

J. Sustainable Design Submittals:

1. Environmental Materials Reporting Form (EMRF) Recycled Content. Provide the following information:

    a. Name of Product and Manufacturer.
    b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).

K. The percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.

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1.4 QUALITY ASSURANCE

A. The workmanship of sheet metal work, method for forming joints, anchoring, cleating, and provisions for expansion shall conform to the standard details and recommendations of the Copper Development Association and the Architectural Sheet Metal Manual published by SMACNA. Workmanship shall be in accordance with the best trade practice and recommendations and specifications of the Sheet Metal and Air Conditioning Contractors National Association, Incorporated.

1. Uplift requirements shall match the requirements for adjacent membrane roofing as specified in Section 07 22 16 – Roof Board Insulation, Section 07 32 13 – Terra Cotta Roof Tiles, and Sections 07 55 56.13 - Hot-Applied Rubberized Asphalt Protected Membrane Roofing, and
2. Wind resistance calculation shall be designed specifically for this project. The Contractor shall calculate and certify that the perimeter roof specialties systems furnished meet the anticipated design pressure as specified in the Detailed Specifications when tested in accordance with SPRI Test Methods RE-2 and RE-3.

B. The forming and assembling of sheet metal components shall be performed using methods that will not void any manufacturer’s warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials in factory packed unopened cartons and crating bearing the manufacturer's labels.

B. Store materials in clean, dry and protected areas in such manner to preclude damage of any nature.

C. Handle all materials with proper care to avoid denting, marring, warping or other distortions during delivery, storage and handling.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.7 WARRANTY

A. The Contractor shall obtain from the manufacturer and provide to the City the manufacturer’s standard warranty, in an acceptable form, warranting against defects in design, materials, abnormal aging, and workmanship.

B. The Contractor shall furnish to the City a fifteen (15) year written Manufacturer's Warranty covering materials and workmanship for the entire "Coping System", including repair and

replacement of components which are deemed faulty or in disrepair during the warranty period. Such items in disrepair shall be repaired at no cost to the City. These guarantees shall cover both labor and materials necessary to effect water tightness, including that required to repair leaks caused by defective material and/or workmanship, without limit as to amount required to effect water tightness.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Copings:

    a. "Permasnap" as manufactured by OMG Roofing Products, Agawam, MA
    b. Or approved equal

2. Roof curbs:

    a. Custom Solutions Roofs and Metal Products, Cedar Rapids, IA.
    b. Or approved equal

3. Fascia and gravel stops:

    a. "Type AP" (gravel stops) and “Type SP” (fascia) as manufactured by Architectural Products Company, Hebron, KY
    b. Or approved equal

2.2 MATERIALS / EQUIPMENT

A. Copings:

1. Coping units over parapet walls to be 22 ga., or as noted on the Contract Drawings.
2. Units to be of size and profiles shown on the Contract Drawings.
3. Provide coping units with mitered welded corners, splice plates and joint trim, retainer clips, compression pads, fasteners and other accessories required to make a complete installation, in accordance with the manufacturer's recommendations.
4. Finish on all exposed surfaces of stainless steel copings and accessories to be 304-2B.
5. Sealants for installation of copings shall be of an approved type acceptable to the manufacturers of materials herein specified.
6. Fastenings shall be concealed type, stainless steel or cadmium plated. Self-tapping screws to be stainless steel of sizes recommended by the manufacturers.
7. Seed clips to be stainless steel.

B. Roof curbs shall be fabricated of Stainless Steel: 0.028 inch thick with continuous mitered and welded corner seams, integral base plates, factory installed pressure treated wood nailed, and insulated with 1½ inch thick rigid fiberglass insulation. Profile shall be as shown on the Contract Drawings.

C. Gutters shall be manufactured of 22 ga. type 304-2B stainless steel. Provide gutters in 10 feet lengths, tapered and notched to provide telescoping lap joints. Gutters shall be installed to

provide for thermal movement, in accord with the SMACNA. Provide profiles of gutters and support brackets as indicated on the Contract Drawings.

D. Downspouts shall be manufactured of 22 ga. type 304-2B stainless steel. Provide telescoping joint design for expansion. Elbows shall be welded construction, and shall match the finish and color of the downspout. Provide brackets and downspout profiles as indicated on the Contract Drawings.

E. Scupper Drains and Flashing: Thru wall scupper flashing in walls and parapets shall be constructed of 1/8-inch thick stainless steel. All joints shall be welded, and inlet shall be installed as indicated on the Contract Drawings.

F. Fascia and gravel stops shall be fabricated of 22 ga. type 304-2B stainless steel 5005-H34 alloy.

G. Fascia and gravel stops shall consist of complete assemblies, composed of hold down clips, joint covers, preformed mitered welded covers and other accessories required for a complete installation in accordance with the manufacturer's recommendation.

H. Manufacturer's Standards: In addition to the standards listed above, the flashing products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

2.3 FABRICATION / ASSEMBLING / FINISHES

A. Not Used

2.4 SOURCE QUALITY CONTROL / SHOP TESTS

A. Not Used

PART 3 - EXECUTION

3.1 EXAMINATION / PREPARATION

A. Examination:

1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, system supports, and other conditions affecting performance of the Work.
2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work. Any work needed to correct unsatisfactory conditions need to be submitted to the Engineer for approval prior to the work being done.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation:

1. Dissimilar metals shall be separated from each other by painting each metal surface in contact with a coating as specified in Specification 09 91 00 – Painting.

2. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
3. Establish straight, side and crosswise benchmarks.
4. Use proper size and length fastener for strength requirements.
5. All surfaces shall be checked for square and straightness.
6. Measure the wall lengthwise and crosswise to confirm lengths, widths, and clearances of roof specialties system components and verify clearances for thermal movement.

3.2 INSTALLATION, GENERAL

A. General:

1. Unless otherwise specified, all roof specialties shall be installed in accordance with the manufacturer's instructions to provide a complete watertight and weatherproof construction, free from bends and buckles and as shown on the Contract Drawings. Ample provision shall be made for expansion and contraction. Repair or replace all materials that have been damaged during installation.

B. Sheet Underlayment:

1. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply over entire parapet or roof-wall edge, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (150 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 90 days.

C. Gutters and Downspouts:

1. Install gutters with a maximum slope of 1/4 inch/40 feet. Install support brackets as indicated on the Contract Drawings. Do not install brackets directly behind downspouts. Provide sealants and fasteners as recommended by the SMACNA for joining gutter sections. Install inside brackets at 30 inches o.c. alternating with support brackets. Do not fasten gutter in a manner that would restrain thermal movement of the product. Provide expansion joints as recommended. Install end caps at all end terminations, fasten and seal. Provide stainless steel outlets. Fasteners shall be compatible to the materials being fastened.

D. Copings:

1. Install copings true and straight. Fasten as recommended by manufacturer. Seal and flash in accordance to primary roofing manufacturer's recommendations.
2. Install in manufacturers standard lengths with anchor plates and concealed joint cover at each joint. All screws shall be of stainless steel. Mitered and welded corners shall be used for all changes in direction.

E. Roof Curbs:

1. Center curbs over openings.
2. Anchor to wood blocking installed under Section 06 10 00 - Rough Carpentry.

F. Leave units ready to receive flashing provided herein and to be installed as the membrane roofing is installed.

3.3 FIELD TESTING / QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect roof specialties system installation, including accessories. Report results in writing.

B. Remove and replace applications of roof specialties system where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 FIELD TESTING / QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect roof specialties system installation, including accessories. Report results in writing.

B. Remove and replace applications of roof specialties system where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 START UP / DEMONSTRATION

A. Not Used

3.6 ADJUSTING / PROTECTION / CLEANUP

A. Check levels and adjust as necessary after roofing and flashing is complete.

B. Protect materials from damage by other trades. Remove protective coatings at completion of project as directed by the Engineer.

END OF SECTION 077100

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SECTION 078413 – PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide firestopping at all penetrations and juncture joints of fire-rated walls, floors and ceilings in accordance with the requirements of the NYC Building Code.

B. Firestopping and Smoke Seals shall be provided, but not limited to the following specific locations:

1. Penetrations for the passage of duct, cable, cable tray, conduit, piping and electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor slabs and floor/ceiling assemblies), and vertical service shafts.
2. Openings between structurally separate sections of walls or floors.
3. Construction Joints between the top of walls and floor or roof slab and steel deck assemblies, or, concrete floor or roof slab.
4. Vertical service shafts at each floor level.
5. Expansion joints in walls and floors.
6. Openings and penetrations in fire-rated partitions or walls containing fire doors.
7. Locations shown specifically on the Drawings.
8. Where firestopping will be exposed to public view, select firestopping material/assembly that can be painted as permitted by the assembly. Paint shall be as approved by the manufacturer and color shall match adjoining painted areas.

1.3 DEFINITIONS

A. Penetration: Any opening or foreign material passing through or into a fire-rated barrier.

B. Fire-Rated: Have the ability to withstand the effects of a standard fire exposure for a specified time period, as determined by qualified testing.

C. Fire-Rated Barrier: A floor, wall, partition or floor-ceiling assembly able to withstand a standard fire and hose stream test without failure.

D. Fire resistance rating: The ability of a structure to act as a barrier to the spread of fire and to confine it to the area of origin. Ratings are expressed in hours and apply to beams, columns, floors, ceilings, roofs, walls and partitions.

E. Firestopping: A means of sealing openings in fire-rated barriers to preserve or restore the fire resistance rating.

F. Firestop System: A material, or combination of materials, installed to retain the integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke or gases through penetrations in fire-rated barriers.

G. F Rating: The time period that the through-penetration firestop system limits the spread of fire through the penetration when tested in accordance with ASTM E814.

H. T Rating: The time period that the penetration firestop system, including the penetrating item, limits the maximum temperature rise to 325°F (163°C) above its initial temperature through the penetration on the non-fire side when tested in accordance with ASTM E814.

1.4 DESIGN REQUIREMENT

A. Technical Requirements

1. Firestopping materials shall be UL Classified as “Fill, Void or Cavity Material” for use in Through-Penetration Firestop Systems.
2. Firestop Systems shall provide a fire resistance rating at least equal to the hourly resistance rating of the fire-rated barrier and resist passage of smoke and other gases.

B. General Considerations

1. Firestop Systems do not re-establish the structural integrity of load bearing partitions. The Contractor shall consult the Authority's Representative prior to penetrating any load bearing assembly.
2. Firestop systems are not intended to support live loads or traffic. Contractor shall consult the Authority's Representative if there is reason to believe these limitations may be violated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.10 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

C. Notify testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
4. Horizontal assemblies include floor/ceiling assemblies
5. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft at both ambient and elevated temperatures.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

E. Manufactured Piping Penetration Firestopping System: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A48/A48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.
5. Temporary forming materials.
6. Masking Tape: Type recommended by firestopping manufacturer or width required by project conditions.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet .

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

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3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silyl-terminated polyether joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals:

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Engineer.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Engineer seven days in advance of dates and times when test joints will be erected.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

4. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F .
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 MANUFACTURERS

A. Exterior and Interior Joints in Vertical Planes: Provide one of the following:

1. Dymeric 240FC as manufactured by Tremco Incorporated, an RPM Company, Beachwood, OH.
2. Sikaflex-2C NS by Sika Corporation, Lindhurst, NJ.
3. Or approved equal.

B. Exterior and Interior Joints in Horizontal Planes: Provide one of the following:

1. THC 900/ 901 by Tremco Incorporated, an RPM Company, Beachwood, OH.
2. Sikaflex-2C SL by Sika Corporation, Lindhurst, NJ.
3. Or approved equal.

C. Expandable Joint Sealers both standard and backer seal:

1. Emseal Corporation, Westborough, MA.
2. Schul International Company, Pelham, NH.
3. Or approved equal.

2.3 MATERIALS / EQUIPMENT

A. Performance Requirements:

1. Installed water resistance: No penetration at fifty percent (50%) compression.
2. Movement capability: One hundred percent (100%) compression and expansion, with one hundred percent (100%) recovery.

3. Water absorption: Maximum three percent (3%) of weight, when tested at fifty percent (50%) compression for one hundred (100) hours under six (6) feet (one-thousand eight hundred thirty [1,830] mm) of water.
4. Ultraviolet light resistant.
5. Mildew resistant.
6. Non-staining to adjacent materials.
7. Non-bleeding, at up to two-hundred twelve (212) degrees Fahrenheit (one hundred [100] degrees Celsius) and twenty percent (20%) compression.
8. Resistant to gasoline, diesel fuel, jet fuel, solvents, salts, anti-freeze, industrial cleaners, corrosive vapors, and acids.
9. Flammability (UL 94): VO, self-extinguishing.
10. Tensile strength (ASTM D3574): 21.8 psi (one-hundred fifty [150] kPa), min.
11. Compression set (ASTM D3574): Two percent (2%), max.
12. Shear strength: Eight (8) N/cu cm, min.
13. Resistance to aging (ASTM G53, Eight-hundred twenty-five [825] hours): No more than minor surface degradation.
14. Softening point (ASTM D816): Fifty (50) degrees Celsius, minimum.
15. Flash point: Five-hundred ninety (590) degrees Fahrenheit (three-hundred ten [310] degrees Celsius), min.

B. Pourable Sealer: Provide Pourable Sealer in locations specifically referred to on the Contract Drawings. Pourable sealer shall not be used with Work associated with Section 07 55 56.13 – Hot-Applied Rubberized Asphalt Protected Membrane Roofing. Pourable Sealer shall be a high-performance, single component, polyurethane-base, self-leveling pitch pan sealant. Pourable Sealer shall be self-priming and shall require no mixing. Provide "Flex Pourable Sealant" as produced by Sonneborn or approved equal with the following properties:

Property	**Test Method**	**Result**
Service temperature range		-40° F to 180° F
Expected life		Up to 20 years
Shrinkage		None
Movement capability	ASTM C 719	±25%
Tensile strength	ASTM D 412	350 psi
Ultimate elongation at break	ASTM D 412	800%
Lower temperature flexibility	ASTM C 746	-40° F
Hardness at standard Conditions/Shore A	ASTM C 661	25 ±2
Accelerated weathering	Atlas 6500 – watt xenon arc	Excellent

VOC Content: 75.2 g/L or 0.63 lbs. of V.O.S. per gallon of material.

C. Metal trim used for pourable sealant containment pan shall be twenty (20) gauge material to match wall panels and shall be compatible with existing wall panel system and match in color. Shape and size shall be as indicated on the Contract Drawings.

D. Lead tee provide seven-eighths (7/8)-inch wide by one-half (1/2)-inch high purity grade level coping stone joint cover as manufactured by LITSCO, Phone: 800-221-0101 or approved equal.

2.4 FABRICATION / ASSEMBLING / FINISHES

A. Comply with sealant manufacturer's written instructions for mixing of two (2)-component sealants.

B. Thoroughly mix components before use.

C. Add entire contents of activator can to base containers. Do not mix partial units.

D. Mix contents for a minimum of five (5) minutes or as recommended by the sealant manufacturer, until color and consistency are uniform.

PART 3 - EXECUTION

3.1 EXAMINATION / PREPARATION

A. The Contractor shall examine the joint surfaces, substrates, backing, and anchorage of units forming sealant rabbet, and the conditions under which the caulking and sealant Work is to be performed, and notify Engineer in writing of any condition detrimental to the proper and timely completion of the Work and the performance of the sealant systems. Do not proceed with the caulking and sealant Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Clean joint surfaces immediately before installation of sealant compound. Remove dirt, insecure coatings, moisture, and other substances which would interfere with bonds of sealant compound as recommended by sealant manufacturer's written instructions.

C. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's written instructions indicate that alkalinity does not interfere with sealant bond and performance.

1. Etch with five percent (5%) solution of muriatic acid.
2. Neutralize with dilute ammonia solution.
3. Rinse thoroughly with water and allow to dry before sealant installation.

D. If necessary, clean porous materials such as concrete and masonry by grinding, abrasive blasting or mechanical abrading. Blow out joints with oil-free compressed air, or by vacuuming joints prior to application of primer or sealant.

E. Roughen joint surfaces on vitreous coated and similar non-porous materials, wherever sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or wool to produce a dull sheen.

3.2 INSTALLATION

A. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified.

B. Prime or seal the joint surfaces wherever recommended by the sealant manufacturer. Do not allow prime or sealer to spill or migrate onto adjoining surfaces. Allow primer to dry prior to application of sealants.

C. Apply masking tape before installation of primer, in continuous strips in alignment with the joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.

D. Do not install sealants without backer rods or bond breaker tape.

E. Roll the back-up rod stock into the joint to avoid lengthwise stretching. Do not twist, braid, puncture or prime backer-rods.

F. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

G. Install sealants to depths as recommended by the sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead.

1. For horizontal joints in sidewalks, pavements and similar locations sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to seventy-five percent (75%) of joint width, but not more than five-eighths (5/8)-inch deep or less than three-eighths (3/8)-inch deep.
2. For vertical joints subjected to normal movement and sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to fifty percent (50%) of joint width, but not more than one-half (1/2)-inch deep or less than one-quarter (1/4)-inch deep.

H. Remove excess and spillage of compounds promptly as the Work progresses.

I. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

J. Provide entry panels at all round penetrations in interior and exterior wall on both sides. For fire rated assemblies, provide complete fire stopping assembly in accordance with Section 07 84 00 – Firestopping prior to installation of entry panel. Provide complete sealant seal at round penetrations and perimeter of entry panels.

K. Pourable Sealer shall be set into a metal form containment pan secured to a substrate. Maximum thickness of pourable sealant shall be three-eighths (3/8)-inch and shall pitch toward the exterior of the structure. Pourable sealant shall be installed in accordance with manufacturer’s requirements.

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3.3 FIELD TESTING / QUALITY CONTROL

A. Where questions of compatibility of sealants and substrate arise the sealant manufacturer shall test the substrate in question for compatibility with the specified sealant and report his findings, with recommendations, to the Engineer. Any required sealant change shall be at no additional expense to DEP.

B. Do not proceed with installation of elastomeric sealants over joint surfaces which have been painted, lacquered, waterproofed or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with Paragraph 4.3.9 of ASTM C 920 has successfully demonstrated that sealant bond is not impaired by the coating or treatment. If laboratory test has not been performed, or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

C. After nominal cure of exterior joint sealants which are exposed to the weather, test for water leaks. Flood the joint exposure with water directed from a three-quarters (3/4)-inch garden hose, without nozzle, held perpendicular to wall face, two (2) feet from joint and connected to a water system with thirty (30) pounds per square inch minimum normal water pressure. Move stream of water along joint at an approximate rate of twenty (20) feet per minute.

D. Test approximately five percent (5%) of total joint system, in locations which are typical of every joint condition, and which can be inspected easily for leakage on opposite face. Conduct test in the presence of the Engineer, who will determine the actual percentage of joints to be tested and the actual period of exposure to water from the hose, based upon the extent of observed leakage, or lack thereof.

E. Where nature of observed leakage indicates the possibility of inadequate joint bond strength, Engineer may direct that additional testing be performed at a time when joints have been fully cured, followed by natural exposure through both extreme temperatures and returned to the lowest range of temperature in which it is feasible to conduct testing. Perform testing as directed at any time within twenty-four (24) months of installation date.

3.4 STARTUP / DEMONSTRATION

A. Not Used

3.5 ADJUSTING / PROTECTION / CLEANUP

A. Repair sealant installation at leaks or, if leakage is excessive, replace sealant installation as directed.

B. Clean adjacent surfaces of sealant or soiling resulting from the Work. Use solvent or cleaning agent recommended by the sealant manufacturer. Leave all finish Work in a neat clean condition.

C. Protect the sealants during the construction period so that they will be without deterioration, soiling, or damage at the time of DEP's Final Acceptance

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.
3. Solvent-based finish coatings.
4. Floor sealers and paints.
5. Dry fall coatings.

B. Related Requirements:

1. Section 028319 “Lead-Based Paint Remediation” for removal and disposal of existing paint films containing lead-based paint.
2. Section 051200 "Structural Steel Framing" for shop priming structural steel.
3. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
4. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
5. Section 055116 "Metal Floor Plate Stairs" for shop priming metal floor plate stairs.
6. Section 055119 "Metal Grating Stairs" for shop priming metal grating stairs.
7. Section 055213 "Pipe and Tube Railings" for pipe and tube railings.
8. Section 055313 "Bar Gratings” for shop priming metal gratings.
9. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
10. Section 099600 "High-Performance Coatings" for tile-like coatings.

C. Surfaces not included as part of field-applied finish work, unless otherwise indicated:

1. Pre-finished Items: Do not include painting when factory-finishing or installer-finishing is specified for such items, such as but not limited to architectural woodwork and casework, metal roof edging systems, pre-finished partition systems, acoustic materials, toilet enclosures, elevator entrance doors, frames, and equipment, and mechanical and electrical equipment, including, fixtures, switchgear, distribution cabinets, and light fixtures.
2. Concealed Surfaces: Finishing of walls and ceilings in concealed and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
3. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials.

4. Operating Parts: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motors, and fan shafts.
5. Code-required Labels: Do not paint over Underwriters' Laboratories, Warnock-Hershey or Factory Mutual labels, or any equipment identification, performance rating, name, or nomenclature plates.

1.3 DEFINITIONS

A. MPI Gloss Levels: Following define gloss levels according to ASTM D 523:

1. MPI Gloss Level 5 - Traditional Semi-Gloss Finish: 35 to 70 units at 60 degrees.
2. MPI Gloss Level 6 - Traditional Gloss: 70 to 85 units at 60 degrees.

B. Paint: Various coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials, whether used as prime, intermediate or finish coats.

C. Finished Areas: Interior rooms, areas, and spaces in which exposed surfaces are finished by Work of this Section or other Sections. Non-exposed spaces above suspended ceilings are not to be included as part of painting Work, unless otherwise indicated.

D. Utility Areas: Exterior and interior rooms, areas, and spaces dedicated for plumbing, mechanical, electrical, communication, and safety equipment.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Upon conclusion of painting, Contractor, paint manufacturer, or supplier shall submit a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal that includes:

1. Area Summary with finish schedule.
2. Area Detail designating where each product, color, and finish was used.
3. Product data pages and safety data sheets.
4. Care and cleaning instructions.
5. Touch-up procedures.

6. Color samples, 4 inches by 5 inches, of each color and finish.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Engineer will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Engineer will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Engineer at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

C. Lead Paint: Lead paint may be present in buildings and structures to be painted. A report on the presence of lead paint is on file for review and use. Examine report to become aware of locations where lead paint is present.

1. Do not disturb lead paint or items suspected of containing hazardous materials except under procedures specified in Section 028319 “Lead-Based Paint Abatement.”
2. Work associated with preparation for painting of substrates known to include lead paint and lead based paint abatement shall be provided in accordance with EPA Renovation, Repair and Painting Rule, additional requirements of authorities having jurisdiction, and as specified under provisions of Section 028319 “Lead-Based Paint Abatement.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Benjamin Moore & Company (BMC).
2. PPG Paints (PPG).
3. The Sherwin-Williams Company (SWC).

B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As indicated in a color schedule

2.3 MIXING

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogenous coating with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

B. Mix and prepare painting materials in accordance with manufacturer's directions.

C. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

D. Stir materials before application to produce a mixture of uniform density and stir during application. Do not stir surface film into material. Remove film and strain material before using.

E. Do not thin painting materials unless recommended by manufacturer. When paint thinning is required, comply with manufacturer's printed instructions; use only thinners approved by paint manufacturer.

2.4 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
2. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
3. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.
3. Wood: 15 percent.
4. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

1. Application of coating indicates acceptance of surfaces and conditions.
2. Repainting of Previously Painted Surfaces: Verify conditions and compatibility between new and existing painting products.

D. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with paint manufacturer's written preparation instructions and recommendations applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, rust, scale, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
2. Remove mildew, efflorescence, deleterious films, and foreign material from surface by appropriate methods as recommended by manufacturer.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

1. SSPC-SP 16, "Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. All Substrates: Remove foreign materials, dust, dirt, and other deleterious films that impairs bond of paints to substrates.

L. Previously Finished Surfaces: Comply with paint manufacturer's specifications appropriate for substrate to be coated, for proper preparation of previously finished surfaces.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
6. Comply with manufacturer's recommendations for drying time required between succeeding coats.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Engineer in writing of anticipated problems in using specified coating systems with substrates primed by others.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Engineer.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

F. Film Thickness: Apply paint in wet film thickness (WFT) recommended by paint manufacturer to achieve specified dry film thickness (DFT) for each coat of paint. Since DFT varies among manufacturers, this reference is not included in Article “Interior Painting Schedule.”

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Paragraphs below identify specific painting materials and appropriate specified painting system to be used on a particular substrate; actual substrate material surfaces for this Project shall be as indicated in this Interior Painting Schedule and as indicated on Drawings.

B. Concrete Substrates, Nontraffic Surfaces.

1. Latex System - Walls and Ceilings:

a. Prime Coat: Alkali resistant acrylic latex:

1) SWC: Loxon Concrete & Masonry Primer/Sealer, LX02-50 Series.
2) PPG: Perma-Crete Interior/Exterior Alkali Resistant Primer 4-603XI.
3) BMC: Ultra Spec 500 Interior Latex Primer N534.

b. Intermediate Coat: Latex, matching topcoat.
c. Topcoat: Acrylic latex enamel, semi-gloss finish (MPI Gloss Level 5):

1) SWC: ProMar 200 Zero VOC Latex Semi-Gloss, B31-12650 Series.
2) PPG: Speedhide Zero Interior Zero VOC Latex Semi-Gloss 6-4510XI.
3) BMC: Ultra Spec 500 Interior Semi-Gloss Finish N539.

d. Topcoat: Acrylic latex enamel, gloss finish (MPI Gloss Level 6):

1) SWC: ProMar 200 Zero VOC Latex Gloss, B21-12650 Series.
2) PPG: Speedhide Interior/Exterior Gloss 100% Acrylic 6-8534 Series.
3) BMC: Ultra Spec 500 Interior Gloss Finish N540.

2. Light Industrial Water Based System - Walls and Ceilings.

a. Prime Coat: Alkali resistant acrylic latex (MPI Gloss Level 1):

1) SWC: Loxon Concrete & Masonry Primer, LX02-50 Series.
2) PPG: Perma-Crete Interior/Exterior Alkali Resistant Primer 4-603XI.
3) BMC: Fresh Start Multi Purpose Primer 023.

b. Intermediate Coat: matching topcoat.
c. Topcoat: Acrylic epoxy enamel, semi-gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46-1150 Series.
2) PPG: Pitt-Glaze WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy 16-510 Series .
3) BMC: Corotech Pre-Catalyzed Waterborne Epoxy Semi- Gloss V341.

C. Concrete Substrates, Traffic Surfaces.

1. Concrete Stain System.

a. First Coat: Stain, interior, for concrete floors, matching topcoat.
b. Second Coat: Stain, interior, for concrete floors:

1) SWC: H&C Heavy Shield Water-Based Solid Color Concrete Stain
2) PPG: Perma-Crete Color Seal WB Acrylic Concrete Stain 4-4210 Series.
3) BMC: TuffCrete WB Acrylic Waterproofing Concrete Stain, CST-2XXX.

2. Clear Acrylic Sealer, Gloss Finish.

a. First Coat: Sealer, water-based, for concrete floors, matching topcoat.
b. Second Coat: Sealer, water-based, for concrete floors:

1) SWC: Clarishield Water-Based Wet-Look Sealer, 50.148154.
2) PPG: Perma-Crete Plex-Seal WB Int/Ext Clear Sealer, 4-6200.
3) BMC: TuffCrete Waterborne Acrylic Clear CST-2xxx.]

D. CMU Substrates.

1. Latex System - Walls:

a. Block Filler: Acrylic latex, interior/exterior:

1) SWC: PrepRite Block Filler, B25W25.
2) PPG: Speedhide Int/Ext Hi Fill Acrylic Latex Block Filler 6-15XI.
3) BMC: Corotech Acrylic Block Filler V114.

b. Primer: Alkali resistant, latex, flat:

1) SWC: Loxon Concrete & Masonry Primer, LX02-50 Series.
2) PPG: Perma-Crete Int/Ext Alkali Resistant Primer, 4-603XI.
3) BMC: Acrylic High-Build Masonry Primer, 609/K609.

c. Intermediate Coat: Latex, matching topcoat.
d. Topcoat: Acrylic latex enamel, semi-gloss finish (MPI Gloss Level 5):

1) SWC: ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-12650 Series.
2) PPG: Speedhide Zero Interior Zero VOC Latex Semi-Gloss 6-4510XI.
3) BMC: Ultra Spec 500 Interior Semi-Gloss Finish N539.

2. Light Industrial Water Based System - Walls:

a. Block Filler: Acrylic latex, interior/exterior:

1) SWC: Heavy Duty Block Filler - B42W46.
2) PPG: Speedhide Int/Ext Hi Fill Acrylic Latex Block Filler 6-15XI.
3) BMC: Corotech Acrylic Block Filler V114.

b. Primer: Alkali resistant, latex, flat.

1) SWC: Loxon Concrete & Masonry Primer, LX-50 Series.
2) PPG: Perma-Crete Int/Ext Alkali Resistant Primer, 4-603XI.
3) BMC: Acrylic High-Build Masonry Primer, 609/K609.

c. Intermediate Coat: Latex, matching topcoat.
d. Topcoat: Acrylic latex enamel, semi-gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46-1150 Series.
2) PPG: Pitt-Glaze WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy 16-510 Series.
3) BMC: Corotech Pre-Catalyzed Waterborne Epoxy Semi- Gloss V341.

3. High Performance, Two Component Water-Based Coating System - Walls:

a. Block Filler: Acrylic latex, interior/exterior:

1) SWC: Heavy Duty Block Filler, B42W46.
2) PPG: Speedhide Interior/Exterior Masonry Hi Fill Latex Block Filler, 6-15XI.
3) BMC: Corotech Waterborne Epoxy Block Filler V163.

b. Primer: Alkali resistant, latex, flat:

1) SWC: Loxon Concrete & Masonry Primer, LX02-50 Series.
2) PPG: Perma-Crete Int/Ext Alkali Resistant Primer, 4-603XI.
3) BMC: Fresh Start All Purpose Primer 023.

c. Intermediate Coat: Latex, matching topcoat.
d. Topcoat: Two component, water-based epoxy, eggshell finish (MPI Gloss Level 3):

1) SWC: Pro Industrial Waterbased Catalyzed Epoxy Eg-Shel, B73-360 Series.
2) PPG: Aquapon WB EP Two-Component Ultra Low VOC Water-Based Epoxy Semi-Gloss Coating 98E-1 / 98E-100 Series.
3) BMC: Corotech Pre-Catalyzed Waterborne Epoxy Eggshell V342.

e. Topcoat: Two component, water-based epoxy, gloss finish (MPI Gloss Level 6):

1) SWC: Pro Industrial Catalyzed Waterbased Epoxy Gloss, B73-300 Series.
2) PPG: Aquapon WB EP Two-Component Ultra Low VOC Water-Based Epoxy Gloss Coating 98E-1 / 98E-98 Series.
3) BMC: Corotech Waterborne Gloss Acrylic Epoxy V450.

E. Steel Substrates.

1. Latex System.

a. Prime Coat: Primer, rust-inhibitive, water-based:

1) SWC: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
2) PPG: Pitt-Tech Plus 4020 Int/Ext Primer DTM Industrial Enamel.
3) BMC: Latex Metal Primer HP04.

b. Prime Coat: Primer, alkyd, quick dry, for metal.

1) SWC: Kem Bond HS Metal Primer, B50WZ series.
2) PPG: Multiprime 4360 Int/Ext Alkyd Industrial Primer.
3) BMC: Coronado Rust Scat Alkyd Metal Primer #35.

c. Prime Coat: Primer, alkyd, anti-corrosive, for metal.

1) SWC: Kem Bond HS Metal Primer, B50WZ series.
2) PPG: Multiprime 4360 Int/Ext Alkyd Industrial Primer.
3) BMC: Alkyd Metal Primer P06.

d. Prime Coat: Shop primer specified in Section where substrate is specified.
e. Intermediate Coat: Matching topcoat.
f. Topcoat: Latex, interior, semi-gloss finish (MPI Gloss Level 5).

1) SWC: ProMar 200 Zero VOC Latex Semi-Gloss, B31-12650 Series.
2) PPG: Speedhide Zero Interior Zero VOC Latex Semi-Gloss 6-4510XI Series.
3) BMC: Ultra Spec 500 Interior Semi-Gloss Finish N539.

g. Topcoat: Latex, interior, gloss finish (MPI Gloss Level 6).

1) SWC: ProMar 200 Zero VOC Latex Gloss, B21-12650 Series.
2) PPG: Speedhide Int/Ext Gloss 100% Acrylic 6-8534 Series.
3) BMC: Ultra Spec 500 Interior Gloss Finish N540.

2. Light Industrial Water Based Alkyd System:

a. Prime Coat: Primer, rust-inhibitive, water-based:

1) SWC: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
2) PPG: Pitt-Tech Int/Ext WB Acrylic Primer DTM Industrial Enamel 90-712.
3) BMC: Acrylic Metal Primer HP04.

b. Prime Coat: Primer, epoxy, anti-corrosive, for metal:

1) SWC: Kem Bond HS Metal Primer, B50WZ series.
2) PPG: Multiprime 4360 Int/Ext Alkyd Industrial Primer.
3) BMC: Corotech Epoxy Mastic V160.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Matching topcoat.
e. Topcoat: Waterbased alkyd, interior, light industrial, semi-gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 series.
2) PPG: Pitt-Tech Plus Int/Ext Semi-Gloss DTM Industrial Enamel 90-1210 Series.
3) BMC: Ultra Spec DTM Semi-Gloss HP29.

f. Topcoat: Waterbased alkyd, interior, light industrial, gloss finish (MPI Gloss Level 6):

1) SWC: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 series.
2) PPG: Pitt-Tech Plus Int/Ext High Gloss DTM Industrial Enamel 90-1310 Series.
3) BMC: Ultra Spec DTM Gloss HP28.

3. High Performance, Two component Water Based Coating System:

a. Prime Coat: Primer, rust-inhibitive, water-based:

1) SWC: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
2) PPG: Pitt-Tech Plus 4020 Int/Ext Primer DTM Industrial Primer.
3) BMC: Acrylic Metal Primer HP04.

b. Prime Coat: Primer, epoxy, anti-corrosive:

1) SWC: Macropoxy 646 Fast Cure Epoxy, B58-600 series.
2) PPG: Pitt-Guard Rapid-Coat Direct-to-Rust Epoxy Mastic Coating 95-245 Series.
3) BMC: Corotech Epoxy Mastic V160.

c. Intermediate Coat: Matching topcoat.
d. Topcoat: Two component, water-based, gloss finish (Gloss Level 6).

1) SWC: Pro Industrial Waterbased Catalyzed Epoxy Gloss, B73-300 Series.
2) PPG: Aquapon WB EP Two-Component Ultra Low VOC Water-Based Epoxy Gloss Coating 98E-1 / 98E-98 Series.
3) BMC: Corotech Waterborne Gloss Acrylic Epoxy V450.

4. Water Based Dry-Fall System:

a. Prime Coat: Primer, rust-inhibitive, water-based:

1) SWC: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
2) PPG: Pitt-Tech Plus 4020 Int/Ext Primer DTM Industrial Primer.
3) BMC: Acrylic Metal Primer HP04.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal:

1) SWC: Kem Bond HS Metal Primer, B50WZ series.
2) PPG: Multiprime 4360 Int/Ext Alkyd Industrial Primer.
3) BMC: Alkyd Metal Primer P06.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Topcoat: Dry fall, latex, semi-gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Waterbased Dryfall Semi-gloss, B42-83 series.
2) PPG: Speedhide Super Tech WB Interior 100% Acrylic Dry-Fog Semi-Gloss Latex 6-724XI.
3) BMC: Super Kote 5000 Latex Dry Fall Semi-Gloss 112.

F. Galvanized-Metal Substrates:

1. Modified Alkyd System: Light Industrial Water Based Alkyd System.

a. Prime Coat: Primer, galvanized, water-based:

1) SWC: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
2) PPG: Pitt-Tech Plus 4020 WB Acrylic DTM Industrial Primer.
3) BMC: Latex Metal Primer HP04.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Water-based alkyd, interior, semi-gloss finish (MPI Gloss Level 5).

1) SWC: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150.
2) PPG: Speedhide Interior/Exterior WB Alkyd Semi-Gloss Enamel 6-1510XI Series.
3) BMC: Advance Semi-Gloss Waterborne Alkyd 793.

d. Topcoat: Water-based alkyd, interior, gloss finish (MPI Gloss Level 6).

1) SWC: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 series.
2) PPG: Speedhide Interior/Exterior WB Alkyd Gloss Enamel 6-1610XI.
3) BMC: Advance High Gloss Waterborne Alkyd N794.

2. High Performance Two-Component Water Based Epoxy Coating System:

a. Prime Coat: Primer, galvanized, water-based:

1) SWC: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
2) PPG: Pitt-Tech Plus 4020 WB Acrylic DTM Industrial Primer.
3) BMC: Acrylic Metal Primer HP04.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Two component water-based epoxy gloss finish (MPI Gloss Level 6).

1) SWC: Pro Industrial Waterbased Catalyzed Epoxy Gloss, B73-300 Series.
2) PPG: Aquapon WB EP Two-Component Ultra Low VOC Water-Based Epoxy Gloss Coating 98E-1 / 98E-98 Series.
3) BMC: Corotech Waterborne Gloss Acrylic Epoxy V450.

3. Water Based Dry-Fall System:

a. Prime Coat: Dry fall, water-based, for galvanized steel, matching topcoat.
b. Topcoat: Dry fall, water-based, for galvanized steel, flat (MPI Gloss Level 1).

1) SWC: Pro Industrial Waterbased Dryfall Flat, B42-81 series.
2) PPG: Speedhide Super Tech Interior Dry-Fog Flat Latex 6-725XI Series.
3) BMC: Super Kote 5000 Latex Dry Fall Flat N110.

G. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Light Industrial Water Based Alkyd System:

a. Prime Coat: Primer, water-based for aluminum:

1) SWC: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
2) PPG: Pitt-Tech Plus 4020 WB Acrylic DTM Industrial Primer.
3) BMC: Acrylic Latex Metal Primer HP04.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Water-based alkyd, interior, gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 series.
2) PPG: Speedhide Interior/Exterior WB Alkyd Gloss Enamel 6-1610XI Series.
3) BMC: Advance High Gloss Waterborne Alkyd N794.

2. High Performance, Two Component, Water Based Coating System:

a. Prime Coat: Primer, water-based for aluminum:

1) SWC: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.
2) PPG: Pitt-Tech Plus 4020 WB Acrylic DTM Industrial Primer.
3) BMC: Acrylic Latex Metal Primer HP04.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Two component, water-based epoxy, interior, gloss finish (MPI Gloss Level 6):

1) SWC: Pro Industrial Waterbased Catalyzed Epoxy Gloss, B73-300 Series.
2) PPG: Aquapon WB EP Two-Component Ultra Low VOC Water-Based Epoxy Gloss Coating 98E-1 / 98E-98 Series.
3) BMC: Corotech Waterborne Gloss Acrylic Epoxy V450.

H. Wood Substrates: Glued-laminated construction.

1. Latex over Latex Primer System:

a. Prime Coat: Primer sealer, latex, interior wood:

1) SWC: PrepRite ProBlock Int./Ext. Primer/Sealer, B51-620 series.
2) PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
3) BMC: Sure Seal Latex Primer Sealer 027.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Acrylic latex, interior, semi-gloss finish (MPI Gloss Level 5):

1) SWC: ProMar 200 HP Zero VOC Latex Semi-Gloss, B31W1950 series.
2) PPG: Speedhide Zero Interior Zero VOC Latex Semi-Gloss 6-4510XI Series.
3) BMC: Ultra Spec 500 Interior Gloss, N539.

2. Light Industrial Water Based Alkyd System:

a. Prime Coat: Primer, acrylic latex, for interior wood:

1) SWC: PrepRite ProBlock Int./Ext. Primer/Sealer, B51-620 series.
2) PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
3) BMC: Fresh Start All Purpose Primer 023.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Water-based alkyd, interior, semi-gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150.
2) PPG: Speedhide Interior/Exterior WB Alkyd Semi-Gloss Enamel 6-1510XI Series.
3) BMC: Advance Semi-Gloss Waterborne Alkyd 793.

d. Topcoat: Water-based alkyd, interior, gloss finish (MPI Gloss Level 6):

1) SWC: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 series.
2) PPG: Speedhide Interior/Exterior WB Alkyd Gloss Enamel 6-1610XI Series.
3) BMC: Advance High Gloss Waterborne Alkyd N794.

I. Wood Substrates: Exposed framing.

1. Light Industrial Water Based Alkyd System:

a. Prime Coat: Primer, acrylic latex, for interior wood:

1) SWC: PrepRite ProBlock Int./Ext. Primer/Sealer, B51-620 series.
2) PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
3) BMC: Fresh Start All Purpose Primer 023.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Water-based alkyd, interior, semi-gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150.

2) PPG: Speedhide Interior/Exterior WB Alkyd Semi-Gloss Enamel 6-1510XI Series.
3) BMC: Advance Semi-Gloss Waterborne Alkyd 793.

d. Topcoat: Water-based alkyd, interior gloss finish (MPI Gloss Level 6):

1) SWC: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 series.
2) PPG: Speedhide Interior/Exterior WB Alkyd Gloss Enamel 6-1610XI Series.
3) BMC: Advance High Gloss Waterborne Alkyd N794.

J. Wood Substrates:

1. Latex over Latex Primer System:

a. Prime Coat: Primer sealer, acrylic latex, interior:

1) SWC: PrepRite ProBlock Int./Ext. Primer/Sealer, B51-620 series.
2) PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
3) BMC: Fresh Start All Purpose Primer 023.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Acrylic latex, interior, semi-gloss finish (MPI Gloss Level 5):

1) SWC: ProMar 200 HP Zero VOC Latex Semi-Gloss, B31W1950 series.
2) PPG: Speedhide Zero Interior Zero VOC Latex Semi-Gloss 6-4510XI Series.
3) BMC: Ultra Spec 500 Interior Semi-Gloss Finish N539.

2. Light Industrial Water Based Alkyd System:

a. Prime Coat: Primer, acrylic latex, for interior wood:

1) SWC: PrepRite ProBlock Int./Ext. Primer/Sealer, B51-620 series.
2) PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
3) BMC: Fresh Start All Purpose Primer 023.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Water-based alkyd, interior, semi-gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150.
2) PPG: Speedhide Interior/Exterior WB Alkyd Semi-Gloss Enamel 6-1510XI Series.
3) BMC: Advance Semi-Gloss Waterborne Alkyd 793.

d. Topcoat: Water-based alkyd , interior, gloss finish (MPI Gloss Level 6).

1) SWC: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 series.
2) PPG: Speedhide Interior/Exterior WB Alkyd Semi-Gloss Enamel 6-1510XI Series.
3) BMC: Advance High Gloss Waterborne Alkyd N794.

K. Plastic Substrates:

1. Latex System:

a. Prime Coat: Primer, bonding, water-based:

1) SWC: Extreme Bond Primer, B51-150.
2) PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
3) BMC: Stix Waterborne Bonding Primer SXA-110.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Latex, interior, semi-gloss finish (MPI Gloss Level 5):

1) SWC: ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-12650 Series.
2) PPG: Speedhide Zero Interior Zero VOC Latex Semi-Gloss 6-4510XI Series.
3) BMC: Ultra Spec 500 Interior Semi-Gloss Finish N539.

2. Light Industrial Water Based System:

a. Prime Coat: Primer, bonding, water-based:

1) SWC: Extreme Bond Primer, B51-150.
2) PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
3) BMC: Stix Waterborne Bonding Primer SXA-110.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Acrylic epoxy, interior, semi-gloss finish (MPI Gloss Level 5):

1) SWC: Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-gloss, K46-1150 Series.
2) PPG: Pitt-Glaze WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy 16-510 Series.
3) BMC: Corotech Pre-Catalyzed Waterborne Epoxy Semi Gloss V341.

L. Gypsum Board Substrates:

1. Latex over Latex Sealer System:

a. Prime Coat: Primer sealer, latex, interior.

1) SWC: ProMar 200 Zero VOC Latex Primer, B28-2600.
2) PPG: Speedhide Zero Interior ZERO VOC Latex Sealer 6-4900XI.
3) BMC: Ultra Spec 500 Interior Primer N534.

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Latex, interior, semi-gloss finish (MPI Gloss Level 5):

1) SWC: ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-12650 Series.
2) PPG: Speedhide Zero Interior Zero VOC Latex Semi-Gloss 6-4510XI Series.
3) BMC: Ultra Spec 500 Interior Semi-Gloss Finish N539.

2. Latex over Alkali Resistant Primer System - Plaster Only:

   a. Prime Coat: Primer sealer, alkali-resistant, interior:

      1) SWC: Loxon Concrete & Masonry Primer, LX02-50 series.
      2) PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
      3) BMC: Fresh Start All Purpose Primer 023.

   b. Intermediate Coat: Matching topcoat.
      Topcoat: Latex, interior, semi-gloss finish (MPI Gloss Level 5):

      1) SWC: ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-12650 Series.
      2) PPG: Speedhide Zero Interior Zero VOC Latex Semi-Gloss 6-4510XI Series.
      3) BMC: Ultra Spec 500 Interior Semi-Gloss Finish N539.

3. Light Industrial Water Based System:

   a. Prime Coat: Primer sealer, interior:

      1) SWC: ProMar 200 Zero VOC Latex Primer, B28-2600.
      2) PPG: Speedhide Interior Latex Sealer 6-2.
      3) BMC: Ultra Spec 500 Interior Primer N534.

   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Acrylic epoxy, interior, semi-gloss finish (MPI Gloss Level 5):

      1) SWC: Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-gloss, K46-1150 Series.
      2) PPG: Pitt-Glaze WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy 16-510 Series.
      3) BMC: Ultra Spec 500 Interior Semi-Gloss Finish N539.

4. High-Performance, Two Component Water Based Coating System:

   a. Prime Coat: Primer sealer, latex, interior:

      1) SWC: ProMar 200 Zero VOC Latex Primer, B28-2600.
      2) PPG: Speedhide Interior Latex Sealer 6-2.
      3) BMC: Fresh Start All Purpose Primer 023.

   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Two component, interior, water-based epoxy, gloss finish (MPI Gloss Level 6).

      1) SWC: Pro Industrial Waterbased Catalyzed Epoxy Gloss, B73-300 Series.
      2) PPG: Aquapon WB EP Two-Component Ultra Low VOC Water-Based Epoxy Gloss Coating 98E-1 / 98E-98 Series.
      3) BMC: Corotech Waterborne Gloss Acrylic Epoxy V450.

3.7 INTERIOR MICROBICIDAL PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.

a. Prime Coat: Primer sealer, latex:

1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300.

b. First Coat: Microbicidal Latex, matching topcoat.
c. Topcoat: Microbicidal Latex, eggshell finish (MPI Gloss Level 3):

1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51. Brush and roll application only.

B. CMU Substrates:

1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.

a. Block Filler: Latex, interior/exterior, one or two coats as required:

1) S-W Loxon Block Surfacer, A24W200.

b. First Coat: Microbicidal Latex, matching topcoat.
c. Topcoat: Microbicidal Latex, eggshell finish (MPI Gloss Level 3):

1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51. Brush and roll application only.

END OF SECTION 099123

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SECTION 099679 – ATMOSPHERIC PROTECTION AND PLANT SERVICE AREAS COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems for water and wastewater treatment on the following substrates:

1. Interior Substrates:

a. Concrete vertical and horizontal surfaces.
b. Concrete masonry units CMUs.
c. Steel.
d. Ductile or cast iron.
e. Galvanized steel.
f. Plastic substrate.

B. Related Requirements:

1. Section 028319 “Lead-Based Paint Remediation” for removal and disposal of existing paint films containing lead-based paint.
2. Section 051200 "Structural Steel Framing for shop priming of structural steel with primers specified in this Section.
3. Section 055213 "Pipe and Tube Railings" for pipe and tube railings with coatings specified in this Section.
4. Section 099100 "Painting" for general field painting.
5. Section 099123 "Interior Painting" for general field painting.

1.3 DEFINITIONS

A. MPI Gloss Level 5 - Traditional Semi-Gloss Finish: 35 to 70 units at 60 degrees.

B. MPI Gloss Level 6 - Traditional Gloss: 70 to 85 units at 60 degrees.

C. Severe Exposure: An aggressively corrosive industrial or predominantly chemical environment with regular exposure to strong chemical fumes, mists, and dust is considered a severe environment. In an industrial setting, a severe environment is one with sustained exposure to high humidity and condensation that results in heavy development of mold and mildew. Frequent spilling and splashing of strong chemicals (acids, alkalis, oxidizers, and solvents) are also characteristic of a severe environment. Metal corrosion can be expected in a severe environment. Immersion conditions, marine environment with sustained exposure to saltwater

spray, and arctic environment with long periods of extremely low temperature are considered severe environments. These are areas where if no high-performance coatings are applied on steel or concrete, very early failure and structural damage will be evident.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on actual substrate material to be coated, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Use same designations indicated on Drawings and in Atmospheric Protection Coating Schedule and Plant Service Areas Coating Schedule. Include color designations and product runs (batch numbers).

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from the same production run (batch number), that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Engineer will select one surface to represent surfaces and conditions for application of each coating system.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Engineer will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Engineer at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.
3. Deliver materials on site in factory sealed containers from the manufacturer. Do not use materials from previous jobs.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are within the coatings manufacturer's recommendations.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point and rising; or to damp or wet surfaces.

C. Lead Paint: Lead paint may be present in buildings and structures to be painted. A report on the presence of lead paint is on file for review and use. Examine report to become aware of locations where lead paint is present.

1. Do not disturb lead paint or items suspected of containing hazardous materials except under procedures specified in Section 028319 "Lead-Based Paint Abatement."
2. Work associated with preparation for painting of substrates known to include lead paint and lead based paint abatement shall be provided in accordance with EPA Renovation, Repair and Painting Rule, additional requirements of authorities having jurisdiction, and as specified under provisions of Section 028319 "Lead-Based Paint Abatement."

D. Do not apply exterior coatings in snow, rain, fog, mist, and in conditions that do not meet the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Carboline Company (CAR).
2. PPG Paints (PPG).
3. The Sherwin-Williams Company (SWC).
4. Tnemec Company, Inc. (TNE).

2.2 HIGH-PERFORMANCE COATINGS

A. Material Compatibility:

1. Each coating system within indicated substrates uses compatible material with one another, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Topcoat manufacturer recommends products in writing for use in each coating system coat and on indicated substrate.

B. Colors: As indicated in color schedule.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, both coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. CMUs: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

1. Application of coating indicates acceptance of surfaces and conditions.
2. Recoating of Previously Coated Surfaces: Verify conditions and compatibility between new and existing high-performance coating products.

D. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be coated.

1. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
2. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed.
3. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 310.2R.
2. Prepare substrate with manufacturer’s recommended Concrete Surface Profile (CSP) based on coating system to be applied:

    a. High-build coatings, 10 to 40 mils: CSP 3 to CSP 5.
    b. Self-leveling toppings, 50 mils to 1/8-inch: CSP 4 to CSP 6.

E. Masonry Substrates: Remove efflorescence and chalk.

1. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
2. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by manufacturer but not less than the following:

1. SSPC-SP 11, "Power Tool Cleaning to Bare Metal.”
2. NAPF 500-03, “Surface Preparation Standard for Ductile Iron Pipe and Cast Ductile Iron Fittings.”

G. Plastic Substrates: Solvent wipe per SSPC-SP1 to remove dirt, grease, and any other surface contamination. Lightly abrade entire surface and repeat solvent wipe process.

3.3 APPLICATION

A. Apply high-performance coatings in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

E. Film Thickness: Apply paint in wet film thickness (WFT) recommended by high-performance manufacturer to achieve specified dry film thickness (DFT) for each coat of paint. Since DFT varies among manufacturers, this reference is not included in Article “Atmospheric Protection Coating Schedule and Plant Service Areas Coating Schedule.”

3.4 FIELD QUALITY CONTROL FOR CONCRETE AND CONCRETE MASONRY UNIT SUBSTRATES

A. General: Field quality control referenced in this Article includes testing of both pre-application quality assurance and post-application quality control of high-performance coatings. Employ approved testing and inspecting agency to perform quality assurance and quality control.

1. Perform Quality Control Testing in the order identified in the following subparagraph.

a. Testing Order: pH Testing, Surface Profile Testing, and Moisture Testing, followed by Dry Film Thickness Testing, Adhesion Testing, and Holiday Testing.
b. Repair substrate, touch up, and restore coated surfaces damaged by testing.
c. If test results show that dry film thickness, holiday, and pull-off strength of applied coating does not comply with coating manufacturer’s written instructions, pay for testing, and apply additional coats as needed to provide dry film thickness, pull-off strength that complies with coating manufacturer's written instructions.

B. Quality Assurance Testing:

1. Surface Preparation Testing:

a. Inspect and test condition of substrate for compliance with coating manufacturer's requirements.
b. Measure surface profile using International Concrete Repair Institute (ICRI) 310.2 Comparator Coupons.
c. Test concrete cleanliness by measuring the pH of the moisture in the concrete capillaries.

1) pH of New Concrete: 12 to 13.
2) pH of Concrete Subjected to Acid Attack: 9.0 minimum.

C. Quality Control Testing:

1. Dry Film Thickness Testing:

a. Inspect and test coatings for dry film thickness per ASTM D6132.

2. Adhesion Testing:

a. Field test pull-off strength of coatings on concrete using portable pull-off adhesion testers. Comply with ASTM D7234. Minimum adhesion of 200 psi with failure in the concrete substrate (concrete over 90 percent of the load fixture surface).

3. Holiday Testing:

a. Field test continuity verification of coatings applied to concrete substrates. Discontinuities include pinholes, internal voids, holidays, cracks, and conductive inclusions. Comply with ASTM D4787.

3.5 FIELD QUALITY CONTROL FOR STEEL, DUCTILE OR CAST IRON, GALVANIZED STEEL, AND PLASTIC SUBSTRATES

A. General: Field quality control referenced in this Article includes testing of both pre-application quality assurance and post-application quality control of high-performance coatings. Employ approved testing and inspecting agency to perform quality assurance and quality control.

1. Perform Quality Control Testing in the order identified in the following subparagraph.

a. Testing Order: Dry Film Thickness Testing, Adhesion Testing, then Holiday Testing.

2. Repair substrate, touch up, and restore coated surfaces damaged by testing.
3. If test results show that dry film thickness, holiday, and pull-off strength of applied coating does not comply with coating manufacturer's written instructions, pay for testing, and apply additional coats as needed to provide dry film thickness and pull-off strength that complies with coating manufacturer's written instructions.
4. Owner or Owner's representative will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating.

B. Quality Assurance Testing:

1. Surface Preparation Testing:

a. Test surface profile of abrasive blasted surfaces with “Press-O-Film” tester tape or equivalent in accordance with NACE RP0287.
b. Provide tester tape suitable for the intended profile height.
c. Measure profile to a minimum tolerance of 0.1 mils, maximum.
d. Use electronic surface profilometers necessary to verify tester tape measurements.

C. Quality Control Testing:

1. Dry Film Thickness Testing:

a. Inspect and test coatings for dry film thickness per ASTM D7091 or ASTM D6132.

2. Adhesion Testing:

a. General:

1) Test a minimum of two pipes for adhesion from each lot of pipes to be coated up to 3,000 square feet of pipe. Conduct an additional adhesion test on every increment up to 2,000 square feet of pipe coated in excess of the first 3,000 square feet of pipe (i.e., if one workday of production is 7,000 square feet of pipe, four adhesion tests will be conducted on the pipe lot.). Conduct adhesion testing on not less than 50 percent of each pipe produced within a lot.
2) A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not exceeding 12 hours.
3) Perform adhesion tests not less than 24 hours after coating application. Tests conducted prior to 24 hours will be acceptable only if test meets or exceeds adhesion criteria specified and the test was requested by Owner.
4) Randomly select pipe for adhesion testing. Owner reserves the right to perform adhesion testing at any time or location.

b. Rejection of Coating:

1) If any coatings within a lot fails to meet test criteria specified for coating type, those coatings are considered rejected along with all other coatings within the lot. Each coating within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in conformance with test procedures and criteria specific for the coating type.
2) Rejected coatings shall have all coating removed from full pipe length, pipe abrasive blasted, and recoated.

3. Holiday Testing:

a. Conduct holiday tests on completed coatings after cure or 24-hours, whichever is less. Provide a high voltage testing equipment and test in accordance with NACE SP0274 and the Specifications.

b. Use actual coating thickness for holiday testing.
c. Provide holiday detector with an audible signal when contact is made between pipeline and electrode at coating holidays (defects). Provide a good ground and a low electrical resistance between pipeline and detector. Make only direct connections to uncoated areas or to pipe ends at holdback areas.
d. Clean and dry pipe surface when testing. Always keep electrode in motion and in firm contact with coated surface while test voltage is being applied. Move electrode evenly over the surface at approximately 0.5 to 1 fps. Do not exceed 1 fps of travel time.
e. Mark location of detected holidays for repair. Retest after making necessary repairs.

3.6 CLEANING AND PROTECTION

A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.7 ATMOSPHERIC PROTECTION COATING SCHEDULE

A. Exterior Weathering and Protection: Non-submerged and atmospheric service.

1. Concrete Substrates: Moderate to Severe Exposure.

a. High-Performance Epoxy Acrylic Polyurethane System:

1) Prime Coat:

a) PPG: Aquapon WB-EP.
b) SWC: Loxon Conditioner.
c) TNE: Series 66.

2) Intermediate Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

3) Topcoat: (MPI Gloss Level 6).

a) CAR: Carbothane 134 HG.
b) PPG: Pitthane Ultra.
c) SWC: Acrolon Ultra.

d) TNE: Series 1074.

2. Masonry Substrates: Mild to Moderate Exposure.

a. Acrylic Polyurethane over Epoxy System:

1) Prime Coat:

a) CAR: Sanitile 500.
b) PPG: 4-100XI.
c) SWC: Loxon Block Surfacer.
d) TNE: Series 130.

2) Intermediate Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646 FC.
d) TNE: Series 66.

3) Topcoat: (MPI Gloss Level 5 or 6).

a) CAR: Carbothane 134 series.
b) PPG: Pitthane Ultra.
c) SWC: Acrolon Ultra.
d) TNE: Series 1094.

3. Steel Substrates: Moderate to Severe Exposure.

a. Pigmented Polyurethane over Self-Priming Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 60/Carboguard 635VOC.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646 PW.
d) TNE: Series 66.

2) Intermediate Coat:

a) CAR: Carboguard 60/Carboguard 635VOC.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646 PW.
d) TNE: Series 66.

3) Topcoat: (MPI Gloss Level 6).

a) CAR: Carbothane 134 UV Ultra.
b) PPG: Pitthane Ultra.
c) SWC: Acrolon 218.
d) TNE: Series 1094.

4. Ductile Iron or Cast-Iron Substrates: Moderate to Severe Exposure.

   a. Polyurethane over Epoxy System:

      1) Prime Coat:

         a) CAR: Carboguard 60/Carboguard 635VOC.
         b) PPG: Amerlock 2/2 VOC/400/600.
         c) SWC: Macropoxy 646 FC Epoxy.
         d) TNE: Series 66.

      2) Topcoat: (MPI Gloss Level 6).

         a) CAR: Carbothane 134 series.
         b) PPG: Pitthane Ultra.
         c) SWC: Acrolon 218.
         d) TNE: Series 1074.

   b. Polysiloxane System:

      1) Prime Coat:

         a) CAR: Carboguard 890.
         b) PPG: Amerlock 2/2 VOC/400/600.
         c) SWC: Macropoxy 646 FC Epoxy.
         d) TNE: Series 66.

      2) Topcoat: (MPI Gloss Level 6).

         a) CAR: Carboxane 2000 Series.
         b) PPG: PSX 700/805/ONE 750.
         c) SWC: Sher-Loxane 800.
         d) TNE: Series 740.

5. Galvanized Metal Substrates: Mild to Moderate Exposure.

   a. Pigmented Polyurethane over Epoxy System:

      1) Prime Coat:

         a) CAR: Carboguard 60/Carboguard 635VOC.
         b) PPG: Amerlock 2/2 VOC/400/600.
         c) SWC: Macropoxy 646.
         d) TNE: Series 66.

      2) Topcoat: (MPI Gloss Level 6).

         a) CAR: Carbothane 134 Series (Gloss) or Carbothane 133 Series (Satin).
         b) PPG: Pitthane Ultra.
         c) SWC: Acrolon Ultra.
         d) TNE: Series 1094.

b. Polysiloxane over Epoxy system:

1) Prime Coat:

a) CAR: Carboguard 890.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboxane 2000 Series.
b) PPG: PSX 700/805/ONE 750.
c) SWC: Sher-Loxane 800.
d) TNE: Series 690.

6. Plastic Piping and, where scheduled to be painted, plastic components. Note: Provide UV and weather protection for plastic coating system.

a. Polyurethane over Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 890.
b) PPG: Amerlock 2/400.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carbothane 133HB.
b) PPG: Pitthane Ultra.
c) SWC: Acrolon 218.
d) TNE: Series 1094.

3.8 PLANT SERVICE AREAS COATING SCHEDULE

A. Miscellaneous Interior Process Support Areas, Non-submerged Surfaces, Mild to Moderate Exposure:

1. Concrete Substrates:

a. Water based Acrylic System:

1) Prime Coat:

a) PPG: Pitt-tech Plus EP Primer/Finish.
b) SWC: Loxon Conditioner.
c) TNE: Series 1254.

2) Intermediate Coat:

a) CAR: Sanitile 3359.
b) PPG: Pitt-tech Plus EP Primer/Finish.
c) SWC: Pro Industrial HP Acrylic.
d) TNE: Series 1028.

3) Topcoat: (MPI Gloss Level 5 or 6).

a) PPG: Pitt-Tech Plus.
b) SWC: Pro Industrial HP Acrylic.
c) TNE: Series 1028.

b. Cross-linked, Water Based Epoxy System:

1) Prime Coat:

a) PPG: Aquapon WB EP.
b) SWC: Loxon Conditioner.
c) TNE: Series 27WB.

2) Intermediate Coat:

a) PPG: Aquapon WB EP.
b) SWC: Pro Industrial Wb Cat Epoxy.
c) TNE: Series 27WB.

3) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboseal 555.
b) PPG: Aquapon WB EP.
c) SWC: Pro Industrial Wb Cat Epoxy.
d) TNE: Series 114.

c. Modified Polyester- Polyurethane over Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

2) Intermediate Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

3) Topcoat: (MPI Gloss Level 6).

a) PPG: Amershield VOC.
b) SWC: Polylon HP.

c) TNE: Series 290.

2. Masonry Substrates:

a. Cross-linked, Water Based Epoxy System:

1) Prime Coat:

a) PPG: 4-100XI.
b) SWC: Loxon Block Surfacer.
c) TNE: Series 1254.

2) Intermediate Coat:

a) PPG: Aquapon WB EP.
b) SWC: Pro Industrial Wb Cat Epoxy.
c) TNE: Series 114.

3) Topcoat: (MPI Gloss Level 5 or 6).

a) CAR: Carboseal 555.
b) PPG: Aquapon WB EP.
c) SWC: Pro Industrial Wb Cat Epoxy.
d) TNE: Series 114.

b. Polysiloxane System:

1) Prime Coat:

a) PPG: 4-100XI.
b) SWC: Loxon Block Surfacer.
c) TNE: Series 1254.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboxane 2000.
b) PPG: PSX700/805.
c) SWC: Sher-Loxane 800.
d) TNE: Series 740.

3. Steel Substrates:

a. Polyamide Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 600.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 5).

a) CAR: Carboguard 635 VOC.
b) PPG: Amerlock 600.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

b. Polysiloxane System:

1) Prime Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboxane 2000.
b) PPG: PSX 700/805/ONE 750.
c) SWC: Sher-Loxane 800.
d) TNE: Series 740.

4. Ductile Iron or Cast-Iron Substrates: Interior Atmospheric Pipe Exposure.

a. Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 5).

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

b. Urethane Over Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carbothane 134 series.
b) PPG: Pitthane Ultra.

c) SWC: Acrolon 218.
d) TNE: Series 1094.

c. Polysiloxane System:

1) Prime Coat:

a) CAR: Carboguard 60/Carboguard 635.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboxane 2000.
b) PPG: PSX 700/805/ONE 750.
c) SWC: Sher-Loxane 800.
d) TNE: Series 740.

5. Galvanized Metal Substrates:

a. Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 5).

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

b. Polysiloxane System:

1) Prime Coat:

a) CAR: Carboguard 60.
b) PPG: Amerlock 2/2 VOC/400/600.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboxane 2000.
b) PPG: PSX 700/805/ONE 750.
c) SWC: Sher-Loxane 800.
d) TNE: Series 740.

B. Interior Flooring, Non-submerged Surfaces: Flooring subject to corrosive fumes, washdown, and splashing from chemical leaks and spills. Mild to Moderate Exposure.

1. Concrete Substrates:

a. Self-leveling Epoxy System:

1) Prime Coat:

a) CAR: Carboseal 720 series.
b) PPG: PPG Flooring 912 LV.
c) SWC: GP3579.
d) TNE: Series 201.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboseal 745.
b) PPG: PPG Flooring 610 SL.
c) SWC: GP 4850.
d) TNE: Series 237.

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SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze lift check valves.
2. Iron swing check valves with closure control.
3. Iron, grooved-end swing check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
b. Milwaukee Valve Company.
c. WATTS; A Watts Water Technologies Company.
d. Zurn; Zurn Elkay.

2. Description:

a. Standard: MSS SP-80, Type 1.

b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B61 or ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

2.3 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Iron Swing Check Valves with Lever- and Spring-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
b. Milwaukee Valve Company.
c. WATTS; A Watts Water Technologies Company.
d. Zurn; Zurn Elkay.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A126, gray iron with bolted bonnet.
e. Ends: Flanged or threaded. See valve schedule articles.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed exterior lever and weight.

2.4 IRON, GROOVED-END SWING CHECK VALVES

A. Iron, Grooved-End Swing Check Valves, 300 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ASC Engineered Solutions.
b. Anvil; an ASC Engineered Solution.
c. Victaulic Company.

2. Description:

a. CWP Rating: 300 psig.
b. Body Material: ASTM A536, ductile iron.
c. Seal: EPDM.
d. Disc: Spring operated, ductile iron or stainless steel.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat check valves.
c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 and Larger: Flanged.
4. For Steel Piping, NPS 2 and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
6. For Steel Piping, NPS 5 and Larger: Flanged.
7. For Grooved-End Steel Piping: Grooved.

END OF SECTION 220523.14

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SECTION 220523.15 - GATE VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Iron gate valves.
2. Chainwheels.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. RS: Rising stem.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. RS Valves in Insulated Piping: With 2-inch stem extensions.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 IRON GATE VALVES

A. Iron Gate Valves, NRS, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
b. Jenkins Valves; a Crane Co. brand.
c. Wilkins; Zurn Elkay.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.

c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

B. Iron Gate Valves, OS&Y, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
b. Milwaukee Valve Company.
c. WATTS; A Watts Water Technologies Company.
d. Zurn; Zurn Elkay.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.3 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries; Rotork.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.

1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc or epoxy coating.
2. Chain: Hot-dip galvanized steel, of size required to fit sprocket rim.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Use gate valves for shutoff service only.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

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C. For Grooved-End Steel Piping: Valve ends may be grooved.

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Metal framing systems.
3. Thermal hanger-shield inserts.
4. Fastener systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

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1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Thomas & Betts Corporation; A Member of the ABB Group.
    b. Atkore International (Unistrut).
    c. Eaton (B-line).

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted stainless-steel, Type 304 channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors

1. Fastening to Concrete Substrate: Zinc plated carbon steel wedge type anchors, complete with zinc plated nuts and washers, unless otherwise noted.
2. Submerged or Weather Exposed Substrates: ASTM A276 Type 316 stainless steel wedge type anchors, complete with Type 316 stainless steel nuts and washers, unless otherwise noted.
3. Meet ICC ES AC01 or ICC ES AC193.
4. Length: When length or anchor embedment is not indicated, provide length sufficient to place the wedge and expansion cone portion of the anchor at least 1 inch behind concrete reinforcing steel.
5. Basis-of-Design:

    a. Anchorage designs indicated are based on Hilti, Kwik-Bolt TZ, unless otherwise noted.
    b. Acceptable Anchors: Hilti Kwik-Bolt TZ; Simpson Strong-Tie Strong Bolt 2 Wedge Anchor; DeWalt Power-Stud+ SD1; DeWalt Power-Stud+ SD6 for stainless steel; or equal.

B. Adhesive Anchoring System

1. Fastening to Concrete Substrate: Manufactured system consisting of post installed threaded rods, nuts, washers, other anchoring hardware, and chemical dispenser for installation in hammer drilled holes.

    a. Anchors: Meet ICC ES AC308.
    b. Injection Adhesive: Two-component epoxy system consisting of a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate.

c. Adhesive Cartridge: Side-by-side design to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
d. Anchor: Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.

1) Basis-of-Design:

a) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.
b) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie SET-3G; ITW Ramset Red Head Epcon G5+; or equal.

e. Reinforcing Bar Dowels: Reinforcing bar, per Section 033000.

1) Basis-of-Design:

a) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.
b) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie SET-3G; ITW Ramset Red Head Epcon G5; or equal.

2. Fastening to Hollow Concrete Block: Three-part threaded rod, screen tube, and chemical dispenser anchoring system.

a. Anchors: Meet ICC ES AC58.
b. Adhesive Cartridges: Contain pre-measured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser.
c. Anchor: Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.
d. Reinforcing Bar Dowel: Reinforcing bar, per Section 033000.
e. Basis-of-Design:

1) Anchorage designs indicated are based on Hilti HIT HY-70 System, unless otherwise noted; or equal.

2.5 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

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PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

H. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

J. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use carbon-steel pipe hangers and supports and attachments for general service applications.

E. Use stainless-steel pipe hangers and metal framing systems and stainless-steel attachments for hostile environment applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal hanger-shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

M. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use mechanical-expansion anchors or adhesive anchors instead of building attachments where required in concrete construction.

END OF SECTION 220529

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

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3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:

   a. Background: Safety green.
   b. Letter Colors: White.

2. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Safety black.
   b. Letter Color: Black.

3. Protected Water Piping:

   a. Background: Safety green.

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b. Letter Colors: White.

END OF SECTION 220553

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Galvanized-steel pipe and fittings.
4. Specialty pipe fittings.

B. Related Requirements:

1. Section 221429 "Sump Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Engineer no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Engineer's written permission.

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1.6 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Waste, Force-Main Piping: 50 psig.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A74, Service class(es).

B. Gaskets: ASTM C564, rubber.

C. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A888 or CISPI 301.

B. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.

C. Cast-Iron, Hubless-Piping Couplings:

1. Standard: ASTM C1277.
2. Description: Two-piece ASTM A48/A48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A53/A53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.

B. Steel Pipe Pressure Fittings:

1. Galvanized-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

C. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:

1. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A536 ductile-iron castings, ASTM A47/A47M malleable-iron castings, ASTM A234/A234M forged steel fittings, or ASTM A106/A106M steel pipes with dimensions matching ASTM A53/A53M steel pipe, and complying with AWWA C606 for grooved ends.
2. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:

a. Standard: ASTM C1173.
b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.
d. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
3) For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

3. Shielded, Nonpressure Transition Couplings:

a. Standard: ASTM C1460.
b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.

4. Pressure Transition Couplings:

a. Standard: AWWA C219.

b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
c. Center-Sleeve Material: Stainless steel.
d. Gasket Material: Natural or synthetic rubber.
e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. Dielectric Unions:

a. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 degrees F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:

a. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 125 psig minimum at 180 degrees F.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

K. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A674 or AWWA C105/A 21.5.

M. Install steel piping according to applicable plumbing code.

N. Install force mains at elevations indicated.

O. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

    a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

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3.2 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

    a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    c. Do not use pipe sections that have cracked or open welds.

D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.3 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

C. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.4 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

    a. Isolate test source and allow to stand for four hours.
    b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.6 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

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3.7 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping all sizes shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; heavy-duty hubless-piping couplings; and coupled joints.

C. Aboveground, vent piping all sizes shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

D. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be the following:

1. Galvanized-steel pipe, pressure fittings, and threaded joints.

E. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be any of the following:

1. Galvanized-steel pipe, pressure fittings, and threaded joints.
2. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

END OF SECTION 221316

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SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submersible sump pumps.
2. Sump-pump basins and basin covers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with manufacturer's written instructions for handling.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 SUBMERSIBLE SUMP PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Weil Series 2500, Model 2519 or comparable product by one of the following:

1. Wilo
2. Xylem
3. Or Equal

B. Configuration: Duplex submersible pumps on guide rail removal system.

C. Hydraulic Performance (Each Pump):

1. Capacity: 300 GPM.
2. Total Dynamic Head: 40 feet.
3. Speed: 1750 RPM.
4. Discharge: 4-inch.

D. Construction:

1. Cast iron casing.
2. Cast iron multi-vane semi-open impeller, dynamically balanced.
3. Series 300 stainless steel shaft with keyed impeller connection.
4. Permanently lubricated double seal ball bearings (sleeve bearings not acceptable).
5. O-ring sealed mating surfaces.
6. Weil 2613-4 removal system for each pump.
7. Weil 4-inch subbase.

E. Motor:

1. 10 HP.
2. 480 Volt, 3 Phase, 60 Hz.
3. 1750 RPM.
4. Class F insulation.
5. Watertight cast iron housing with extended cooling fins.
6. 50-foot power cable per pump.

2.3 LEVEL CONTROL SYSTEM

A. Level Transmitter with 50-foot cable.

B. Two backup fail-safe mechanical suspended float switches with 50-foot cables.

C. Control Panel: Duplex NEMA 4 Control Panel with color touchscreen.

2.4 BASIN AND COVER

A. Existing 60” x 60” x 12'-0” deep concrete pit.

B. 66” x 66” square steel gas-tight cover with all necessary openings.

2.5 MOTORS

A. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

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SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.

B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.
6. Or equal.

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20-psig.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Stainless steel, Type 316.
5. Connecting Bolts and Nuts: Stainless steel, Type 316, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.
    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
3. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls Above Grade:

a. Piping Smaller Than NPS 6 Steel pipe sleeves.
b. Piping NPS 6 and Larger: Steel pipe sleeves.

2. Exterior Concrete Walls Below Grade:

a. Piping Smaller Than NPS 6 Steel pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6 Steel pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs Above Grade:

a. Piping Smaller Than NPS 6: Steel pipe sleeves.
b. Piping NPS 6 and Larger: Steel pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 24: Steel pipe sleeves.

END OF SECTION 230517

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SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Miljoco Corporation.
b. Trerice, H. O. Co.

c. Weiss Instruments, Inc.
d. Weksler Glass Thermometer Corp.
e. Or equal.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 DIAL-TYPE PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Ametek U.S. Gauge.
b. Miljoco Corporation.
c. Trerice, H. O. Co.

d. Weiss Instruments, Inc.
e. Weksler Glass Thermometer Corp.
f. Or equal.

2. Standard: ASME B40.100.
3. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 pipe threads.

C. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Miljoco Corporation.
2. Peterson Equipment Company.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Glass Thermometer Corp.
6. Or equal.

B. Description: Test-station fitting made for insertion in piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install connection fittings in accessible locations for attachment to portable indicators.

N. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic coil in air-handling units.
2. Two inlets and two outlets of each hydronic heat exchanger.

O. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

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3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:

1. Industrial-style, liquid-in-glass type.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.

B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

C. Scale Range for Steam and Steam-Condensate Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at suction and discharge of each pump shall be the following:

1. Sealed, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi.

B. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

C. Scale Range for Steam Piping: 0 to 160 psi.

END OF SECTION 230519

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SECTION 230523.12 - BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.1 for power piping valves.
7. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Refer to HVAC valve schedule articles for applications of valves.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types: Handlever

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Watts.

e. Or equal.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: bronze ball valves, two piece, with stainless-steel trim, and full port.

1. Valves may be provided with solder-joint ends instead of threaded ends.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: bronze ball valves, two piece, with stainless-steel trim, and full port.

1. Valves may be provided with solder-joint ends instead of threaded ends.

3.6 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

A. Pipe NPS 2 and Smaller: bronze ball valves, two piece, with stainless-steel trim, and full port.

1. Valves may be provided with solder-joint ends instead of threaded ends.

3.7 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: bronze ball valves, two piece, with stainless-steel trim, and full port.

1. Valves may be provided with solder-joint ends instead of threaded ends.

END OF SECTION 230523.12

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SECTION 230523.13 - BUTTERFLY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Iron, single-flange butterfly valves.
2. Iron, grooved-end butterfly valves.
3. High-performance butterfly valves.
4. Chainwheels.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B16.5 for pipe flanges and flanged fittings, NPS 1/2 through NPS 24.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.1 for power piping valves.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Types:

1. Gear Actuator: For valves NPS 8 and larger.
2. Handlever: For valves NPS 6 and smaller.
3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Valve Installation" Article.

G. Valves in Insulated Piping: With 2-inch stem extensions with extended necks.

2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Jenkins Valves; Crane Energy Flow Solutions.
c. Mueller Steam Specialty; A WATTS Brand.
d. NIBCO INC.
e. WATTS.
f. Or equal.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.3 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

A. Iron, Grooved-End Butterfly Valves, 175 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Grinnell G-Fire by Johnson Controls Company.
b. Tyco by Johnson Controls Company.
c. Victaulic Company.
d. Or equal.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig.
c. Body Material: Coated, ductile iron.
d. Stem: Two-piece stainless steel.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: Stainless-steel disc, 200 CWP, and EPDM seat.
2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: Stainless-steel disc, 200 CWP, and EPDM seat.
2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.

END OF SECTION 230523.13

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Metal framing systems.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Delegated Design.

B. Related Requirements:

1. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELEGATED DESIGN SUBMITTALS

A. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Metal framing systems.
2. Pipe stands.
3. Equipment supports.

B. Qualifications Statement: Submit qualifications for licensed professional.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

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1.6 QUALITY ASSURANCE

A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the jurisdiction of the project location.

B. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers, metal framing systems, pipe stands, and equipment supports for loads in excess of 200 lb.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

D. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems for indoor general service applications.:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Thomas & Betts Corporation; A Member of the ABB Group.
   b. Atkore International (Unistrut).
   c. Eaton (B-line).

2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating: Pregalvanized G90.

B. MFMA Manufacturer Metal Framing Systems for Outdoor Environment Applications:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. B-line, an Eaton business.
   b. Thomas & Betts Corporation; A Member of the ABB Group.
   c. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted stainless-steel, Type 316 channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
8. Metallic Coating: No coating.

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2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Buckaroos, Inc.
2. Pipe Shields Inc.
3. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psi or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psi or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors

1. Fastening to Concrete Substrate: Zinc plated carbon steel wedge type anchors, complete with zinc plated nuts and washers, unless otherwise noted.
2. Submerged or Weather Exposed Substrates: ASTM A276 Type 316 stainless steel wedge type anchors, complete with Type 316 stainless steel nuts and washers, unless otherwise noted.
3. Meet ICC ES AC01 or ICC ES AC193.
4. Length: When length or anchor embedment is not indicated, provide length sufficient to place the wedge and expansion cone portion of the anchor at least 1 inch behind concrete reinforcing steel.
5. Basis-of-Design:

    a. Anchorage designs indicated are based on Hilti, Kwik-Bolt TZ, unless otherwise noted.
    b. Acceptable Anchors: Hilti Kwik-Bolt TZ; Simpson Strong-Tie Strong Bolt 2 Wedge Anchor; DeWalt Power-Stud+ SD1; DeWalt Power-Stud+ SD6 for stainless steel; or equal.

B. Adhesive Anchoring System

1. Fastening to Concrete Substrate: Manufactured system consisting of post installed threaded rods, nuts, washers, other anchoring hardware, and chemical dispenser for installation in hammer drilled holes.

a. Anchors: Meet ICC ES AC308.
b. Injection Adhesive: Two-component epoxy system consisting of a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate.
c. Adhesive Cartridge: Side-by-side design to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
d. Anchor: Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.

1) Basis-of-Design:

a) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.
b) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie SET-3G; ITW Ramset Red Head Epcon G5+; or equal.

e. Reinforcing Bar Dowels: Reinforcing bar, per Section 033000.

1) Basis-of-Design:

a) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.
b) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie SET-3G; ITW Ramset Red Head Epcon G5; or equal.

2. Fastening to Hollow Concrete Block: Three-part threaded rod, screen tube, and chemical dispenser anchoring system.

a. Anchors: Meet ICC ES AC58.
b. Adhesive Cartridges: Contain pre-measured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser.
c. Anchor: Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.
d. Reinforcing Bar Dowel: Reinforcing bar, per Section 033000.
e. Basis-of-Design:

1) Anchorage designs indicated are based on Hilti HIT HY-70 System, unless otherwise noted; or equal.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:

1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Hardware: Galvanized steel or polycarbonate.
4. Accessories: Protection pads.

C. Low-Profile, Single Base, Single-Pipe Stand:

1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two, stainless-steel, continuous-thread 1/2-inch rods.
4. Horizontal Member: Adjustable horizontal, stainless-steel pipe support channels.
5. Pipe Supports: RollerStrut clamps Clevis hanger Swivel hanger.
6. Hardware: Stainlesssteel.
7. Accessories: Protection pads.
8. Height: 12 inches above roof.

D. High-Profile, Single Base, Single-Pipe Stand:

1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single vulcanized rubber or molded polypropylene.
3. Vertical Members: Two, stainless-steel, continuous-thread 1/2-inch rods.
4. Horizontal Member: One, adjustable height, galvanized- or stainless-steel pipe support slotted channel or plate.
5. Pipe Supports: Roller, Clevis hanger, or Swivel hanger.
6. Hardware: Stainless steel.
7. Accessories: Protection pads, 1/2-inch continuous-thread stainless-steel rod.
8. Height: 36 inches above roof.

E. High-Profile, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; vulcanized rubber.
3. Vertical Members: Two or more, stainless-steel channels.
4. Horizontal Members: One or more, adjustable height, stainless-steel pipe support.
5. Pipe Supports: Strut clamps.
6. Hardware: Stainlesssteel.
7. Height: 36 inches above roof.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

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2.7 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

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3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment and outdoor applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors or adhesive anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

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SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Elastomeric hangers.
9. Spring hangers.
10. Vibration isolation equipment bases.
11. Delegated design.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 DELEGATED-DESIGN SUBMITTAL

A. For each vibration isolation device:

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

B. Qualifications Statement: Submit qualifications for licensed professional.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For restrained-air-spring mounts to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the jurisdiction of the project location.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolators and vibration isolation bases.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: Type 1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Ribbed or Waffle pattern.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: Type 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.

2. Mounting Plates:

   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: Type 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

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2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: Type 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top housing with attachment and leveling bolt.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: Type 4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top plate with threaded mounting holes.
    c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.

6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: Type 4.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: Type 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.9 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: Type 3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.10 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. California Dynamics Corporation.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

D. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.

5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: White and orange.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2.4 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Heating Water Piping: White letters on a safety-green background.
3. Low-Pressure Steam Piping: White letters on a safety-purple background.
4. Steam Condensate Piping: White letters on a safety-purple background.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:

    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.

3. Balancing steam systems.
4. Testing, Adjusting, and Balancing Equipment:

    a. Heat exchangers.
    b. Motors.
    c. Heat-transfer coils.

5. Testing, adjusting, and balancing existing systems and equipment.
6. Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

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1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by NEBB or AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or AABC.

2. TAB Technician: Employee of the TAB specialist and certified by NEBB or AABC as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.7 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible, and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete, and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started, and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete, and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.

b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.

c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

10. Verify that memory stops have been set.

3.9 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.10 PROCEDURES FOR HEAT EXCHANGERS

A. Adjust water flow to within specified tolerances.

B. Measure inlet and outlet water temperatures.

C. Measure inlet steam pressure.

D. Check settings and operation of safety and relief valves. Record settings.

3.11 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.12 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.

2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.13 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.14 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.15 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check the condition of coils.
5. Check the operation of the drain pan and condensate-drain trap.
6. Check bearings and other lubricated parts for proper lubrication.
7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.

2. Coils are clean, and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.16 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.17 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.18 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Engineer's name and address.
6. Contractor's name and address.
7. Report date.
8. Signature of TAB supervisor who certifies the report.
9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
10. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer's name, type, size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.

5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.

c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

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3.19 VERIFICATION OF TAB REPORT

A. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

B. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

C. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

D. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

E. Prepare test and inspection reports.

3.20 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, exposed supply and outdoor air.
2. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
3. Outdoor, exposed supply and return.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

1.3 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application.

C. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.4 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

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1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

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PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Aeroflex USA.
    b. Armacell LLC.
    c. K-Flex USA.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Knauf Insulation.
    c. Owens Corning.

2.2 LOUVER BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 2 inches.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard channel frames, with corners mitered and with same finish as panels.

5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same type of finish applied to louvers, but black color.
7. Attach blank-off panels with clips.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.
e. Or equal.

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Knauf Insulation.
d. Vimasco Corporation.
e. Or equal.

C. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.

1. Service Temperature Range: Minus 20 to plus 180 deg F.
2. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
3. Color: White.

D. Vapor-Retarder Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Or equal.

E. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.

1. Service Temperature Range: 0 to 180 deg F.
2. Color: White.

F. Vapor-Retarder Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Or equal.

G. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.

1. Service Temperature Range: Minus 50 to plus 220 deg F.
2. Color: White.

H. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Knauf Insulation.
    e. Mon-Eco Industries, Inc.
    f. Vimasco Corporation.
    g. Or equal.

I. Water-Vapor Permeance: ASTM E96, greater than 1.0 perm at manufacturer's recommended dry film thickness.

1. Service Temperature Range: Minus 20 to plus 180 deg F.
2. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.

C. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Factory cut and rolled to size.
2. Finish and thickness are indicated in field-applied jacket schedules.
3. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick polysurlyn.

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2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Engineer. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engagea qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.

6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Exposed ductwork located in the area it serves.
9. Return air ductwork located in return air ceiling spaces above the area it serves, except where the return ductwork is installed in ceiling spaces with a roof above.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

C. Exposed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Aluminum, Smooth: 0.020 inch thick.

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END OF SECTION 230713

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SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulation for HVAC piping systems.

B. Related Sections:

1. Section 230713 "Duct Insulation" for duct insulation.
2. Section 230716 "HVAC Equipment Insulation" for equipment insulation.

1.3 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.4 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

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PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

A. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Owens Corning.
d. Or equal.

2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
3. 850 deg F.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
2. Wet Flash Point: Below 0 deg F.

3. Service Temperature Range: 40 to 200 deg F.
4. Color: Black.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to 180 deg F.
3. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.

a. Service Temperature Range: Minus 150 to plus 250 deg F.
b. Color: White or gray.

C. ASJ Flashing Sealants and PVDC, and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.

2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: White.

D. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inchesbeyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word “union” matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Engineer. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.9 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Chilled Water and Brine, Above 40 Deg F:

1. NPS 12 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 12 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

C. Steam and Steam Condensate, Vents, Drains, and Safety Relief Vents 350 Deg F and Below:

1. NPS 3/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

2. NPS 1 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed:

1. PVC: 20 mils thick.

END OF SECTION 230719

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SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. DDC system for monitoring and controlling of HVAC systems.

B. Related Requirements:

1. Communications Cabling:

a. Section 260523 "Control-Voltage Electrical Power Cables" for balanced twisted pair communications cable.
b. Section 271513 "Communications Copper Horizontal Cabling" for balanced twisted pair communications cable.
c. Section 271523 "Communications Optical Fiber Horizontal Cabling" for optical fiber communications cable.

2. Raceways:

a. Section 260533 "Raceways and Boxes for Electrical Systems" for raceways for low-voltage control cable.
b. Section 270528 "Pathways for Communications Systems" for raceways for balanced twisted pair cabling and optical fiber cable.

3. Section 260553 "Identification for Electrical Systems" for identification requirements for electrical components.
4. Section 270553 "Identification for Communications Systems" for identification requirements for communications components.

1.3 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. Binary: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

J. DOCSIS: Data-Over Cable Service Interface Specifications.

K. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

L. HLC: Heavy load conditions.

M. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

N. I/P: Current to pneumatic.

O. LAN: Local area network.

P. LNS: LonWorks Network Services.

Q. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

R. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.

S. Modbus TCP/IP: An open protocol for exchange of process data.

T. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

U. MTBF: Mean time between failures.

V. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

W. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

X. Peer to Peer: Networking architecture that treats all network stations as equal partners.

Y. POT: Portable operator's terminal.

Z. PUE: Performance usage effectiveness.

AA. RAM: Random access memory.

BB. RF: Radio frequency.

CC. Router: Device connecting two or more networks at network layer.

DD. Server: Computer used to maintain system configuration, historical and programming database.

EE. TCP/IP: Transport control protocol/Internet protocol.

FF. UPS: Uninterruptible power supply.

GG. USB: Universal Serial Bus.

HH. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

II. VAV: Variable air volume.

JJ. WLED: White light emitting diode.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Multiple Submissions:

1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.
2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.
3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.

B. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

    a. Workstations.
    b. Gateways.
    c. Protocol analyzers.
    d. DDC controllers.
    e. Enclosures.
    f. Electrical power devices.
    g. UPS units.
    h. Accessories.
    i. Instruments.
    j. Control dampers and actuators.
    k. Control valves and actuators.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

C. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

D. Shop Drawings:

1. General Requirements:

    a. Include cover drawing with Project name, location, Owner, Engineer, Contractor and issue date with each Shop Drawings submission.
    b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
    c. Drawings Size: 11”x17”.

2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail means of vibration isolation and show attachments to rotating equipment.
5. Plan Drawings indicating the following:

    a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
    b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
    c. Each desktop workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
    d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.

e. Network communication cable and raceway routing.
f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

6. Schematic drawings for each controlled HVAC system indicating the following:

a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
c. A graphic showing location of control I/O in proper relationship to HVAC system.
d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
g. Narrative sequence of operation.
h. Graphic sequence of operation, showing all inputs and output logical blocks.

7. Control panel drawings indicating the following:

a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
c. Front, rear, and side elevations and nameplate legend.
d. Unique drawing for each panel.

8. DDC system network riser diagram indicating the following:

a. Each device connected to network with unique identification for each.
b. Interconnection of each different network in DDC system.
c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.
d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

9. DDC system electrical power riser diagram indicating the following:

a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
d. Power wiring type and size, race type, and size for each.

10. Monitoring and control signal diagrams indicating the following:

    a. Control signal cable and wiring between controllers and I/O.
    b. Point-to-point schematic wiring diagrams for each product.
    c. Control signal tubing to sensors, switches and transmitters.
    d. Process signal tubing to sensors, switches and transmitters.

11. Color graphics indicating the following:

    a. Itemized list of color graphic displays to be provided.
    b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
    c. Intended operator access between related hierarchical display screens.

E. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. System and product operation under each potential failure condition including, but not limited to, the following:

    a. Loss of power.
    b. Loss of network communication signal.
    c. Loss of controller signals to inputs and outpoints.
    d. Operator workstation failure.
    e. Server failure.
    f. Gateway failure.
    g. Network failure
    h. Controller failure.
    i. Instrument failure.
    j. Control damper and valve actuator failure.

4. Complete bibliography of documentation and media to be delivered to Owner.
5. Description of testing plans and procedures.
6. Description of Owner training.

1.6 DELEGATED-DESIGN SUBMITTAL

A. For DDC system products and installation indicated as being delegated.

1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
2. Schedule and design calculations for control dampers and actuators.

    a. Flow at Project design and minimum flow conditions.
    b. Face velocity at Project design and minimum airflow conditions.

c. Pressure drop across damper at Project design and minimum airflow conditions.
d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
e. Maximum close-off pressure.
f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.
i. Actuator signal to control damper (on, close or modulate).
j. Actuator position on loss of power.
k. Actuator position on loss of control signal.

3. Schedule and design calculations for control valves and actuators.

a. Flow at Project design and minimum flow conditions.
b. Pressure-differential drop across valve at Project design flow condition.
c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
d. Design and minimum control valve coefficient with corresponding valve position.
e. Maximum close-off pressure.
f. Leakage flow at maximum system pressure differential.
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.
i. Actuator signal to control damper (on, close or modulate).
j. Actuator position on loss of power.
k. Actuator position on loss of control signal.

4. Schedule and design calculations for selecting flow instruments.

a. Instrument flow range.
b. Project design and minimum flow conditions with corresponding accuracy, control signal to transmitter and output signal for remote control.
c. Extreme points of extended flow range with corresponding accuracy, control signal to transmitter and output signal for remote control.
d. Pressure-differential loss across instrument at Project design flow conditions.
e. Where flow sensors are mated with pressure transmitters, provide information for each instrument separately and as an operating pair.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. Systems Provider Qualification Data:

a. Resume of project manager assigned to Project.
b. Resumes of application engineering staff assigned to Project.
c. Resumes of installation and programming technicians assigned to Project.
d. Resumes of service technicians assigned to Project.
e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.

f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
h. Owner contact information for past project including name, phone number, and e-mail address.
i. Contractor contact information for past project including name, phone number, and e-mail address.
j. Engineer contact information for past project including name, phone number, and e-mail address.

2. Manufacturer's qualification data.
3. Testing agency's qualifications data.

B. Welding certificates.

C. Product Certificates:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranty: For manufacturer's warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

1. Include the following:

a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to:

1) Design and install new points, panels, and other hardware.

2) Perform preventive maintenance and calibration.
3) Debug hardware problems.
4) Repair or replace hardware.

h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
j. List of recommended spare parts with part numbers and suppliers.
k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
m. Licenses, guarantees, and warranty documents.
n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
o. Owner training materials.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish quantity indicated of matching product(s) in Project inventory for each unique size and type of following:

1. Programmable Application Controller: One.
2. Transformer: One.
3. DC Power Supply: One.

1.10 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of five years within time of bid.
3. DDC systems and products that have been successfully tested and in use on at least three past projects.
4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:

a. Product research and development.
b. Product and application engineering.
c. Product manufacturing, testing and quality control.

d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
e. Owner operator training.

B. DDC System Provider Qualifications:

1. Authorized representative of, and trained by, DDC system manufacturer.
2. In-place facility located within 30 miles of Project.
3. Demonstrate experience with installation of DDC system products being installed for period within three consecutive years before time of bid.
4. Demonstrate experience on five projects of similar complexity, scope and value.
5. Each person assigned to Project shall have demonstrated past experience.
6. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
7. Service and maintenance staff assigned to support Project during warranty period.
8. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
9. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.

PART 2 - PRODUCTS

2.1 DDC SYSTEM MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Automated Logic Corporation.
2. Honeywell International Inc.
3. Johnson Controls, Inc.
4. Schneider Electric USA, Inc.
5. Trane.

2.2 DDC SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.

1. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, operator interfaces, and software.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 WEB ACCESS

A. DDC system shall be Web based.

1. Web-Based Access to DDC System:

a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.
b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
c. Web access shall be password protected.

2.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.

1. System Performance Objectives:

a. DDC system shall manage HVAC systems.
b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
d. DDC system shall operate while unattended by an operator and through operator interaction.
e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

D. DDC Data Access:

1. When logged into the system, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
2. System(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.

E. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.

a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

a. Outdoors: Type 4X.
b. Indoors, Mezzanine Level: Type 1.
c. Indoors, Ground Floor: Type 1.
d. Indoors below Ground Floor: Type 4X.

F. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

a. Outdoors: Type 4X.
b. Indoors, Mezzanine Level: Type 1.
c. Indoors, Ground Floor: Type 1.
d. Indoors below Ground Floor: Type 4X.

2.5 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than two or three levels of LANs.

1. Level one LAN shall connect network controllers and operator workstations.
2. Level one or Level two LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.
3. Level two or Level three LAN shall connect application-specific controllers to programmable application controllers and network controllers.
4. Level two or Level three LAN shall connect application-specific controllers to application-specific controllers.

B. DDC system shall consist of dedicated and separated LANs that are not shared with other building systems and tenant data and communication networks.

C. System architecture shall perform modifications without having to remove and replace existing network equipment.

D. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

E. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

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2.6 DDC SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:

1. Desktop and portable workstation with hardwired connection through LAN port.
2. Remote connection through web access.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. Network Ports: For hardwired connection of desktop or portable workstation. Network port shall be easily accessible, properly protected, clearly labeled.

D. Portable Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Portable workstation shall be able to communicate with any device connected to any system LAN regardless of point of physical connection to system.
4. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
5. Have dynamic graphic displays that are identical to desktop workstations.

E. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
2. DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
3. DDC system shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.

F. Simultaneous Operator Use: Capable of accommodating up to 10 simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.7 NETWORKS

A. Acceptable networks for connecting workstations, mobile devices, and network controllers include the following:

1. ATA 878.1, ARCNET.
2. IP.
3. IEEE 8802-3, Ethernet.

B. Acceptable networks for connecting programmable application controllers include the following:

1. ATA 878.1, ARCNET.
2. IP.

3. IEEE 8802-3, Ethernet.

C. Acceptable networks for connecting application-specific controllers include the following:

1. ATA 878.1, ARCNET.
2. EIA-485A.
3. IP.
4. IEEE 8802-3, Ethernet.

2.8 NETWORK COMMUNICATION PROTOCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to Owner and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:

1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.

C. Industry Standard Protocols:

1. DDC system shall use any one or a combination of the following industry standard protocols for network communication while complying with other DDC system requirements indicated:

a. ASHRAE 135.
b. CEA-709.1-C.
c. Modbus Application Protocol Specification V1.1b.

2. Operator workstations and network controllers shall communicate through ASHRAE 135 protocol.
3. Portions of DDC system networks using ASHRAE 135 communication protocol shall be an open implementation of network devices complying with ASHRAE 135. Network devices shall be tested and listed by BACnet Testing Laboratories.
4. Gateways shall be used to connect networks and network devices using different protocols.

2.9 PORTABLE WORKSTATIONS

A. Description: A self-contained computer designed to allow for normal use in different locations and conditions.

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2.10 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 32- or 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:

    a. Operator access to DDC system shall be under password control.
    b. An alphanumeric password shall be field assignable to each operator.
    c. Operators shall be able to access DDC system by entry of proper password.
    d. Operator password shall be same regardless of which computer or other interface means is used.
    e. Additions or changes made to passwords shall be updated automatically.
    f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.
    g. Software shall have at least five access levels.
    h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
    i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

7. Data Segregation:

    a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
    b. Include at least 32 segregation groups.
    c. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
    d. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
    e. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
    f. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.

8. Operators shall be able to perform commands including, but not limited to, the following:

    a. Start or stop selected equipment.
    b. Adjust set points.
    c. Add, modify, and delete time programming.
    d. Enable and disable process execution.
    e. Lock and unlock alarm reporting for each point.
    f. Enable and disable totalization for each point.
    g. Enable and disable trending for each point.
    h. Override control loop set points.
    i. Enter temporary override schedules.
    j. Define holiday schedules.
    k. Change time and date.
    l. Enter and modify analog alarm limits.
    m. Enter and modify analog warning limits.
    n. View limits.
    o. Enable and disable demand limiting.
    p. Enable and disable duty cycle.
    q. Display logic programming for each control sequence.

9. Reporting:

    a. Generated automatically and manually.
    b. Sent to displays, printers and disk files.
    c. Types of Reporting:

        1) General listing of points.
        2) List points currently in alarm.
        3) List of off-line points.
        4) List points currently in override status.
        5) List of disabled points.
        6) List points currently locked out.
        7) List of items defined in a "Follow-Up" file.
        8) List weekly schedules.
        9) List holiday programming.

10) List of limits and deadbands.

10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.
4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.
5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.
6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
7. Graphics are to be online programmable and under password control.
8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
9. Graphics shall also contain software points.
10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.
12. Display operator accessed data on the monitor.
13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
14. Include operator with means to directly access graphics without going through penetration path.
15. Dynamic data shall be assignable to graphics.
16. Display points (physical and software) with dynamic data provided by DDC system with appropriate text descriptors, status or value, and engineering unit.
17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.
18. Points shall be dynamic with operator adjustable update rates on a per point basis from one second to over a minute.
19. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.

    a. For an analog command point such as set point, current conditions and limits shall be displayed and operator can position new set point using pointing device.

b. For a digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.
c. Keyboard equivalent shall be available for those operators with that preference.

20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.
21. Help Features:

a. On-line context-sensitive help utility to facilitate operator training and understanding.
b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.

1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed word-processing program, which shall run concurrently with operating system software.

c. Available for Every Menu Item:

1) Index items for each system menu item.

22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.

a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves pumps, and electrical symbols similar to those indicated.
b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:

1) Define background screens.
2) Define connecting lines and curves.
3) Locate, orient and size descriptive text.
4) Define and display colors for all elements.
5) Establish correlation between symbols or text and associated system points or other displays.

D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:

a. Room layouts with room identification and name.
b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.

c. Location and identification of each hardware point being controlled or monitored by DDC system.

3. Control schematic for each of following, including a graphic system schematic representation, similar to that indicated on Drawings, with point identification, set point and dynamic value indication, sequence of operation.
4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.

E. Customizing Software:

1. Software to modify and tailor DDC system to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
2. Online modification of DDC system configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
3. As a minimum, include the following modification capability:

a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
b. Peripheral assignment capability shall include assignment of segregation groups and operators to consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
c. System configuration and diagnostic capability shall include communications and peripheral port assignments, DDC controller assignments to network, DDC controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.
d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.
e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.
f. Point related change capability shall include the following:

1) System and point enable and disable.
2) Run-time enable and disable.
3) Assignment of points to segregation groups, calibration tables, lockout, and run time and to a fixed I/O value.
4) Assignment of alarm and warning limits.

g. Application program change capability shall include the following:

1) Enable and disable of software programs.
2) Programming changes.
3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.

4. Software shall allow operator to add points, or groups of points, to DDC system and to link them to energy optimization and management programs. Additions and

modifications shall be online programmable using operator workstation, downloaded to other network devices and entered into their databases. After verification of point additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.

5. Include high-level language programming software capability for implementation of custom DDC programs. Software shall include a compiler, linker, and up- and down-load capability.
6. Include a library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences. Also include, as a minimum, the following:

    a. Proportional control (P).
    b. Proportional plus integral (PI).
    c. Proportional plus integral plus derivative (PID).
    d. Adaptive and intelligent self-learning control.

        1) Algorithm shall monitor loop response to output corrections and adjust loop response characteristics according to time constant changes imposed.
        2) Algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of system dynamics so that on system shut down and restart, learning process starts from where it left off.

7. Fully implemented intrinsic control operators including sequence, reversing, ratio, time delay, time of day, highest select AO, lowest select AO, analog controlled digital output, analog control AO, and digitally controlled AO.
8. Logic operators such as "And," "Or," "Not," and others that are part of a standard set available with a high-level language.
9. Arithmetic operators such as "Add," "Subtract," "Multiply," "Divide," and others that are part of a standard set available with a high-level language.
10. Relational operators such as "Equal To," "Not Equal To," "Less Than," "Greater Than," and others that are part of a standard set available with a high-level language.

F. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways and other network devices.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
4. Alarms display shall include the following:

    a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
    b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
    c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."

d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
6. Send e-mail alarm messages to designated operators.
7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
8. Alarms shall be categorized and processed by class.

a. Class 1:

1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.

b. Class 2:

1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
2) Acknowledgement may be through a multiple alarm acknowledgment.

c. Class 3:

1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.

d. Class 4:

1) Routine maintenance or other types of warning alarms.
2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.

9. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
10. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

G. Reports and Logs:

1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on workstation hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

H. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:

    a. Alarm history.
    b. System messages.
    c. System events.
    d. Trends.

I. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.

J. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.

1. Each trend shall include interval, start time, and stop time.
2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation hard drives.
3. Data shall be retrievable for use in spreadsheets and standard database programs.

K. Programming Software:

1. Include programming software to execute sequences of operation indicated.
2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
3. Programming software shall be any of the following:

    a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for DDC control systems.

1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
2) Programming tools shall be viewable in real time to show present values and logical results of each function block.

b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.
c. Line by Line and Text Based: Programming shall declare variable types such as local, global, real, integer, and so on, at the beginning of the program. Use descriptive comments frequently to describe programming code.

4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

L. Database Management Software:

1. Where a separate SQL database is used for information storage, DDC system shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.
2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of DDC system applications.
3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:

a. Backup.
b. Purge.
c. Restore.

4. Database management software shall support the following:

a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
b. Maintenance: Include method of purging records from trend, alarm, event and audit databases by supporting separate screens for creating a backup before purging, selecting database, and allowing for retention of a selected number of day's data.
c. Backup: Include means to create a database backup file and select a storage location.
d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.

5. Database management software shall include information of current database activity, including the following:

a. Ready.
b. Purging record from a database.
c. Action failed.
d. Refreshing statistics.
e. Restoring database.
f. Shrinking a database.

g. Backing up a database.
h. Resetting Internet information services.
i. Starting network device manager.
j. Shutting down the network device manager.
k. Action successful.

6. Database management software monitoring functions shall continuously read database information once operator has logged on.
7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.
8. Monitoring settings window shall have the following sections:

a. Allow operator to set and review scan intervals and start times.
b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.
c. Warning: Allow operator to define warning limit parameters, set reminder frequency and link e-mail message.
d. Alarm: Allow operator to define alarm limit parameters, set reminder frequency and link e-mail message.
e. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit databases as well as operator proper security access to restore a database.

9. Monitoring settings taskbar shall include the following informational icons:

a. Normal: Indicates by color and size, or other easily identifiable means that all databases are within their limits.
b. Warning: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their warning limit.
c. Alarm: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their alarm limit.

2.11 OFFICE APPLICATION SOFTWARE

A. Include current version of office application software at time of Substantial Completion.

B. Office application software package shall include multiple separate applications and use a common platform for all applications, similar to Microsoft's "Office Professional."

1. Database.
2. E-mail.
3. Presentation.
4. Publisher.
5. Spreadsheet.
6. Word processing.

2.12 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, chillers, and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment, only when specifically requested and approved by Owner.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.13 ASHRAE 135 PROTOCOL ANALYZER

A. Analyzer and required cables and fittings for connection to ASHRAE 135 network.

B. Analyzer shall include the following minimum capabilities:

1. Capture and store to a file data traffic on all network levels.
2. Measure bandwidth usage.
3. Filtering options with ability to ignore select traffic.

2.14 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:

1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. Controllers located in conditioned space shall be rated for operation at 32 to 120 degrees F.
3. Controllers located outdoors shall be rated for operation at 40 to 150 degrees F.

F. Power and Noise Immunity:

1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. DDC Controller Spare Processing Capacity:

1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:

a. Network Controllers: 50 percent.
b. Programmable Application Controllers: Not less than 60 percent.
c. Application-Specific Controllers: Not less than 70 percent.

2. Memory shall support DDC controller's operating system and database and shall include the following:

a. Monitoring and control.
b. Energy management, operation and optimization applications.
c. Alarm management.
d. Historical trend data of all connected I/O points.
e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Programmable Application Controllers:

a. 20Insert number percent of each AI, AO, BI, and BO point connected to controller.

I. Maintenance and Support: Include the following features to facilitate maintenance and support:

1. Mount microprocessor components on circuit cards for ease of removal and replacement.
2. Means to quickly and easily disconnect controller from network.

3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

J. Input and Output Point Interface:

1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
4. AIs:

   a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
   b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
   c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
   d. Signal conditioning including transient rejection shall be provided for each AI.
   e. Capable of being individually calibrated for zero and span.
   f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.

5. AOs:

   a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
   b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
   c. Capable of being individually calibrated for zero and span.
   d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.

6. BIs:

   a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
   b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
   c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
   d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
   e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided

to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.

7. BOs:

a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.

1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.

b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
c. BOs shall be selectable for either normally open or normally closed operation.

2.15 NETWORK CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Communication:

1. Network controllers shall communicate with other devices on DDC system Level one network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:

a. Equip controller with local keypad and digital display for interrogating and editing data.
b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.16 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers that perform scheduling shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:

1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

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2.17 CONTROLLER SOFTWARE

A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
3. Control functions shall be executed within controllers using DDC algorithms.
4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:

1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:

1. Weekly Schedule:

a. Include separate schedules for each day of week.
b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
c. Each schedule may consist of up to 10 events.
d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.

2. Exception Schedules:

a. Include ability for operator to designate any day of the year as an exception schedule.
b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.

3. Holiday Schedules:

a. Include capability for operator to define up to 99 special or holiday schedules.
b. Schedules may be placed on scheduling calendar and will be repeated each year.
c. Operator shall be able to define length of each holiday period.

D. System Coordination:

1. Include standard application for proper coordination of equipment.

2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:

1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:

1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:

1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:

1. System shall have ability to dial out in the event of an alarm.

I. Electric Power Demand Limiting:

1. Demand-limiting program shall monitor building or other operator-defined electric power consumption from signals connected to electric power meter or from a watt transducer or current transformer.
2. Demand-limiting program shall predict probable power demand such that action can be taken to prevent exceeding demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When demand prediction indicates demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
3. Demand reduction shall be accomplished by the following means:

    a. Reset air-handling unit supply temperature set points.
    b. Reset space temperature set points.
    c. De-energize equipment based on priority.

4. Demand-limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which electric power service provider computes demand charges.
5. Include demand-limiting prediction and control for any individual meter monitored by system or for total of any combination of meters.
6. Include means operator to make the following changes online:

    a. Addition and deletion of loads controlled.
    b. Changes in demand intervals.

c. Changes in demand limit for meter(s).
d. Maximum shutoff time for equipment.
e. Minimum shutoff time for equipment.
f. Select rotational or sequential shedding and restoring.
g. Shed and restore priority.

7. Include the following information and reports, to be available on an hourly, daily, weekly, monthly and annual basis:

a. Total electric consumption.
b. Peak demand.
c. Date and time of peak demand.
d. Daily peak demand.

J. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

K. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

L. Control Loops:

1. Support any of the following control loops, as applicable to control required:

a. Two-position (on/off, open/close, slow/fast) control.
b. Proportional control.
c. Proportional plus integral (PI) control.
d. Proportional plus integral plus derivative (PID) control.

1) Include PID algorithms with direct or reverse action and anti-windup.
2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
3) Controlled variable, set point, and PID gains shall be operator-selectable.

e. Adaptive (automatic tuning).

M. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

N. Energy Calculations:

1. Include software to allow instantaneous power or flow rates to be accumulated and converted to energy usage data.
2. Include an algorithm that calculates a sliding-window average (rolling average). Algorithm shall be flexible to allow window intervals to be operator specified (such as 15, 30, or 60 minutes).
3. Include an algorithm that calculates a fixed-window average. A digital input signal shall define start of window period (such as signal from utility meter) to synchronize fixed-window average with that used by utility.

O. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

P. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

Q. Run-Time Totalization:

1. Include software to totalize run-times for all BI and BO points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.18 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in a enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Do not house more than one controller in a single enclosure.
3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
4. Individual wall-mounted single-door enclosures shall not exceed 36 inches wide and 60 inches high.
5. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
6. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spare terminals, equal to not less than 10 percent of used terminals.
7. Include spade lugs for stranded cable and wire.
8. Install a maximum of two wires on each side of a terminal.
9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.

11. Mount products within enclosure on removable internal panel(s).
12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch- high lettering.
13. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
14. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
15. Size enclosure internal panel to include at least 25 percent spare area on face of panel.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

D. Wall-Mounted, NEMA 250, Type 1:

1. Enclosure shall be NRTL listed according to UL 50 or UL 50E.
2. Construct enclosure of steel, not less than:

    a. Enclosure size less than 24 inches: 0.053 inch thick.
    b. Enclosure size 24 inches and larger: 0.067 inch thick.

3. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be manufacturer's standard.
    b. Interior color shall be manufacturer's standard.

4. Hinged door full size of front face of enclosure and supported using:

    a. Enclosures sizes less than 36 inches tall: Multiple butt hinges.
    b. Enclosures sizes 36 inches tall and larger: Continuous piano hinges.

5. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Size less than 24 inches: Solid steel, 0.053 inch thick.
    b. Size 24 inches and larger: Solid steel, 0.093 inch thick.

6. Internal panel mounting hardware, grounding hardware and sealing washers.
7. Grounding stud on enclosure body.
8. Thermoplastic pocket on inside of door for record Drawings and Product Data.

E. Wall Mounted NEMA 250, Types 4 and 12:

1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
4. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
5. Single-door enclosure sizes up to 60 inches tall by 36 inches wide.
6. Double-door enclosure sizes up to 36 inches tall by 60 inches wide.
7. Construct enclosure of steel, not less than the following:

    a. Size Less Than 24 Inches: 0.053 inch thick.
    b. Size 24 Inches and Larger: 0.067 inch thick.

8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be manufacturer's standard.
    b. Interior color shall be manufacturer's standard.

9. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.

    a. Sizes through 24 Inches Tall: Two hinges.
    b. Sizes between 24 Inches through 48 Inches Tall: Three hinges.
    c. Sizes Larger 48 Inches Tall: Four hinges.

10. Double-door enclosures with overlapping door design to include unobstructed full-width access.

    a. Single-door enclosures 48 inches and taller, and all double-door enclosures, with three-point (top, middle and bottom) latch system.

11. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Size Less Than 24 Inches: Solid steel, 0.053 inch thick.
    b. Size 24 Inches and Larger: Solid steel, 0.093 inch thick.

12. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.

13. Grounding stud on enclosure body.
14. Thermoplastic pocket on inside of door for record Drawings and Product Data.

F. Wall-Mounted, NEMA 250, Type 4X SS:

1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
4. Construct enclosure of Type 304 stainless steel, not less than the following:

    a. Size Less Than 24 Inches: 0.053 inch thick.
    b. Size 24 Inches and Larger: 0.067 inch thick.

5. Outside body and door of enclosure with brushed No. 4 finish.
6. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.

    a. Sizes through 24 InchesTall: Two hinges.
    b. Sizes between 24 Inchesthrough 48 InchesTall: Three hinges.
    c. Sizes Larger 48 InchesTall: Four hinges.

7. Corner-formed door, full size of enclosure face, supported using continuous piano hinge full length of door.
8. Doors fitted with three-point (top, middle, and bottom) latch system with single, heavy-duty, liquid-tight Type 316 stainless-steel handle with integral locking mechanism.
9. Removable internal panel shall be 0.093-inch solid steel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
10. Internal panel mounting studs and hardware, grounding hardware, and sealing washers.
11. Install corrosion-resistant polyester vent drain in a stainless-steel sleeve at the bottom of enclosure.
12. Include enclosure with stainless-steel mounting brackets.

G. Accessories:

1. Ventilation Fans, Filtered Intake and Exhaust Grilles:

    a. Number and size of fans, filters and grilles as required by application.
    b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
    c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
    d. Thermostatic control with adjustable set point from 32 to 140 degrees F.
    e. Airflow Capacity at Zero Pressure:

        1) 4-Inch Fan: 100 cfm.
        2) 6-Inch Fan: 240 cfm.
        3) 10-Inch Fan: 560 cfm.

    f. Maximum operating temperature of 158 degrees F.

g. 4-inch fan thermally protected and provided with permanently lubricated ball-bearings.
h. 6- and 10-inch fans with ball-bearing construction and split capacitor motors thermally protected to avoid premature failure.
i. Dynamically balanced impellers molded from polycarbonate material.
j. Fan furnished with power cord and polarized plug for power connection.
k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.
l. Removable Intake and Exhaust Grilles: ABS plastic ors tainless steel of size to match fan size and suitable for NEMA 250, Types 1 and 12 enclosures.
m. Filters for NEMA 250, Type 1 Enclosures: Washable foam, of a size to match intake grille.
n. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.

2. Air Conditioner:

a. Electric-powered, self-contained air-conditioning unit specially designed for electrical enclosures to maintain temperature inside enclosure below ambient temperature outside enclosure.
b. Thermostatic control with adjustable set point from 60 to 120 degrees F.
c. Enclosure side or top mounting with unit capacity as required by application.
d. Designed for closed-loop cooling with continuous operation in ambient environments up to 125 degrees F.
e. HFC refrigerant.
f. Reusable and washable air filter.
g. High-performance, industrial-grade, and high-efficiency fans.
h. Furnished with power cord and polarized plug for power connection.
i. Condensate management system with base pan side drain.
j. Mounting hardware, gaskets, mounting template and instruction manual furnished with unit.
k. Outdoor units equipped with head pressure control for low ambient operation, compressor heater, coated condenser coil and thermostat.

3. Bar handle with keyed cylinder lock set.

2.19 RELAYS

A. General-Purpose Relays:

1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Relays shall have LED indication and a manual reset and push-to-test button.
7. Performance:

a. Mechanical Life: At least 10 million cycles.
b. Electrical Life: At least 100,000 cycles at rated load.
c. Pickup Time: 15 ms or less.
d. Dropout Time: 10 ms or less.
e. Pull-in Voltage: 85 percent of rated voltage.
f. Dropout Voltage: 50 percent of nominal rated voltage.
g. Power Consumption: 2 VA.
h. Ambient Operating Temperatures: Minus 40 to 115 degrees F.

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a dust-tight cover.
6. Include knob and dial scale for setting delay time.
7. Performance:

a. Mechanical Life: At least 10 million cycles.
b. Electrical Life: At least 100,000 cycles at rated load.
c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
d. Repeatability: Within 2 percent.
e. Recycle Time: 45 ms.
f. Minimum Pulse Width Control: 50 ms.
g. Power Consumption: 5 VA or less at 120-V ac.
h. Ambient Operating Temperatures: Minus 40 to 115 degrees F.

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with a multibladed plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Performance:

a. Mechanical Life: At least 10 million cycles.
b. Electrical Life: At least 100,000 cycles at rated load.
c. Pickup Time: 15 ms or less.
d. Dropout Time: 10 ms or less.
e. Pull-in Voltage: 85 percent of rated voltage.
f. Dropout Voltage: 50 percent of nominal rated voltage.
g. Power Consumption: 2 VA.
h. Ambient Operating Temperatures: Minus 40 to 115 degrees F.

7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:

1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:

1. Description:

a. On-off control and status indication in a single device.
b. LED status indication of activated relay and current trigger.
c. Closed-Open-Auto override switch located on the load side of the relay.

2. Performance:

a. Ambient Temperature: Minus 30 to 140 degrees F.
b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.

3. Status Indication:

a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
b. Current Sensor Range: As required by application.
c. Current Set Point: Fixed or adjustable as required by application.
d. Current Sensor Output:

1) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.

4. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.
5. Enclosure: NEMA 250, Type 1 enclosure.

2.20 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 100 VA.
3. Transformer shall have both primary and secondary fuses.

B. Transient Voltage Suppression and High-Frequency Noise Filter Unit:

1. The maximum continuous operating voltage shall be at least 125 percent.
2. The operating frequency range shall be 47 to 63 Hz.
3. Protection modes according to NEMA LS-1.
4. The rated single-pulse surge current capacity, for each mode of protection, shall be no less than the following:

    a. Line to Neutral: 45,000 A.
    b. Neutral to Ground: 45,000 A.
    c. Line to Ground: 45,000 A.
    d. Per Phase: 90,000 A.

5. Clamping voltages shall be in compliance with test and evaluation procedures defined in NEMA LS-1. Maximum clamping voltage shall be as follows:

    a. Line to Neutral: 360 V.
    b. Line to Ground: 360 V.
    c. Neutral to Ground: 360 V.

6. Electromagnetic interference and RF interference noise rejection or attenuation values shall comply with test and evaluation procedures defined in NEMA LS-1.

    a. Line to Neutral:

        1) 100 kHz: 42 dB.
        2) 1 MHz: 25 dB.
        3) 10 MHz: 21 dB.
        4) 100 MHz: 36 dB.

    b. Line to Ground:

        1) 100 kHz: 16 dB.
        2) 1 MHz: 55 dB.
        3) 10 MHz: 81 dB.
        4) 100 MHz: 80 dB.

7. Unit shall have LED status indicator that extinguishes to indicate a failure.
8. Unit shall be listed by an NRTL as a transient voltage surge suppressor per UL 1449, and as an electromagnetic interference filter per UL 1283.
9. Unit shall not generate any appreciable magnetic field.
10. Unit shall not generate an audible noise.

C. DC Power Supply:

1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
2. Enclose circuitry in a housing.
3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
4. Performance:

   a. Output voltage nominally 25-V dc within 5 percent.
   b. Output current up to 100 mA.
   c. Input voltage nominally 120-V ac, 60 Hz.
   d. Load regulation within 0.5 percent from zero- to 100-mA load.
   e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
   f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

2.21 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire size shall be at least No. 18 AWG.
2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 degrees C according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be a minimum No. 18 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 600-V, 90-degrees C rating and shall be Type TC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be a minimum No. 18 AWG.

2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.
3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 300-V, 105-degrees C rating and shall be Type PLTC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1. Cable shall be balanced twisted pair.
2. Comply with the following requirements and for balanced twisted pair cable described in Section 260523 "Control-Voltage Electrical Power Cables."

a. Cable shall be plenum rated.
b. Cable shall have a unique color that is different from other cables used on Project.

2.22 RACEWAYS

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for raceways for balanced twisted pair cables and optical fiber cables.

2.23 ACCESSORIES

A. Damper Blade Limit Switches:

1. Sense positive open and/or closed position of the damper blades.
2. NEMA 250, Type 13, oil-tight construction.
3. Arrange for the mounting application.
4. Additional waterproof enclosure when required by its environment.
5. Arrange to prevent "over-center" operation.

B. Instrument Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Hammond Mfg. Co. Inc.
b. Hoffman; brand of nVent Electrical plc.
c. Saginaw Control and Engineering.

2. Include instrument enclosure for secondary protection to comply with requirements indicated in "Performance Requirements" Article.
3. NRTL listed and labeled to UL 50.
4. Sized to include at least 25 percent spare area on subpanel.
5. Instrument(s) mounted within enclosure on internal subpanel(s).
6. Enclosure face with engraved, laminated phenolic nameplate for each instrument within enclosure.
7. Enclosures housing pneumatic instruments shall include main pressure gage and a branch pressure gage for each pneumatic device, installed inside.
8. Enclosures housing multiple instruments shall route tubing and wiring within enclosure in a raceway having a continuous removable cover.
9. Enclosures larger than 12 inches shall have a hinged full-size face cover.
10. Equip enclosure with lock and common key.

C. Manual Valves:

1. Needle Type:
   a. PTFE packing.
   b. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless-steel tubing.
   c. Aluminum T-bar handle.
   d. Include tubing connections.

2. Ball Type:

   a. Body: Bronze ASTM B 62 or ASTM B 61.
   b. Ball: Type 316 stainless steel.
   c. Stem: Type 316 stainless steel.
   d. Seats: Reinforced PTFE.
   e. Packing Ring: Reinforced PTFE.
   f. Lever: Stainless steel with a vinyl grip.
   g. 600 WOG.
   h. Threaded end connections.

D. Wall-Mounted Portable Workstation Cabinet:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. AtlasIED.
   b. Lowell Manufacturing Co.

2. Surface-mounted wall cabinet for tilt-out operation of laptop computers and large-format mobile devices.
3. Cabinet shall have a load limit of 50 lb.
4. Cabinet shall include the following:

   a. Oil-filled dampers for controlled lowering of equipment to operational position.
   b. 3RU EIA mounting rails.
   c. Removable laptop shelf.

d. Separate top compartment with mounting area, hinged rail and security lock.
e. Front ventilation slots.
f. Knockouts for conduit connections on top and bottom of cabinet.

5. Cabinet shall be constructed of steel and painted with a powder-coat epoxy.
6. Inside center of backbox shall have provision to mount a field-furnished and -installed, single gang electrical outlet box.

2.24 IDENTIFICATION

A. Control Equipment, Instruments, and Control Devices:

1. Laminated acrylic or melamine plastic sign bearing unique identification.

a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.

2. Letter size shall be as follows: 0.25 inch high.
3. Legend shall consist of white lettering on black background.
4. Laminated acrylic or melamine plastic sign shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer and shall be fastened with drive pins.
5. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.

B. Raceway and Boxes:

1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.

C. Equipment Warning Labels:

1. Self-adhesive label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

2.25 SOURCE QUALITY CONTROL

A. Product(s) and material(s) will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a 5 pound force.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop Penetrations Made in Fire-Rated Assemblies: Comply with requirements in Section 078413 "Penetration Firestopping."

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."

H. Welding Requirements:

1. Restrict welding and burning to supports and bracing.
2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.

I. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

J. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

K. Corrosive Environments:

1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:

   a. Laboratory exhaust-air streams.
   b. Process exhaust-air streams.

2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Network Controllers:

1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 84 inches of finished floor.

F. Installation of Programmable Application Controllers:

1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 84 inches of finished floor.

G. Application-Specific Controllers:

1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.4 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Electrical power devices.
5. UPS units.
6. Relays.
7. Accessories.
8. Instruments.
9. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use corrosion-resistant-coated steel strut and hardware.
2. For NEMA 250, Type 4X Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top of adjacent enclosures of like size.

3.5 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.

B. Install laminated acrylic or melamine plastic signs with unique identification on face for each of the following:

1. Gateway.
2. Router.
3. Protocol analyzer.
4. DDC controller.
5. Enclosure.
6. Electrical power device.
7. UPS unit.
8. Accessory.

C. Install unique instrument identification on face of each instrument connected to a DDC controller.

D. Install unique identification on face of each control damper and valve actuator connected to a DDC controller.

E. Warning Labels and Signs:

1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
2. Shall be located in highly visible location near power service entry points.

3.7 NETWORK INSTALLATION

A. Install cable in continuous raceway.

1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.8 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:

1. MAC Address:

a. Every network device shall have an assigned and documented MAC address unique to its network.
b. Ethernet Networks: Document MAC address assigned at its creation.
c. ARCNET or MS/TP networks: Assign from 00 to 64.

2. Network Numbering:

a. Assign unique numbers to each new network.
b. Provide ability for changing network number through device switches or operator interface.
c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3. Device Object Identifier Property Number:

a. Assign unique device object identifier property numbers or device instances for each device network.
b. Provide for future modification of device instance number by device switches or operator interface.
c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:

a. Device object name property field shall support 32 minimum printable characters.
b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".

5. Object Name Property Text for Other Than Device Objects:

a. Object name property field shall support 32 minimum printable characters.
b. Assign object name properties with plain-English names descriptive of application.

1) Example 1: "Zone 1 Temperature."
2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:

a. Assign object identifier property numbers according to Drawings indicated.

b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.9 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Wire and Cable Installation:

1. Comply with installation requirements in Section 260523 "Control-Voltage Electrical Power Cables."
2. Comply with installation requirements in Section 271313 "Communications Copper Backbone Cabling."
3. Comply with installation requirements in Section 271513 "Communications Copper Horizontal Cabling."
4. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 degrees C with no measurable effect on physical and electrical properties of cable.

    a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

5. Terminate wiring in a junction box.

    a. Clamp cable over jacket in junction box.
    b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.

6. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
7. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
8. Use shielded cable to transmitters.
9. Use shielded cable to temperature sensors.
10. Perform continuity and meager testing on wire and cable after installation.

C. Conduit Installation:

1. Comply with Section "260533 "Raceways and Boxes for Electrical Systems" for control-voltage conductors.
2. Comply with Section 270528 "Pathways for Communications Systems" for balanced twisted pair cabling and optical fiber installation.

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Testing:

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use an optical fiber time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

3.11 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. For pneumatic products, verify that air supply for each product is properly installed.

F. Control Damper Checkout:

1. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
2. Verify that control dampers are installed correctly for flow direction.
3. Verify that proper blade alignment, either parallel or opposed, has been provided.
4. Verify that damper frame attachment is properly secured and sealed.
5. Verify that damper actuator and linkage attachment is secure.
6. Verify that actuator wiring is complete, enclosed and connected to correct power source.

7. Verify that damper blade travel is unobstructed.

G. Control Valve Checkout:

1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
2. Verify that control valves are installed correctly for flow direction.
3. Verify that valve body attachment is properly secured and sealed.
4. Verify that valve actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that valve ball, disc or plug travel is unobstructed.
7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

H. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:

a. Verify sensing element type and proper material.
b. Verify length and insertion.

3.12 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.

G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

J. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:

1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.

O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

P. Switches: Calibrate switches to make or break contact at set points indicated.

Q. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.13 DDC SYSTEM CONTROLLER CHECKOUT

A. Verify power supply.

1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.
6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.

C. Verify that spare I/O capacity is provided.

3.14 DDC CONTROLLER I/O CONTROL LOOP TESTS

A. Testing:

1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:

   a. Upper quarter of range.
   b. Lower quarter of range.
   c. At midpoint of range.

8. Exercise each binary point.

9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.15 DDC SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.

B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.
5. Installed DDC system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. DDC system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller's programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.
15. Each control damper and actuator goes to failed position on loss of power.
16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.
22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

E. Test Plan:

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 10 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in DDC system.

    a. Verify analog I/O points at operating value.
    b. Make adjustments to out-of-tolerance I/O points.

        1) Identify I/O points for future reference.
        2) Simulate abnormal conditions to demonstrate proper function of safety devices.
        3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.

2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:

    a. Re-check I/O points that required corrections during initial test.
    b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.

5. After 24 Hours of Second Validation Test:

    a. Re-check I/O points that required corrections during second test.
    b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. DDC System Response Time Test:

1. Simulate HLC.

    a. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total

connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.

2. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.
3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
4. Purpose of test is to demonstrate DDC system, as follows:

    a. Reaction to COV and alarm conditions during HLC.
    b. Ability to update DDC system database during HLC.

5. Passing test is contingent on the following:

    a. Alarm reporting at printer beginning no more than two seconds after the initiation (time zero) of HLC.
    b. All alarms, both binary and analog, are reported and printed; none are lost.
    c. Compliance with response times specified.

6. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.

H. DDC System Network Bandwidth Test:

1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.16 DDC SYSTEM WIRELESS NETWORK VERIFICATION

A. DDC system Installer shall design wireless DDC system networks to comply with performance requirements indicated.

B. Installer shall verify wireless network performance through field testing and shall document results in a field test report.

C. Testing and verification of all wireless devices shall include, but not be limited to, the following:

1. Speed.
2. Online status.
3. Signal strength.

3.17 FINAL REVIEW

A. Submit written request to Engineer when DDC system is ready for final review. Written request shall state the following:

1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.

2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Review by Engineer shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals and begin procedures indicated in "Extended Operation Test" Article when no deficiencies are reported.

F. A part of DDC system final review shall include a demonstration to parties participating in final review.

1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.

3.18 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.19 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for one year(s).

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one year(s) from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

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3.20 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:

a. Provide not less than five days of training total.
b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
c. Total days of training shall be broken into not more than two separate training classes.
d. Each training class shall be not less than one consecutive day(s).

C. Training Schedule:

1. Schedule training with Owner 20 business days before expected Substantial Completion.
2. Schedule training to provide Owner with at least 10 business days of notice in advance of training.
3. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions. Each morning session and afternoon session shall be split in half with 15-minute break between sessions. Morning and afternoon sessions shall be separated by 30-minute lunch period. Training, including breaks and excluding lunch period, shall not exceed eight hours per day.
4. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Training Attendee Headcount:

1. Plan in advance of training for five attendees.
2. Make allowance for Owner to add up to one attendee(s) at time of training.
3. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.

F. Training Attendee Prior Knowledge: For guidance in planning required training and instruction, assume attendees have the following:

1. High school and technical school education and degree.
2. Basic user knowledge of computers and office applications.
3. Basic knowledge of HVAC systems.
4. Basic knowledge of DDC systems.
5. Basic knowledge of DDC system and products installed.

G. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

H. Instructor Requirements:

1. One or multiple qualified instructors, as required, to provide training.
2. Instructors shall have not less than five years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

I. Organization of Training Sessions:

1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:

   a. Daily operators.
   b. Advanced operators.
   c. System managers and administrators.

2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

J. Training Outline:

1. Submit training outline for Owner review at least 10 business day before scheduling training.

2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

K. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

L. Off-Site Training:

1. Provide conditioned training rooms and workspace with ample tables desks or tables, chairs, power and data connectivity for each attendee.
2. Provide capability to remotely access to Project DDC system for use in training.
3. Provide a workstation for use by each attendee.

M. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
13. Operating portable operator workstations.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
18. Executing digital and analog commands in graphic mode.

19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
21. Demonstrating scan, update, and alarm responsiveness.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:

    a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
    b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.
    c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
    d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
    e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
    f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
    g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

N. Training Content for Advanced Operators:

1. Making and changing workstation graphics.
2. Creating, deleting and modifying alarms including annunciation and routing.
3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
4. Creating, deleting and modifying reports.
5. Creating, deleting and modifying points.
6. Creating, deleting and modifying programming including ability to edit control programs off-line.
7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
9. Adding operator workstations.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.
12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.

15. Adjusting, calibrating and replacing DDC system components.

O. Training Content for System Managers and Administrators:

1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

P. Video of Training Sessions:

1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

END OF SECTION 230923

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SECTION 230923.11 - CONTROL VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control valves and actuators for DDC systems.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations made in fire-rated assemblies.
2. Section 079219 "Acoustical Joint Sealants" for penetrations made in acoustically rated assemblies.
3. Section 230923 "Direct Digital Control (DDC) System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS

A. Cv: Design valve coefficient.

B. DDC: Direct-digital control.

C. NBR: Nitrile butadiene rubber.

D. PTFE: Polytetrafluoroethylene

E. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation, and maintenance instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for pneumatic signal and main air tubing.

1.5 DELEGATED-DESIGN SUBMITTAL:

1. Schedule and design calculations for control valves and actuators, including the following:

a. Flow at project design and minimum flow conditions.
b. Pressure differential drop across valve at project design flow condition.
c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
d. Design and minimum control valve coefficient with corresponding valve position.
e. Maximum close-off pressure.
f. Leakage flow at maximum system pressure differential.
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Environmental Conditions:

1. Provide electric control valve actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control valve actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.

    a. Hazardous Locations: Explosion-proof rating for condition.

F. Determine control valve sizes and flow coefficients by ISA 75.01.01.

G. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

H. Selection Criteria:

1. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.
2. Valve pattern, three-way or straight through, shall be as indicated on Drawings.
3. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.
4. Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.
5. Modulating butterfly valves shall have linear or equal percentage flow-throttling characteristics.
6. Fail positions unless otherwise indicated:

    a. Chilled Water: Close.
    b. Heating Hot Water: Open.

7. Rotary-type control valves, such as ball and butterfly valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.
8. Selection shall consider viscosity, flashing, and cavitation corrections.
9. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.
10. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
11. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.
12. Modulating valve sizes for steam service shall provide a pressure drop at design flow equal to lesser of the following:

    a. 50 percent of the valve inlet pressure.
    b. 50 percent of the absolute steam pressure at the valve inlet.

13. Two-position control valves shall be line size unless otherwise indicated.
14. In water systems, use ball- or globe-style control valves for two-position control for valves NPS 2 and smaller and butterfly style for valves larger than NPS 2.
15. In steam systems, use ball- or globe-style control valves regardless of size.

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2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Belimo Aircontrols (USA), Inc.
    b. Honeywell.
    c. Johnson Controls Inc.
    d. Or equal.

2. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
3. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
4. Close-off Pressure: 200 psig.
5. Process Temperature Range: Zero to 212 deg F.
6. Body and Tail Piece: Cast bronze ASTM B61, ASTM B62, ASTM B584, or forged brass with nickel plating.
7. End Connections: Threaded (NPT) ends.
8. Ball: 300 series stainless steel.
9. Stem and Stem Extension:

    a. Material to match ball.
    b. Blowout-proof design.
    c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.

10. Ball Seats: Reinforced PTFE.
11. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
12. Flow Characteristic: Equal percentage.

B. Ball Valves with Two Ports and Characterized Disk:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Belimo Aircontrols (USA), Inc.
    b. Honeywell.
    c. Johnson Controls Inc.
    d. Or equal.

2. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
3. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
4. Close-off Pressure: 200 psig.
5. Process Temperature Range: Zero to 212 deg F.

6. Body and Tail Piece: Cast bronze ASTM B61, ASTM B62, ASTM B584, or forged brass with nickel plating.
7. End Connections: Threaded (NPT) ends.
8. Ball: 300 series stainless steel.
9. Stem and Stem Extension:

    a. Material to match ball.
    b. Blowout-proof design.
    c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.

10. Ball Seats: Reinforced PTFE.
11. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
12. Flow Characteristics for A-Port: Equal percentage.
13. Flow Characteristics for B-Port: Modified for constant common port flow.

2.3 BUTTERFLY-STYLE CONTROL VALVES

A. Commercial-Grade, Two-Way Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Belimo Aircontrols (USA), Inc.
    b. Honeywell.
    c. Johnson Controls Inc.
    d. Or equal.

2. Performance:

    a. Bi-directional bubble tight shutoff at 250 psig.
    b. Comply with MSS SP-67 or MSS SP-68.
    c. Rotation: Zero to 90 degrees.
    d. Linear or modified equal percentage flow characteristic.

3. Body: Cast iron ASTM A126, Class B, ductile iron ASTM A536 or cast steel ASTM A216/A216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
4. Disc: 316 stainless steel.
5. Shaft: 316 or 17-4 PH stainless steel.
6. Seat: Reinforced EPDM or reinforced PTFE with retaining ring.
7. Shaft Bushings: Reinforced PTFE or stainless steel.
8. Replaceable seat, disc, and shaft bushings.
9. Corrosion-resistant nameplate indicating:

    a. Manufacturer's name, model number, and serial number.
    b. Body size.

c. Body and trim materials.
d. Flow arrow.

B. Commercial-Grade, Three-Way Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Belimo Aircontrols (USA), Inc.
b. Honeywell.
c. Johnson Controls Inc.
d. Or equal.

2. Arrangement: Two valves mated to a fabricated tee with interconnecting mechanical linkage.
3. Performance:

a. Bi-directional bubble tight shutoff at 250 psig.
b. Comply with MSS SP-67 or MSS SP-68.
c. Rotation: Zero to 90 degrees.
d. Linear or modified equal percentage flow characteristic.

4. Body: Cast iron ASTM A126, Class B, ductile iron ASTM A536 or cast steel ASTM A216/A216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
5. Disc: 316 stainless steel.
6. Shaft: 316 or 17-4 PH stainless steel.
7. Seat: Reinforced EPDM or reinforced PTFE seat with retaining ring.
8. Shaft Bushings: Reinforced PTFE or stainless steel.
9. Replaceable seat, disc, and shaft bushings.
10. Corrosion-resistant nameplate indicating:

a. Manufacturer's name, model number, and serial number.
b. Body size.
c. Body and trim materials.
d. Flow arrow.

2.4 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Belimo Aircontrols (USA), Inc.
b. Honeywell.
c. Johnson Controls Inc.
d. Or equal.

B. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

C. Position indicator and graduated scale on each actuator.

D. Type: Motor operated, with or without gears, electric and electronic.

E. Voltage: Voltage selection delegated to professional designing control system 24-V ac.

F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

G. Function properly within a range of 85 to 120 percent of nameplate voltage.

H. Construction:

1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

I. Field Adjustment:

1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

J. Two-Position Actuators: Single direction, spring return or reversing type.

K. Modulating Actuators:

1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:

a. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero-10 or 2-10-V dc and 4-20-mA signals.

L. Position Feedback:

1. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

M. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.

2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

N. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

O. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

P. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

Q. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

R. Stroke Time:

1. Operate valve from fully closed to fully open within 90 seconds.
2. Operate valve from fully open to fully closed within 90 seconds.
3. Move valve to failed position within 30 seconds.
4. Select operating speed to be compatible with equipment and system operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL VALVE APPLICATIONS

1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

3.3 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 5 pound force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

H. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including. but not limited to, the following:

a. Laboratory exhaust airstreams.
b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.5 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Where indicated, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.

D. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 2.

E. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 2.

F. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
2. Install valves in a position to allow full stem movement.
3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

G. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

H. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

I. Flanged Valves:

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.6 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with valve identification on valve.

3.8 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.9 CHECKOUT PROCEDURES

A. Control Valve Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Verify that control valves are installed correctly for flow direction.
5. Verify that valve body attachment is properly secured and sealed.
6. Verify that valve actuator and linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. Verify that valve ball, disc, and plug travel are unobstructed.
9. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.10 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.11

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SECTION 230923.12 - CONTROL DAMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of control dampers and actuators for DDC systems:

1. Rectangular control dampers.
2. General control-damper actuator requirements.
3. Electric and electronic actuators.
4. Delegated Design.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations made in fire-rated assemblies.
2. Section 079219 "Acoustical Joint Sealants" for penetrations made in acoustically rated assemblies.
3. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS

A. DDC: Direct-digital control.

B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for air and process signal tubing.
5. Include diagrams for pneumatic signal and main air tubing.

1.5 DELEGATED DESIGN SUBMITTALS

A. Schedule and design calculations for control dampers and actuators, including the following.

1. Flow at project design and minimum flow conditions.
2. Face velocity at project design and minimum airflow conditions.
3. Pressure drop across damper at project design and minimum airflow conditions.
4. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
5. Maximum close-off pressure.
6. Leakage airflow at maximum system pressure differential (fan close-off pressure).
7. Torque required at worst case condition for sizing actuator.
8. Actuator selection indicating torque provided.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.

F. Environmental Conditions:

1. Provide electric control-damper actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control-damper actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.

a. Hazardous Locations: Explosion-proof rating for condition.

G. Selection Criteria:

1. Control dampers shall be suitable for operation at following conditions:

a. Supply Air: 3 inches water column.
b. Return Air: 3 inches water column .
c. Outdoor Air: 3 inches water column .
d. Mixed Air: 3 inches water column .
e. Exhaust Air: 3 inches water column .

2. Fail positions unless otherwise indicated:

a. Supply Air: Close.
b. Return Air: Open.
c. Outdoor Air: Close.
d. Exhaust Air: Close.

3. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
4. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.
5. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

2.2 RECTANGULAR CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.

B. Rectangular Dampers with Aluminum Airfoil Blades:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Greenheck.
    b. Pottorff.
    c. Ruskin Company.
    d. Or equal.

C. Requirements in subparagraphs below are based on Ruskin's "CD50 series."

1. Performance:

    a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
    b. Pressure Drop: 0.05-inch wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
    c. Velocity: Up to 6000 fpm.
    d. Temperature: Minus 40 to plus 185 degrees F.
    e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
    f. Damper shall have AMCA seal for both air leakage and air performance.

2. Construction:

    a. Frame:

        1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.
        2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
        3) Width not less than 5 inches.

    b. Blades:

        1) Hollow, airfoil, extruded aluminum.
        2) Parallel or opposed blade configuration as required by application.
        3) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.07 inch thick.
        4) Width not to exceed 6 inches.
        5) Length as required by close-off pressure, not to exceed 48 inches.

    c. Seals:

        1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
        2) Jambs: Stainless steel, compression type.

    d. Axles: 0.5-inch- diameter stainless steel, mechanically attached to blades.
    e. Bearings:

        1) Molded synthetic or stainless-steel sleeve mounted in frame.

2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of aluminum and stainless steel.
3) Hardware: Stainless steel.

g. Transition:

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection:

1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail in desired position in the event of a power failure.

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2.4 ELECTRIC AND ELECTRONIC ACTUATORS

A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:

1. 24 V.
2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Modulating Actuators:

1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:

    a. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.

G. Position Feedback:

1. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

H. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

I. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

K. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 degrees F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

L. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with a heater and controller where required by application.

M. Stroke Time:

1. Operate damper from fully closed to fully open within 90 seconds.
2. Operate damper from fully open to fully closed within 90 seconds.
3. Move damper to failed position within 30 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Provide products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 5 pound force.

C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:

1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER

A. Provide electrical power to products requiring electrical connections.

B. Provide circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Provide power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Provide raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL DAMPERS

A. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

B. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

C. Service Access:

1. Dampers and actuators shall be accessible for visual inspection and service.
2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."

D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

E. Attach actuator(s) to damper drive shaft.

F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.5 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with damper identification on damper.

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3.7 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Verify that control dampers are installed correctly for flow direction.
4. Verify that proper blade alignment, either parallel or opposed, has been provided.
5. Verify that damper frame attachment is properly secured and sealed.
6. Verify that damper actuator and linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. Verify that damper blade travel is unobstructed.

3.8 ADJUSTMENT, CALIBRATION, AND TESTING:

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.12

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SECTION 230923.23 - PRESSURE INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Air-pressure switches.
2. Liquid-pressure transmitters.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, anddetails.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

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1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

a. If instrument alone cannot comply with requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, filtered, and ventilated as required by instrument and application.

2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument-installed location shall dictate following NEMA 250 enclosure requirements:

a. Outdoors: Type 4X.
b. Indoors, Mezzanine Level: Type 1.
c. Indoors, Ground Floor: Type 1.
d. Indoors below Ground Floor: Type 4X.

2.2 AIR-PRESSURE SWITCHES

A. Air-Pressure Differential Switch:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Cleveland Controls Inc.
b. Dwyer Instruments, Inc.
c. Johnson Controls, Inc.

d. Penn Controls.

2. Diaphragm operated to actuate an DPDT snap switch.
3. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
4. Enclosure Conduit Connection: Knock out or threaded connection.
5. User Interface: Screw-type set-point adjustment located inside removable enclosure cover.
6. High and Low Process Connections: Threaded, NPS 1/8.
7. Enclosure: NEMA 250, Type 4.
8. Operating Data:

   a. Electrical Rating: 15 A at 120- to 480-V ac.
   b. Pressure Limits:

      1) Continuous: 45 inches wg.
      2) Surge: 10 psig.

   c. Temperature Limits: Minus 30 to 180 deg F.
   d. Operating Range: Approximately 2 times set point.
   e. Repeatability: Within 3 percent.
   f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 LIQUID-PRESSURE TRANSMITTERS

A. Liquid-Pressure Differential Transmitter:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Dwyer Instruments, Inc.
   b. Setra Systems Inc.

2. Performance:

   a. Range: Approximately 2 times set point.
   b. Span: Adjustable plus or minus one milliamp, noninteractive.
   c. Accuracy: Within 0.25 percent of full scale.
   d. Pressure: Maximum operating pressure 2.5 times range.
   e. Temperature Limits: Zero to 175 deg F.
   f. Compensate Temperature Limits: 30 to 150 deg F.
   g. Thermal Effects: 0.02 percent of full scale per degree F.
   h. Response Time: 30 to 50 ms.
   i. Shock and vibration shall not harm the transmitter.

3. Analog Output Current Signal:

   a. Two-wire, 4- to 20-mA dc current source.

b. Signal capable of operating into 1000-ohm load.

4. Operator Interface:

a. Zero and span adjustments located behind cover.
b. Bleed screws on side of body, two screws on low-pressure side, and one screw on high-pressure side, for air in line and pressure cavity.

5. Construction:

a. Aluminum and stainless-steel enclosure with removable cover.
b. Wetted parts of transmitter constructed of 17-4 PH or 300 Series stainless steel.
c. Threaded, NPS 1/4 process connections on side of instrument enclosure.
d. Knock out for 1/2-inch nominal conduit connection on side of instrument enclosure.
e. Screw terminal block for wire connections.
f. NEMA 250, Type 4X.
g. Mounting Bracket: Appropriate for installation.

6. Three-valve manifold. Construct manifold of brass, bronze, or stainless steel. Manifold shall have threaded, NPS 1/4 process connections.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled pressure instruments, as indicated by instrument requirements. Affix standards organization's certification and label.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement, sway, or a break in attachment when subjected to a 5 pound force.

C. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not to overstress threads by using excessive force or oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

F. Corrosive Environments:

1. Use products that are suitable for environment to which they are subjected.
2. If possible, avoid or limit use of materials in corrosive environments.
3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRICAL POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 PRESSURE INSTRUMENT INSTALLATION

A. Mounting Location:

1. Rough-in: Outline instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
2. Install switches and transmitters for air and liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
3. Install liquid and steam pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Install air-pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
6. Install instruments (except pressure gages) in steam, liquid, and liquid-sealed piped services below their process connection point. Slope tubing down to instrument with a slope of 2 percent.
7. Install instruments in dry gas and noncondensable vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.

B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

C. Duct Pressure Sensors:

1. Install sensors using manufacturer's recommended upstream and downstream distances.
2. Unless indicated on Drawings, locate sensors approximately 50 percent of distance of longest hydraulic run. Location of sensors shall be submitted and approved before installation.
3. Install mounting hardware and gaskets to make sensor installation airtight.
4. Route tubing from the sensor to transmitter.
5. Use compression fittings at terminations.
6. Install sensor in accordance with manufacturer's instructions.
7. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.

D. Air-Pressure Differential Switches:

1. Install air-pressure sensor in system for each switch connection. Install sensor in an accessible location for inspection and replacement.
2. A single sensor may be used to share a common signal to multiple pressure instruments.
3. Install access door in duct and equipment to access sensors that cannot be inspected and replaced from outside.
4. Route NPS 3/8 tubing from sensor to switch connection.

5. Do not mount switches on rotating equipment.
6. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
7. Install switches in an easily accessible location serviceable from floor.
8. Install switches adjacent to system control panel if within 50 feet; otherwise, locate switch in vicinity of system connection.

E. Liquid-Pressure Transmitters:

1. Where process connections are installed in mechanical equipment room, install transmitter in convenient and accessible location near system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate transmitter near system control panel.
3. Where multiple transmitters serving same system are installed in same room, install transmitters by system to provide service personnel a single and convenient location for inspection and service.
4. System process tubing connection shall be full size of switch connection, but not less than NPS 1/2. Install stainless-steel bushing if required to mate switch to system connection.
5. Connect process tubing from point of system connection and extend to transmitter.
6. Install isolation valves in process tubing as close to system connection as practical.
7. Install dirt leg and drain valve at each transmitter connection.
8. Do not mount transmitters on equipment.
9. Install in a location free from vibration, heat, moisture, or adverse effects, which could damage and hinder accurate operation.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification.

3.6 CHECKOUT PROCEDURES

A. Check out installed products before continuity tests, leak tests, and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

3.7 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
4. Equipment and procedures used for calibration shall comply with instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of project design values.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

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3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate pressure instrument demonstration video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 230923.23

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SECTION 230923.27 - TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Air temperature sensors.
2. Air temperature switches.
3. Liquid and steam temperature sensors.
4. High-end, commercial-grade, liquid and steam temperature transmitters.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS

A. RTD: Resistance temperature detector.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation, and maintenance instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to room, duct, pipe, and equipment.
2. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
3. Sizes and locations of wall access panels for instruments installed behind walls.
4. Sizes and locations of ceiling access panels for instruments installed in inaccessible ceilings.

B. Product Certificates: For each product requiring a certificate.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

    a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, filtered, and ventilated as required by instrument and application.

2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:

    a. Outdoors: Type 4X.

b. Indoors, Mezzanine Level: Type 1.
c. Indoors, Ground Floor: Type 1.
d. Indoors below Ground Floor: Type 4X.

2.2 AIR TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:

1. 100 or 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:

   a. Range: Minus 50 to 275 deg F.
   b. Interchangeable Accuracy: At 32 deg F within 0.5 deg F.
   c. Repeatability: Within 0.5 deg F.
   d. Self-Heating: Negligible.

4. Transmitter Requirements:

   a. Transmitter required for each 100-ohm RTD.
   b. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.

B. Thermal Resistors (Thermistors): Common Requirements:

1. 10,000 ohms at 25 deg C and a temperature coefficient of 23.5 ohms/ohm/deg C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:

   a. Range: Minus 50 to 275 deg F.
   b. Interchangeable Accuracy: At 77 deg F within 0.5 deg F.
   c. Repeatability: Within 0.5 deg F.
   d. Drift: Within 0.5 deg F over 10 years.
   e. Self-Heating: Negligible.

4. Transmitter optional, contingent on compliance with end-to-end control accuracy.

C. Thermistor, Single-Point Duct Air Temperature Sensors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Dwyer Instruments, Inc.
   b. Honeywell International Inc.
   c. Johnson Controls Inc.
   d. Or equal.

2. Temperature Range: Minus 50 to 275 deg F

3. Probe: Single-point sensor with a stainless-steel sheath.
4. Length: As required by application to achieve tip at midpoint of air tunnel, up to 18 inches.
5. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
6. Gasket for attachment to duct or equipment to seal penetration airtight.
7. Conduit Connection: 1/2- inch trade size

D. Thermistor Outdoor Air Temperature Sensors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Dwyer Instruments, Inc.
    b. Honeywell International Inc.
    c. Johnson Controls Inc.
    d. Or equal.

2. Temperature Range: Minus 50 to 275 deg F
3. Probe: Single-point sensor with a stainless-steel sheath.
4. Solar Shield: Stainless steel.
5. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
6. Conduit Connection: 1/2-inch trade size.

E. Space Air Temperature Sensors for Use with DDC Controllers Controlling Terminal Units:

1. 100-ohm platinum RTD or thermistor.
2. Thermistor:

    a. Pre-aged, burned in, and coated with glass; inserted in a metal sleeve; and entire unit encased in epoxy.
    b. Thermistor drift shall be less than plus or minus 0.5 deg F over 10 years.

3. Temperature Transmitter Requirements:

    a. Mating transmitter required with each 100-ohm RTD.
    b. Mating transmitters optional for 1000-ohm RTD and thermistor, contingent on compliance with end-to-end control accuracy.

4. Provide digital display of sensed temperature.

2.3 AIR TEMPERATURE SWITCHES

A. Thermostat and Switch for Low Temperature Control in Duct Applications:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dwyer Instruments, Inc.
b. Honeywell International Inc.
c. Johnson Controls Inc.
d. Or equal.

2. Description:

a. Two-position control.
b. Field-adjustable set point.
c. Manual reset.
d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Performance:

a. Operating Temperature Range: 15 to 55 deg F.
b. Temperature Differential: 5 deg F, non-adjustable and additive.
c. Enclosure Ambient Temperature: Minus 20 to 140 deg F.
d. Sensing Element Maximum Temperature: 250 deg F.
e. Voltage: 120-V ac.
f. Current: 16 FLA.
g. Switch Type: Two SPDT snap switches operate on coldest 12-inchsection along element length.

4. Construction:

a. Vapor-Filled Sensing Element: Nominal 20 feetlong.
b. Dual Temperature Scale: Fahrenheit and Celsius visible on face.
c. Set-Point Adjustment: Screw.
d. Enclosure: Painted metal, NEMA 250, Type 1.
e. Electrical Connections: Screw terminals.
f. Conduit Connection: 1/2-inch trade size.

2.4 AIR TEMPERATURE RTD TRANSMITTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Dwyer Instruments, Inc.
2. Honeywell International Inc.
3. Johnson Controls Inc.
4. Or equal.

B. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.

C. House electronics in NEMA 250 enclosure.

1. Duct: Type 4.
2. Outdoor: Type 4X.

3. Space: Type 4.

D. Conduit Connection: 1/2-inch

E. Functional Characteristics:

1. Input:

a. 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
b. 1000-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.

2. Span (Adjustable):

a. Space: 40 to 90 deg F.
b. Supply Air Cooling and Heating: 40 to 120 deg F.
c. Supply Air Cooling Only: 40 to 90 deg F.
d. Supply Air Heating Only: 40 to 120 deg F.
e. Exhaust Air: 50 to 100 deg F.
f. Return Air: 50 to 100 deg F.
g. Mixed Air: Minus 40 to 140 deg F.
h. Outdoor: Minus 40 to 140 deg F.

3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc .
4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.
5. Match sensor with temperature transmitter and factory calibrate together.

F. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

2.5 LIQUID AND STEAM TEMPERATURE SENSORS, COMMERCIAL GRADE

A. RTD:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dwyer Instruments, Inc.
b. Honeywell International Inc.
c. Johnson Controls Inc.
d. Or equal.

2. Description:

a. Platinum with a value of 100 or 1000ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
b. Encase RTD in a stainless-steel sheath with a 0.25-inch OD.
c. Sensor Length: 4, 6, or 8 inchesas required by application.
d. Process Connection: Threaded, NPS 1/2
e. Two-stranded copper lead wires.
f. Powder-coated steel enclosure, NEMA 250, Type 4.
g. Conduit Connection: 1/2-inch
h. Performance Characteristics:

1) Range: Minus 40 to 210 deg F.
2) Interchangeable Accuracy: Within 0.54 deg F at 32 deg F.

B. Thermowells:

1. Stem: Straight or stepped shank formed from solid bar stock.
2. Material: stainless steel.
3. Process Connection: Threaded, NPS 3/4.
4. Sensor Connection: Threaded, NPS 1/2.
5. Bore: Sized to accommodate sensor with tight tolerance between sensor and well.
6. Furnish thermowells installed in insulated pipes and equipment with an extended neck.
7. Length: 4, 6, or 8 inchesas required by application.
8. Thermowells furnished with heat-transfer compound to eliminate air gap between wall of sensor and thermowell and to reduce time constant.

2.6 LIQUID AND STEAM TEMPERATURE TRANSMITTERS, COMMERCIAL GRADE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Dwyer Instruments, Inc.
2. Honeywell International Inc.
3. Johnson Controls Inc.
4. Or equal.

B. House electronics in NEMA 250, Type 4X enclosure.

C. Enclosure Connection: 1/2-inch trade size.

D. Functional Characteristics:

1. Input: 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two- or three-wire sensors.
2. Default Span (Adjustable):

a. Chilled Water: Zero to 100 deg F.
b. Heating Hot Water: 32 to 212 deg F.

3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc.

4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.
5. Match sensor with temperature transmitter and factory calibrate together. Each matched sensor and transmitter set shall include factory calibration data traceable to NIST.

E. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 5 pound force.

C. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

E. Corrosive Environments:

1. Use products that are suitable for environment to which they are subjected.
2. If possible, avoid or limit use of materials in corrosive environments.
3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 TEMPERATURE INSTRUMENT INSTALLATIONS

A. Mounting Location:

1. Roughing In:

   a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
   b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.

      1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
      2) Do not begin installation without submittal approval of mounting location.

   c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Engineer on request.

2. Install switches and transmitters for air and liquid temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
3. Install liquid and steam temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.

4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Special Mounting Requirements:

1. Protect products installed outdoors from solar radiation, building and wind effect with stand-offs and shields constructed of Type 316 stainless.
2. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.

C. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 72 inchesabove the adjacent floor, grade, or service catwalk or platform.

    a. Make every effort to mount at 60 inches.

D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

E. Space Temperature Sensor Installation:

1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.
2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
3. In finished areas, recess electrical box within wall.
4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.
5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.

F. Outdoor Air Temperature Sensor Installation:

1. Mount sensor in a discrete location facing north.
2. Protect installed sensor from solar radiation and other influences that could impact performance.
3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.

G. Single-Point Duct Temperature Sensor Installation:

1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed 24 inches in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

H. Averaging Duct Temperature Sensor Installation:

1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of 20 sq. ft. and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.
4. If required to have transmitter, mount transmitter in an accessible and serviceable location.

I. Low-Limit Air Temperature Switch Installation:

1. Install multiple low-limit switches to maintain coverage over entire cross-sectional area of air tunnel.
2. Fasten and support sensing element with manufacturer-furnished clips to keep element taut throughout entire length.
3. Mount switches outside of airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.
4. Install on entering side of cooling coil unless otherwise indicated on Drawings.

J. Liquid Temperature Sensor Installation:

1. Assembly shall include sensor, thermowell and connection head.
2. For pipe NPS 4 and larger, install sensor and thermowell length to extend into pipe between 50 to 75 percent of pipe cross section.
3. For pipe smaller than NPS 4:

    a. Install reducers to increase pipe size to NPS 4at point of thermowell installation.
    b. For pipe sizes NPS 2-1/2 and NPS 3, thermowell and sensor may be installed at pipe elbow or tee to achieve manufacturer-recommended immersion depth in lieu of increasing pipe size.
    c. Minimum insertion depth shall be 2-1/2 inches.

4. Install matching thermowell.
5. Fill thermowell with heat-transfer fluid before inserting sensor.
6. Tip of spring-loaded sensors shall contact inside of thermowell.

7. For insulated piping, install thermowells with extension neck to extend beyond face of insulation.
8. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement. If top dead center location is not possible due to field constraints, install thermowell at location along top half of pipe.
9. For applications with transmitters, mount transmitter remote from sensor in an accessible and serviceable location from floor.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification.

3.6 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.7 CHECK-OUT PROCEDURES

A. Check installed products before continuity tests, leak tests, and calibration.

B. Check temperature instruments for proper location and accessibility.

C. Verify sensing element type and proper material.

D. Verify location and length.

E. Verify that wiring is correct and secure.

3.8 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform according to manufacturer's written instruction.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports.

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3.10 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.

B. Provide a complete set of instructional videos covering each product specified and installed and showing the following:

1. Software programming.
2. Calibration and test procedures.
3. Operation and maintenance requirements and procedures.
4. Troubleshooting procedures.

C. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

D. Record videos on DVD disks.

E. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 230923.27

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SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Joining materials.
4. Transition fittings.
5. Dielectric fittings.
6. Bypass chemical feeder.
7. Automatic Glycol Feed System

B. Related Requirements:

1. Steam and condensate heating piping is included in Section 232213.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe.
2. Fittings.
3. Joining materials.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.
5. Seismic and thermal analysis for pipe supports, anchors and guides.

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1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services, including light fixture and sprinkler layouts.
3. Structural members.
4. Architectural layout showing smoke and firewalls, floors and full height walls/partitions.

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports.

E. Welding inspection certificates

F. Preconstruction Test Reports:

1. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," ASME B31.3 "Process Piping" or ASME B31.1 "Power Piping" for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on water quality.

B. Preconstruction Testing for Existing Hydronic Systems: Contractor shall engage a Testing and Balancing agent/organization. Agency shall test and document water flows of existing pumps, mains and specified branches. Agency shall comply with requirements of Section 230593 "Testing, Adjusting, and Balancing for HVAC."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping, gaskets, and covering shall comply with ASTM 25/50, Flame Spread/Smoke Developed testing.

B. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 150 psig at 250 deg F.
2. Chilled-Water Piping: 150 psig at 100 deg F.
3. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Hard-Drawn-Temper Copper Tubing: ASTM B88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B88, Type K.

C. DWV Copper Tubing: ASTM B306, Type DWV.

D. Copper or Bronze Pressure-Seal Fittings:

1. Housing: Copper.
2. O-Rings and Pipe Stops: EPDM.
3. Tools: Manufacturer's special tools.
4. Minimum 200-psig working-pressure rating at 250 deg F.

E. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Anvil International.
   b. Grinnell G-Fire by Johnson Controls Company.
   c. Victaulic Company.
   d. Or equal.

2. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Victaulic Company.
   b. Viega LLC.
   c. Or equal.

2. Housing: Steel.
3. O-Rings and Pipe Stop: EPDM.
4. Tools: Manufacturer's special tool.
5. Minimum 300-psig working-pressure rating at 230 deg F.

J. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F or 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 125 psig minimum at 180 deg F.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Description:

a. Standard: IAPMO PS 66.
b. Electroplated steel nipple, complying with ASTM F1545.
c. Pressure Rating: 300 psig at 225 deg F.
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

2.6 BYPASS CHEMICAL "SHOT" FEEDER

A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.7 AUTOMATIC GLYCOL FEED SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Neptune Chemical Pump Co. Inc., model G-50-1-RC or comparable product by one of the following:

1. Bell and Gossett.
2. A&F Machine Products Company.

B. Description: The system automatically maintains pressure in the piping system by adding premixed glycol solution to make-up losses in the system.

C. Pump: 1.5 gpm bronze gear pump

D. Tank: 50-gallon polyethylene mounted in a steel frame with float switch for low level pump shutoff and alarm.

E. Control is by an adjustable pressure control switch. The pressure range shall be selected based on the pressures expected in the system.

F. Control Components:

1. NEMA 4X Control Panel

2. Hand-off auto-selector switch for pump motor
3. Pump "on" indicator light
4. "Low" tank level indicator light
5. Dry contact for remote low level indication
6. Hand-Off-Auto selector switch
7. Float switch for pump shutoff and activate light and audible alarm
8. Dry contact for remote alarm

G. Power: 115 volt, single phase.

H. Discharge piping accessories:

1. Shutoff ball valve
2. Check valve
3. Relief valve
4. Pressure valve
5. Pressure switch

I. Suction piping accessories:

1. Shutoff ball valve
2. Strainer

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, hard-drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed, or pressure-seal joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, hard-drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed, or pressure-seal joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

E. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install air vents, consisting of a tee, 3/4-inch ball valve, short threaded nipple with cap or an automatic vent at all system high points.

N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

P. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

Q. Install valves according to the following:

1. Section 230523.12 "Ball Valves for HVAC Piping."
2. Section 230523.13 "Butterfly Valves for HVAC Piping."

R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated. Route piping and install unions and shutoff valves to allow equipment removal without disturbing piping.

S. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

T. Install shutoff valve immediately upstream of each dielectric fitting.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges and flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Install hangers for fiberglass piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support horizontal piping within 12 inches of each fitting and coupling.

G. Support vertical runs of copper tubing and steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

H. Support vertical runs of fiberglass piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply flux to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using solder alloy.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

1. pH: 9.0 to 10.5.
2. "P" Alkalinity: 100 to 500 ppm.
3. Boron: 100 to 200 ppm.
4. Chemical Oxygen Demand: Maximum of 100 ppm. Revise this value if closed system contains glycol.
5. Corrosion Inhibitor:

    a. Sodium Nitrate: 1000 to 1500 ppm.
    b. Molybdate: 200 to 300 ppm.
    c. Chromate: 200 to 300 ppm.
    d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
    e. Chromate Plus Molybdate: 50 to 100 ppm each.

6. Soluble Copper: Maximum of 0.20 ppm.
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum of 10 ppm.
8. Total Suspended Solids: Maximum of 10 ppm.
9. Ammonia: Maximum of 20 ppm.
10. Free Caustic Alkalinity: Maximum of 20 ppm.
11. Microbiological Limits:

    a. Total Aerobic Plate Count: Maximum of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maximum of 100 organisms/mL.
    c. Nitrate Reducers: 100 organisms/mL.

d. Sulfate Reducers: Maximum of zero organisms/mL.
e. Iron Bacteria: Maximum of zero organisms/mL.

B. Install bypass chemical feeders in each hydronic system where indicated.

1. Install in upright position with top of funnel not more than 48 inches above the floor.
2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.

C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

E. Fill systems that have antifreeze or glycol solutions with the following concentrations:

1. Hot-Water Heating Piping: Minimum of 40 percent propylene glycol.
2. Chilled-Water Piping: Minimum of 40 percent propylene glycol.
3. Dual-Temperature Heating and Cooling Water Piping: Minimum of 40 percent propylene glycol.
4. Glycol Cooling-Water Piping: Minimum of 40 percent propylene glycol.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or another source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any

vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

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SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hydronic specialty valves.
2. Air-control devices.
3. Strainers.
4. Connectors.

B. Related Requirements:

1. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
2. Section 230523.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
3. Section 230923.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product:

1. Include construction details and material descriptions for hydronic piping specialties.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

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1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Safety Valves and Pressure Vessels: Shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bell & Gossett; a Xylem brand; CB or a comparable product by one of the following:

    a. Taco Comfort Solutions.
    b. WATTS.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bell & Gossett; a Xylem brand; CB or a comparable product by one of the following:

    a. Victaulic Company.
    b. WATTS.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.

6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bell & Gossett; a Xylem brand; No. 97 or a comparable product by one of the following:

    a. Spirotherm, Inc.
    b. Taco Comfort Solutions.
    c. WATTS.

2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

C. Bladder-Type ASME Expansion Tanks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bell & Gossett; a Xylem brand; Series B or a comparable product by one of the following:

    a. AMTROL, Inc.
    b. Taco Comfort Solutions.
    c. WATTS.

2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Coalescing-Type Air and Dirt Separators:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Spirotherm; Series VDT or a comparable product by one of the following:

   a. AMTROL, Inc.
   b. Taco Comfort Solutions.
   c. WATTS.

2. Tank: Fabricated steel tank; ASME constructed and stamped for 125-psig (862-kPa) working pressure and 270 deg F (130 deg C) maximum operating temperature.
3. Coalescing Medium: Stainless steel.
4. Air Vent: Threaded to the top of the separator.
5. Inline Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; Class 150 flanged connections for NPS 2-1/2 (DN 65) and larger.
6. Blowdown Connection: Threaded to the bottom of the separator.
7. Size: Match system flow capacity.

2.3 STRAINERS

A. Cast Iron Y-Pattern Strainers for Steel Piping:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

B. Bronze Y-Pattern Strainers for Copper Tubing:

1. Body: ASTM B584 Cast Bronze
2. End Connections: Threaded.
3. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

2.4 CONNECTORS

A. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

B. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment, (shall not be used to connect misaligned parts).
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install cast iron Y-pattern strainers in steel piping systems, and bronze Y-pattern strainers in copper tubing systems.

END OF SECTION 232116

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SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Separately coupled, vertically mounted, in-line centrifugal pumps.

1.3 DEFINITIONS

A. ECM: Electronically commutated motor.

B. EPDM: Ethylene propylene diene monomer.

C. EPR: Ethylene propylene rubber.

D. FKM: Fluoroelastomer polymer.

E. HI: Hydraulic Institute.

F. NBR: Nitrile rubber or Buna-N

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump.

1. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.
2. Indicate pump's operating point on curves.

a. Show pump runout GPM.
b. Show NPSH required.
c. Show maximum BHP
d. Show motor selection with volts, phase and cycle.
e. Show shutoff head submergence for vertical turbine pumps.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong.
2. Bell and Gosset.
3. Taco.

B. Source Limitations: Obtain pumps from single source and from single manufacturer.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

D. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet, replaceable bronze wear rings, and threaded union-end connections.
2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft Sleeve: Type 304 stainless steel.
4. Pump Stub Shaft: Type 304 stainless steel.
5. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and EPDM rubber bellows and gasket. Include water slinger on shaft between motor and seal.
6. Seal Flushing: Flush, cool, and lubricate pump seal by directing pump discharge water to flow over the seal.
7. Pump Bearings: Permanently lubricated ball bearings.

E. Shaft Coupling: Rigid, axially-split spacer coupling to allow service of pump seal without disturbing pump or motor.

F. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Enclosure: Totally enclosed, fan cooled.
2. NEMA Premium Efficient motors as defined in NEMA MG 1.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Single-speed motor.

2.3 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong.
2. Bell and Gosset.
3. Taco.

B. Source Limitations: Obtain pumps from single source and from single manufacturer.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.

D. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.

2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Type 304 stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and EPDM bellows and gasket.
5. Pump Bearings: Re-greaseable ball bearings.

E. Shaft Coupling: Molded-rubber insert with interlocking spider capable of absorbing vibration.

F. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Enclosure: Totally enclosed, fan cooled.
2. NEMA Premium Efficient motors as defined in NEMA MG 1.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Single or Variable-speed motor.
6. Provide integral pump motor variable-speed controller.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting.
3. Bronze 16-mesh wire startup and Type 304 stainless steel permanent strainers with 3/16-inch.
4. Type 304 stainless steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig pressure rating, ductile-iron body, pump-discharge fitting.
3. Valve with multi-turn stem and memory stop to allow valve to be returned to its original position after shutoff.
4. Brass valve disc with EPDM rubber seat.
5. Type 304 stainless steel valve stem.
6. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
7. Brass gauge ports with integral check valve and orifice for flow measurement.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Equipment Mounting:

1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.

1. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Perform alignment service. When required by manufacturer to maintain warranty coverage, engage a factory-authorized service representative to perform it.

C. Comply with requirements in HI standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

D. Comply with pump and coupling manufacturers' written instructions.

E. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple-duty valve on discharge side of pumps.

F. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps.

1. Use startup strainer for initial system startup. Install permanent strainer element before turnover of system to Owner.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.

I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping. Use startup strainer for initial startup.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Hydronic pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

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SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pipe and fittings for steam and condensate piping:

1. Steel pipe and fittings.
2. Joining materials.

B. Related Requirements:

1. Section 232216 "Steam and Condensate Heating Piping Specialties" for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Steel pipe and fitting.
2. Joining material.

1.4 DELEGATED-DESIGN SUBMITTAL

A. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.

B. Locations of pipe anchors and alignment guides and expansion joints and loops.

C. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

D. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

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1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Field quality-control reports.

D. Welding inspector certification.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to the following:

1. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
3. Certify that each welding inspector has current AWS qualifications.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:

1. LP Steam Piping: 15 psig.
2. Condensate Piping: 250 deg F.
3. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
4. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, welded and seamless, Grade B, and Schedule as indicated in piping applications articles.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in piping applications articles.

C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in piping applications articles.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in piping applications articles.

E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in piping applications articles; raised ground face, and bolt holes spot faced.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

PART 3 - EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

A. LP Steam Piping, NPS 2 and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. LP Steam Piping, NPS 2-1/2 through NPS 18: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

C. Condensate piping above grade, NPS 2 and smaller, shall be the following:

1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

3.2 ANCILLARY PIPING APPLICATIONS

A. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

B. Vacuum-Breaker Piping: Outlet, same as service where installed.

C. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

K. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

O. Install steam branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe. Provide a minimum of two elbows "Z", for horizontal branch connections and full "swing joints" for branch connections to risers.

P. Install valves according to the following Sections or other Sections as needed:

1. Section 230523.11 "Globe Valves for HVAC Piping."
2. Section 230523.12 "Ball Valves for HVAC Piping."
3. Section 230523.13 "Butterfly Valves for HVAC Piping."
4. Section 230523.14 "Check Valves for HVAC Piping."
5. Section 230523.15 "Gate Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

U. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

V. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

W. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.
2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

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3.4 STEAM AND CONDENSATE PIPING SPECIALTIES INSTALLATION

A. Comply with requirements in Section 232216 "Steam and Condensate Heating Piping Specialties" for installation requirements for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for installation of hangers, supports, and anchor devices.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

C. Install hangers for steel steam supply piping and steel steam condensate piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for fiberglass piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of steel steam supply piping and steel steam condensate piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of fiberglass piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install traps and control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install vacuum breakers downstream from control valve, close to coil inlet connection, or on the coil.

E. Install a drip leg at coil outlet.

3.8 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform the following tests and inspections:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel,

pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.

3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

E. Prepare test and inspection reports.

END OF SECTION 232213

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SECTION 232216 - STEAM AND CONDENSATE HEATING PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following piping specialties for steam and condensate piping:

1. Y-Pattern Strainer
2. Steam traps.
3. Thermostatic air vents and vacuum breakers.

B. Related Requirements:

1. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for expansion fittings and loops.
2. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
3. Section 230523.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
4. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Strainer.
2. Steam trap.
3. Air vent and vacuum breaker.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to the following:

1. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:

1. LP Steam Piping: 15 psig.
2. Condensate Piping: 15 psig at 250 deg F.
3. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
4. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
5. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.2 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20-mesh strainer or perforated stainless-steel basket.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig working steam pressure.

2.3 STEAM TRAPS

A. Float and Thermostatic Steam Traps:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Armstrong International, Inc.
    b. Hoffman Specialty.
    c. Spirax Sarco, Inc.

2. Body and Bolted Cap: ASTM A 126 cast iron.
3. End Connections: Threaded.
4. Float Mechanism: Replaceable, stainless steel.
5. Head and Seat: Hardened stainless steel.
6. Trap Type: Balanced pressure.
7. Thermostatic Bellows: Stainless steel or monel.

8. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless-steel cage, valve, and seat.
10. Maximum Operating Pressure: 125 psig.

B. Inverted Bucket Steam Traps:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Armstrong International, Inc.
   b. Hoffman Specialty.
   c. Spirax Sarco, Inc.

2. Body and Cap: Cast iron.
3. End Connections: Threaded.
4. Head and Seat: Stainless steel.
5. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
6. Bucket: Brass or stainless steel.
7. Strainer: Integral stainless-steel inlet strainer within the trap body.
8. Air Vent: Stainless-steel thermostatic vent.
9. Pressure Rating: 250 psig.

2.4 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Armstrong International, Inc.
   b. Hoffman Specialty.
   c. Spirax Sarco, Inc.

2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Float, Valve, and Seat: Stainless steel.
5. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

B. Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Armstrong International, Inc.
b. Hoffman Specialty.
c. Spirax Sarco, Inc.

2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
5. O-Ring Seal: Ethylene propylene rubber.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

3.2 PIPING INSTALLATION

A. Install piping to permit valve servicing.

B. Install drains, consisting of a tee fitting, NPS 3/4 full-port ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

C. Install valves according to Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."

D. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment and elsewhere as indicated.

E. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full-port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

3.3 STEAM-TRAP INSTALLATION

A. Install steam traps in accessible locations as close as possible to connected equipment.

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B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

END OF SECTION 232216

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SECTION 232223 - STEAM CONDENSATE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes steam condensate pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated. Indicate pump's operating point on curves. Include receiver capacity and material.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 SINGLE-STAGE, CENTRIFUGAL PUMPS WITH ELEVATED RECEIVER

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. ITT Corporation.
2. Skidmore Pump.
3. Spirax Sarco Limited.
4. Sterling.

B. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pumps, controls, and accessories suitable for operation with steam condensate.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. ASME Compliance: Fabricate and label steam condensate receivers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Configuration: Duplex floor-mounted pump with elevated receiver, float switches, and connecting piping; rated to pump 212 deg F steam condensate.

D. Receiver:

1. Mounted on fabricated-steel supports.
2. Close-grained cast iron.
3. Externally adjustable float switches.
4. Water-level gage and dial thermometer.
5. Pressure gage at pump discharge.
6. Bronze isolation valves between receiver and pumps.
7. Lifting eyebolts.
8. Inlet cascade baffle and convex heads.
9. Cast-iron inlet strainer with self-cleaning bronze screen, dirt pocket, and cleanout plug on receiver inlet.

E. Pumps:

1. Centrifugal, close coupled.
2. Permanently aligned.
3. Bronze fitted with enclosed bronze impellers.
4. Replaceable bronze case rings.
5. Stainless-steel shafts.
6. Mechanical seals rated at 250 deg F.
7. Mounted on base below receiver.
8. Rated to operate with a minimum of 2 feet of NPSH.

F. Motor:

1. Enclosure: Totally enclosed, fan cooled.

G. Pipe: ASTM A53/A53M, Type S, Grade B or ASTM A106/A106M; Schedule 80; seamless steel.

H. Fittings NPS 2 and Smaller: ASME B16.1, Class 125 cast iron, threaded.

I. Fittings NPS 2-1/2 and Larger: ASTM A234/A234M, steel, for welded connections.

J. Control Panel:

1. Factory wired between pumps and float switches, for single external electrical connection.

2. Provide fused, control-power transformer if voltage exceeds 230 V ac.
3. NEMA 250, Type 4X enclosure with hinged door and grounding lug, mounted on pump.
4. Motor controller for each pump.
5. Electrical pump alternator.
6. Numbered terminal strip.
7. Disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install pumps according to HI 1.1-1.2, HI 1.3, and HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps.

D. Install thermometers and pressure gages.

E. Equipment Mounting:

1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties."

B. Where installing piping adjacent to machine, allow space for service and maintenance.

C. Install a ball and check valve at pump outlet.

D. Pipe drain to nearest floor drain for overflow and drain piping connections.

E. Install full-size vent piping, terminating in 180-degree elbow at point above highest steam system connection or as indicated.

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Clean strainers.
3. Set steam condensate pump controls.
4. Set pump controls for automatic start, stop, and alarm operation.
5. Perform the following preventive maintenance operations and checks before starting:

    a. Set float switches to operate at proper levels.
    b. Set throttling valves on pump discharge for specified flow.
    c. Check motors for proper rotation.
    d. Test pump controls and demonstrate compliance with requirements.
    e. Replace damaged or malfunctioning pump controls and equipment.
    f. Verify that pump controls are correct for required application.

6. Start steam condensate pumps according to manufacturer's written startup instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain steam condensate pumps.

END OF SECTION 232223

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Delegated Design.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.

11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 DELEGATED DESIGN SUBMITTALS

A. Sheet metal thicknesses.

B. Joint and seam construction and sealing.

C. Reinforcement details and spacing.

D. Materials, fabrication, assembly, and spacing of hangers and supports.

E. Design Calculations: Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Engage a qualified professional engineer, as defined in Section 014000 “Quality Requirements” to design the following:

1. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and New York State Mechanical Code.

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

D. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.

6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Stainless-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Stainless steel, all-thread rods and nuts.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

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PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Elbows: Use long-radius elbows wherever they fit.

M. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:

1. Ductwork shall be Type 304 stainless steel.
2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.4 DUCT SEALING

A. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. See drawings for ductwork pressure class, seal class and leakage class.

END OF SECTION 233113

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SECTION 233116 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Thermoset FRP ducts and fittings.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for nonmetal ducts.
2. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.
3. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 REFERENCES

A. SMACNA Publications:

1. Thermoset FRP Duct Construction Manual.
2. Seismic Restraint Manual - Guidelines for Mechanical Systems.
3. Round Industrial Dust Construction Standards

B. ASTM Publications:

1. D2996 – Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
2. C581 – Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service
3. D4097 – Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.
4. D3982 – Contact Molded “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Ducts.
5. E84 – Standard Method of Testing for Surface Burning Characteristics of Building Materials.
6. D3418 – Standard Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry

C. FM Approval Standards:

1. FM 4910.
2. FM 4922.

1.4 COORDINATION

A. Coordinate the location of the duct joints and flanges to accommodate the construction sequencing requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Thermoset FRP duct materials.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevation of top of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.6 DELEGATED DESIGN SUBMITTALS

A. Delegation of Duct Design:

1. Calculation shall be to ASTM D3982 – Contact Molded “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Ducts.
2. Duct materials and thicknesses.
3. Joint and seam construction and sealing.
4. Reinforcement details and spacing.
5. Design Calculations Submittals:

    a. Calculations, including analysis data, prepared by a qualified professional responsible for their preparation for designing the duct.

B. Delegation of Duct Supports:

1. Where the Drawings show support types and/or locations the delegated designer shall analyze the support types, locations, loads, and stresses for adequacy. The supports shall be modified, if required, installed, generally where shown.
2. Engage the services of an independent registered professional engineer, licensed in the of State of Connecticut, ordinarily engaged in the business of structural support design and

engineering to develop a detailed support system design, specific to the duct material, duct joints, and duct appurtenances proposed for use.

a. The proposed support engineer shall have at least 5 years of experience in the analysis and design of similar supports.

3. The support system design deliverables shall be an organized signed and sealed calculation and design package prepared by a Professional Engineer in the State of Connecticut that shall be submitted to the Engineer and will include:

a. A summary outlining design inputs, criteria, and assumptions made, organized by duct system.
b. Support calculations must include/consider duct dead weight, thermal expansion/contraction (if applicable), seismic (if applicable), wind (if applicable) effects.
c. A Nodal Map presenting each system in a graphical format showing the nodes that correspond with the selected and designed supports.
d. Coordinate support design and placement to eliminate clashes with existing or new infrastructure.

1) Complete duct support shop drawings shall be submitted.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

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1.8 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

B. NFPA Compliance:

1. NFPA 91, "Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including duct closure, reinforcements, and hangers and supports, shall comply with SMACNA's "Fibrous Glass Duct Construction Standards" and performance requirements and design criteria indicated.

1. Static-Pressure Classes: -15-inch wg to +15-inch wg.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions to comply with ASCE/SEI 7.

C. In general, provide substantially airtight FRP ductwork for any passageway used for conveying air, gas, or materials. Included are fittings, transitions, bracing, fasteners, sealers, and accessories such as access doors, turning vanes, and manual air balancing dampers. Provide ductwork of size and material as specified herein and as shown on the Drawings. All duct sizes indicated on the Drawings are clear, inside dimensions.

D. Submit for approval any change in duct sizes, offsets, transitions, and fittings that is required to accommodate job condition.

E. All ductwork, piping, and equipment shown on the Drawings is intended to be approximately correct to scale. Consult figured dimensions and detailed drawings of the furnished equipment for the actual dimensions and details. The sizes of ductwork and piping are shown, but the Drawings do not show every offset, fitting, hanger, or support that may be required. The Drawings do not show structural difficulties that may be encountered during construction. Furnish all necessary parts to make a complete working system ready for use without extra charge. Coordinate the system installation and routing with the work of all trades.

2.2 THERMOSET FRP DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ECS.
2. Daniel Company.
3. Belco Manufacturing.
4. Diamond Fiberglass.

5. Augusta Fiberglass
6. An-Cor.
7. Midwestern Fabricators.
8. Spunstrand.
9. Perry Fiberglass.
10. Or approved equal.

B. Duct and Fittings:

C. Duct and Fittings:

1. Thermoset FRP Resin:

a. Utilize corrosion-resistant vinyl ester resin with fire retardant. Utilize resin that does not require additives such as antimony which detract from visual inspection or deplete the corrosion resistance. Provide a resin that yields a translucent laminate.
b. Resins used in the laminate shall be premium corrosion resistant and fire retardant vinyl ester resin without the use of Antimony Trioxide additive. Resin shall be:

1) Derakane 510-B-400.
2) Cor VE 8401.
3) AOC Vipel K022.
4) Reichold's Dion Impact 9303-54.
5) Or equal.

c. The following materials are expected to be in the air stream or surrounding area. The resins used shall be suitable for all of the following:

1) Hydrogen Sulfide.
2) Organic compounds.

2. Round Duct: ASTM D2996, Type I, Grade 2, Class E, filament-wound duct, minimum wall thickness as follows, with tapered bell and spigot ends for adhesive joints, or plain ends with couplings.

a. Duct Thickness:

1) Based on 10:1 safety factor for pressure service and 5:1 safety factor for vacuum service.
2) Minimum Round Duct Wall Thickness:

a) 0-23 inch diameter: 0.225 inch.
b) 24-30 inch diameter: 0.275 inch.
c) 32-42 inch diameter: 0.375 inch.
d) 44-60 inch diameter: 0.525 inch.
e) 62 inches and greater diameter: 0.625 inch.

3. Laminates shall consist of a 20 mil (finished thickness) minimum chemical resistant interior liner with an apertured synthetic surface veil embedded in a resin rich surface. The corrosion barrier shall be a minimum of 100 mils thick and include not less than two

layers of 1-1/2 oz mat with 25 percent glass and 75 percent resin content. The structural layer shall be Type E filament winding glass or alternating layers of chopped strand mat and woven roving of sufficient thickness to meet the minimum thickness requirements specified. The exterior surface layer shall be resin rich “C” – glass or apertured nexus veil not less than 20 mils thick. Outside finish shall be pigmented, paraffinated gel coat with an ultraviolet inhibitor. The inner surface shall be free of cracks and crazing with a smooth finish and with an average of not over two pits per square foot, providing the pits are less than 1/8-in diameter and not over 1/32 -in deep and are covered with sufficient resin to avoid exposure of inner surface fabric. Some waviness is permissible as long as the surface is smooth and free of pits.

4. Fittings and Joints: All fittings such as elbows, laterals, tees and reducers shall be of the same resin as an equal or superior in strength to the adjacent duct section and shall have the same internal dimensions as the adjacent duct. Non flanged duct joints shall be butt wrapped or bell and spigot joints. Bell and spigot joints shall be sealed with a standard butt joint overlay as per ASTM D3982. The interior opening between the bell and spigot shall be sealed with a resin paste so that no glass fibers are exposed, and all voids are filled. Field cut duct ends and exposed glass fibers shall be resin coated prior to joint assembly to maintain a continuous interior corrosion barrier. Coat all exterior surfaces of joints with a paraffinated resin rich gel coat with UV inhibitors. Joints: Butt-wrapped, bell and spigot, or flanged.
5. Total width of overlay butt-wrap joints shall be not less than 6-in for diameters from 6-in up to and including 30-in, 36-in and larger shall be not less than 10-in.
6. Round Fittings: Compression or spray-up/contact, molded of same material, pressure class, and joining method as duct
7. Thermoset FRP Resin: Manufacture duct with resin that complies with UL 181, Class 1, maximum flame-spread index of 25 and maximum smoke developed index of 50 when tested by NRTL according to ASTM E84
8. Inner Liner: FSK liner rated by an NRTL to comply with UL 181, Class1.

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, and access doors and panels according to SMACNA's "Thermoset FRP Duct Construction Manual," Chapter 7, "Requirements."
2. Fabricate 90-degree round elbows:

    a. For duct 12 inches and smaller: a minimum of three segments and two prefabricated mitered joints
    b. For duct 14 inches and larger: a minimum of five segments and four prefabricated mitered joints Fabricate 45-degree round elbows with a minimum of two prefabricated mitered joints and three segments.

3. Fabricate 45-degree round elbows with a minimum of two prefabricated mitered joints and three segments.
4. Provide long-radius elbows unless otherwise noted.
5. Fabricate round elbows with a 1.5 radius-to-diameter ratio unless shown otherwise in the Drawings.
6. Fabricate duct elbows with integral stanchion and baseplate when necessary to support from the floor.
7. Fabricate ducts with a laminated ring, angle, or lug to support vertical sections.

8. There shall be not less than a 1/4 in buildup of FRP over the duct at each support and as shown on the Drawings.

E. Flanged Connections:

1. All connections to expansion joints, butterfly dampers, fire dampers, tanks, or other equipment shall be flanged. Gaskets shall be Viton with very good to excellent resistance to chemicals. Flanges shall be hand laid up to thickness specified ASTM 3982 except that minimum thickness shall be 3/4-in. Each flange face shall be ground flat, and a new 100 mil corrosion barrier shall be applied. The flange shall be anchored to a waxed table to ensure the flatness tolerance outlined above. The face shall be textured for use with full face Viton gaskets, 1/8-in minimum thickness. Flange drilling shall be as per ASTM D3982. All bolt holes shall be back spot faced for a washer seat. All flange bolts shall be torqued to values as recommended by manufacturer.
2. Hardware: Type 316 stainless steel.

F. FRP Transition Pieces:

1. Provide transition pieces as shown on drawings and specified herein.
2. Construction:

   a. Thickness of transition pieces shall be designed using a safety factor of 10 to 1 for pressure and 5 to 1 for vacuum service with the pressure classification listed below.
   b. Custom flanges shall be designed as required to connect to fans, coils, dampers and ductwork. Coordinate flange sizes to match approved equipment dimensions.

3. Pressure Classification: Manufacturer shall design transition pieces so that they shall be free from buckling, pulsing, warpage and sagging at design pressures.

G. Drains:

1. Provide drains in the main and branch ducts larger than 75 sq in in area for removal of condensate.
2. Predetermine locations of duct drains prior to manufacturer’s fabrication. Locate drains at each rise in duct or at the heel of drops to allow removal of condensate. Coordinate condensate collection with duct slope

H. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, and access doors and panels according to SMACNA's "Thermoset FRP Duct Construction Manual," Chapter 7, "Requirements."

2.3 HANGERS AND SUPPORTS

A. General

1. Provide duct hanger and support material gauges to comply with details on the Drawings. Where details are not provided, support FRP ductwork using details and methods

described in the SMACNA Thermoset FRP Duct Construction Manual. Include a minimum live load of 50 percent volume filled with water for the design of supports for systems shown with fire protection installed, as shown on the Drawings. Protect the duct from clamping force of strap hangers with a 1/8-inch-thick layer of neoprene pad.

2. Suspend ductwork with threaded rod, flat bar, split rings, structural shapes, or strut material. The use of metal strap or wire as suspension material is prohibited.
3. In locations where hangers are exposed to corrosive atmosphere, provide stainless steel hanger materials and attaching hardware, with a suitable protective coating, thermoplastic shapes, or fiberglass strut.
4. In locations where hangers are not subjected to corrosive fumes, hanger materials and attaching hardware may be fabricated of mild plated or coated steel or similar structural material.
5. Externally bond anchors to the duct when required. Driving screws into, or other penetrations of the duct are not permitted.
6. Provide supports which are independent of equipment and walls.

B. Upper Attachments:

1. Concrete Construction

   a. Utilize cast-in-place inserts as specified in another division of work are acceptable if written approved by Owner.
   b. Utilize expanding concrete anchors as specified in another division of work may be used if written approved by Owner.
   c. The use of powder-actuated fasteners is prohibited without prior written consent by the Owner.

2. Steel Construction:

   a. Acceptable Manufacturers:

      1) Fee and Mason Manufacturing Company.
      2) Anvil (Grinnell).
      3) Cooper B Line.
      4) Or equal.

   b. Support ductwork from structure or supplementary steel, utilizing beam clamps designed for the intended service. Other support hardware is prohibited without prior written consent by the Owner. Support from metal decks above is prohibited. Provide supplementary steel as detailed and as required.

C. Support Frames: Provide structural steel shapes or strut frames for support of ductwork, accessories, and HVAC system components with nuts, bolts, fittings, etc., compatible with the frame material.

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PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. General:

1. Install ducts with fewest possible joints.
2. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
3. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
4. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
5. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
6. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
7. Install fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards."
8. Install thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual."

B. Branch Takeoffs:

1. Provide takeoffs to equipment the same free area as the equipment outlet or the size shown, whichever is larger.
2. Position exhaust stream branches to avoid entry to the main at positions directly across from one another.
3. Tap branches into mains at an elevation that prevents condensation in the main from backflowing into the branch.

3.2 HANGER AND SUPPORT INSTALLATION

A. General Support Locations:

1. Locate hangers of ducts penetrating walls or partitions as though the walls will contribute no support to the duct.
2. Install hangers in pairs on exact opposite sides of duct. Install duct supports from floors and walls when necessary.
3. Install hangers at the midpoint of small- and medium-sized (less than 10 square feet) square elbows. On wide square elbows, install additional hangers at maximum allowable intervals (or less) measured along the heel lines of the elbows.
4. Provide a set of hangers at the midpoint of small- and medium-sized horizontal radius elbows with greater than 20-degree offset. Install one or more supplementary hangers along the inside and outside arcs of large-radius elbows of an angle when the length of these arcs exceeds the maximum hanger spacing length for that duct size.
5. Provide at least one set of hangers for short duct branches 3 feet or less in length.

6. Provide each duct riser with a minimum of two supports completely spanning the shaft opening at each floor. One pair of supports may be used to support more than one duct riser, provided that the strength of the supports is increased appropriately, and proper additional supplementary steel is used at the extra risers.
7. Support duct risers located between floors that are more than 15 feet high at each floor and halfway points between floors. The distance between intermediate supports on high floors should not exceed 12 feet for round ducts or 10 feet for rectangular ducts (intermediate hangers may be supported from an adjacent wall or hung by rods from supports on the floor above).

B. Specific Support Locations – Locate Duct Hangers:

1. Approximately 2 to 24 inches from flexible connections at fans.
2. Approximately 12 to 36 inches from the main duct to the first hanger of long branch ducts.
3. Approximately 2 inches to half the duct width, plus 2 inches from the vertical centerline of the lower elbow of short vertical offsets made with vaned square elbows. The width refers to the dimension of the elbow in the plane of the turn. The heavier the duct, the closer the hanger should be to the centerline of the elbow.
4. Approximately 2 inches to half the duct width, plus 2 inches from the vertical centerline of the bottom and top elbows of vaned square elbow offsets over 8 feet high. Increase the diameters of hanger rods of heavy offsets proportionately. The heavier the duct, the closer the hanger should be to the centerline of the elbow.
5. Approximately one-eighth of the arc in from the ends of bottom and top radius elbows of vertical offsets longer than 8 feet. Short vertical offsets require hangers at the bottom elbow. Sloping offsets need at least one set of hangers at their lower-radius elbow. Fasten hangers on sloping or arched surfaces to ducts to prevent slippage.
6. Approximately 6 to 12 inches from transverse joints of ducts whose lengths are the same as specified hanger intervals.
7. Approximately 6 to 12 inches from one side of walls or partitions penetrated by ducts.

C. Support Method:

1. Support low ductwork from floors or other steel structures acceptable to the Owner using struts or structural steel shapes or bars. Where possible, maintain 6 inches clear between the bottom of the duct and the supporting structure.
2. Support ductwork suspended from overhead structure using trapeze supports for rectangular ducts or straps for round ducts 10 inches in diameter and smaller with the hanger strap wound completely around the duct. Use rolled split angles as detailed on Drawing for round ducts 12 inches in diameter and larger. Use threaded rod for support from above.
3. Use of sheet metal screws for attaching support straps to ducts is prohibited.
4. Trim support material to minimum length after elevation is adjusted.
5. Provide supports at fittings and takeoffs as required to prevent stresses at joints.
6. Support ductwork from structural steel, supplementary steel, or concrete ribs. Submit the supporting methods from pre-cast concrete elements for review. Support from metal decks above is prohibited. Provide supplementary steel as required.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the entire duct system.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.4 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.5 DUCT SCHEDULE

A. Fabricate ducts to achieve SMACNA pressure class as indicated below:

1. Pressure Class: Positive 15-inch wg.
2. Pressure Class: Negative 15-inch wg.

B. Design ducts and thermal expansion system to accommodate 120 degrees F of ambient temperature range.

END OF SECTION 233116

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SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Flange connectors.
3. Turning vanes.
4. Duct-mounted access doors.
5. Flexible connectors.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

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1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

A. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Greenheck.
b. McGill AirFlow LLC.
c. Pottorff.
d. Ruskin Company.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Axles: Stainless steel.
7. Bearings:

a. Stainless-steel sleeve.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

B. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.2 DUCT SMOKE DETECTORS FOR UNCLASSIFIED AIR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

1. Air Products and Controls.
2. System Sensor.

B. Type: UL or CSA listed, photoelectric.

C. Housing: Refer to Materials of Construction Schedule.

D. Sampling Tube Material: Galvanized steel for galvanized steel ducts. Aluminum for aluminum ducts.

E. Operating Voltage: 115 VAC, 24 VAC, or 24 VDC.

F. Relay Contacts: Alarm condition, trouble condition, and equipment shutdown.

2.3 FLANGE CONNECTORS

A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gauge and Shape: Match connecting ductwork.

2.4 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Aero-Dyne Sound Control Co.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.5 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Greenheck Fan Corporation.
4. Pottorff.
5. Ruskin.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

    a. Double wall, rectangular.
    b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    c. Vision panel.
    d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
    e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

    a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    b. Access Doors up to 18 Inches Square: Continuousand two sash locks.
    c. Access Doors up to 24 by 48 Inches: Continuousand two compression latches with outside and inside handles.
    d. Access Doors Larger Than 24 by 48 Inches: Continuousand two compression latches with outside and inside handles.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

2.7 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

H. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

I. Install flexible connectors to connect ducts to equipment.

J. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

K. Install duct test holes where required for testing and balancing purposes.

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3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

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SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Utility set fans.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties, and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor basis, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

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1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in normal operation, emergency, operation, and maintenance manuals with replacement parts listing.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AMCA Compliance:

1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

2.2 UTILITY SET FANS - SUPPLY

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck.
2. Loren Cook Company.
3. New York Blower Company (The).
4. Twin City Blower.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fan utility vent sets, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

C. Housings:

1. Housing Material: Reinforced steel.
2. Housing Coating: Industrial grade alkyd enamel.
3. Formed panels to make curved-scroll housings with shaped cutoff.
4. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
5. Discharge Arrangement: Fan scroll housing field rotatable to any of seven discharge positions. Provide fan with discharge positioned in proper direction to minimize connected duct turns.

D. Wheels:

1. Wheel Configuration: DWDI, with hub keyed to shaft.
2. Wheel and Blade Materials: Steel.
3. Backward-Inclined Airfoil Blades:

    a. Aerodynamic design.
    b. Heavy backplate.
    c. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.

E. Shafts:

1. Turned, ground, and polished steel; keyed to wheel hub. First critical speed at least 1.25 times maximum class speed.

F. Bearings:

1. Heavy-duty regreasable ball or roller type in a cast iron pillowblock housing.
2. Roller-Bearing Rating Life: ABMA 11, L(10) of 250,000 hours.
3. Extend grease fitting to accessible location outside of unit.

G. Belt Drive:

1. Factory mounted, with final alignment and belt adjustment made after installation.
2. Service Factor Based on Fan Motor Size: 1.5.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Comply with OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards," 0.146 inch- thick, 3/4-inch diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short-circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

H. Motor Enclosure: Totally enclosed, fan cooled.

I. Accessories:

1. Outlet: Flanged.
2. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades, with felt edges in steel frame installed on fan discharge.
3. Access Door: Gasketed door in scroll with latch-type handles.
4. Inlet Screens: Removable wire mesh.
5. Belt Guard: OSHA-compliant, completely enclosed shaft and drive components.

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2.3 UTILITY SET FANS - EXHAUST

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck.
2. Loren Cook Company.
3. New York Blower Company (The).
4. Twin City Blower.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fan utility vent sets, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

C. Housings:

1. Housing Material: Reinforced steel.
2. Housing Coating: Industrial grade alkyd enamel.
3. Formed panels to make curved-scroll housings with shaped cutoff.
4. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
5. Discharge Arrangement: Fan scroll housing field rotatable to any of seven discharge positions. Provide fan with discharge positioned in proper direction to minimize connected duct turns.

D. Wheels:

1. Wheel Configuration: SWSI, with hub keyed to shaft.
2. Wheel and Blade Materials: Steel.
3. Backward-Inclined Airfoil Blades:

    a. Aerodynamic design.
    b. Heavy backplate.
    c. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.

E. Shafts:

1. Turned, ground, and polished steel; keyed to wheel hub. First critical speed at least 1.4 times maximum class speed.

F. Bearings:

1. Heavy-duty regreasable ball or roller type in a cast iron pillowblock housing.
2. Ball-Bearing Rating Life: ABMA 9, L(50) of 200,000 hours.
3. Roller-Bearing Rating Life: ABMA 11, L(50) of 200,000 hours.
4. Extend grease fitting to accessible location outside of unit.

G. Belt Drive:

1. Factory mounted, with final alignment and belt adjustment made after installation.
2. Service Factor Based on Fan Motor Size: 1.5.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Comply with OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards," 0.146 inch- thick, 3/4-inch diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short-circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

H. Motor Enclosure: Totally enclosed, fan cooled.

I. Accessories:

1. Inlet and Outlet: Flanged.
2. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades, with felt edges in steel frame installed on fan discharge.
3. Access Door: Gasketed door in scroll with latch-type handles.
4. Inlet Screens: Removable wire mesh.
5. Belt Guard: OSHA-compliant, completely enclosed shaft and drive components.

2.4 MOTORS

A. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.

2.5 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. AMCA Compliance: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

C. Fan Sound Ratings: Comply with AMCA 311 and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

E. Operating Limits: Classify fans according to AMCA 99.

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PART 3 - EXECUTION

3.1 INSTALLATION OF CENTRIFUGAL HVAC FANS

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Install floor-mounted centrifugal fans on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install units with clearances for service and maintenance.

F. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK AND PIPING CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
11. Remove and replace malfunctioning units and retest as specified above.

D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

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E. Lubricate bearings.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

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SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Centrifugal ventilators - roof upblast and sidewall.
2. Delegated design.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators.

1.4 DELEGATED DESIGN SUBMITTALS

A. For unit hangers and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

B. Qualifications Statement: Submit qualifications for licensed professional.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Seismic Qualification Data: For fans, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

1.8 QUALITY ASSURANCE

A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the jurisdiction of the project location.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL VENTILATORS - ROOF UPBLAST OR SIDEWALL

A. Configuration: Centrifugal roof upblast ventilator.

B. Housing: Removable spun-aluminum dome top and outlet baffle; square, one-piece aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings; minimum ABMA9, L(10) of 100,000 hours.
4. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions. Provide fixed pitch for use with motors larger than 5 hp.
6. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
6. Spark-resistant, all-aluminum wheel construction.
7. Mounting Pedestal: Galvanized steel with removable access panel.
8. Wall Mount Adapter: Attach wall-mounted fan to wall.
9. Restaurant Kitchen Exhaust: UL 762 listed for grease-laden air exhaust.

F. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.

2.2 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

E. Operating Limits: Classify according to AMCA 99.

F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Install power ventilators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233423

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SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adjustable blade face registers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Adjustable Blade Face Register SR:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Titus; brand of Johnson Controls International plc, Global Products; 272 or a comparable product by one of the following:

a. Carnes Company.

b. METALAIRE, Inc.
c. Price Industries Limited.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
5. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed blade.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Engineer for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

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SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hooded ventilators.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. For louvered-penthouse ventilators specified to bear AMCA seal, include printed catalog pages, showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For gravity ventilators.

1. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

1.4 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

2. Wind Loads: Determine loads based on a uniform pressure of 40 lbf/sq. ft., acting inward or outward.
3. Snow Load: Unit to withstand a minimum of 20- lbf/sq. ft.snow load.

B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."

2.2 FABRICATION

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 HOODED VENTILATORS

A. Description: Hooded rectangular penthouse for intake air.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. Twin City Fan & Blower.

C. Source Limitations: Obtain hooded ventilators from single manufacturer.

D. Construction:

1. Material: Galvanized steel, of thickness required to comply with structural performance requirements, but not less than 0.064-inch- thick base and 0.040-inch- thick hood; suitably reinforced.
2. Material: Aluminum, of thickness required to comply with structural performance requirements, but not less than 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.
3. Insulation: None.
4. Bird Screening: Galvanized-steel, 1/2-inch- square mesh wire.

E. Galvanized-Steel Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas, and repair galvanizing according to ASTM A780/A780M. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.

    a. Color and Gloss: As indicated by manufacturer's designations.

F. Dampers:

1. Location: Curb damper tray.
2. Control: Motorized.
3. Tray: Provide damper tray or shelf with opening 3 inches less than interior curb dimensions indicated.

G. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.

2.4 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating, mill phosphatized.

D. Stainless Steel Sheet: ASTM A666, Type 304, with No. 4 finish.

E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined

by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Secure gravity ventilators to roof curbs with zinc-plated hardware, that comply with the wind and seismic fastening requirements. Use concealed anchorages where possible. Refer to Section 077200 "Roof Accessories."

C. Install gravity ventilators with clearances for service and maintenance.

D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.

F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes, so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

I. Refer to Section 077200 "Roof Accessories" for flashing and counterflashing of roof curbs.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

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SECTION 235700 - HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gasketed-plate heat exchangers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room plan or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Source quality-control reports.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

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1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of heat exchangers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including heat exchanger, storage tank, and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Plate Heat Exchangers:

1) Gasketed-Plate Type: One year(s).

PART 2 - PRODUCTS

2.1 GASKETED-PLATE HEAT EXCHANGERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Alfa Laval Inc.
2. Armstrong Fluid Technology.
3. Bell & Gossett; a Xylem brand.

B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets. Floor-mounted heat exchangers must have integral legs with mounting feet.

C. Construction: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

D. Frame:

1. Capacity to accommodate 20 percent additional plates.
2. Painted carbon steel with provisions for anchoring to support.

E. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.

1. Fabricate attachment of heat-exchanger support bars and guide bars with reinforcement strong enough to resist heat-exchanger movement during seismic event when heat-exchanger support bars and guide bars are anchored to building structure.

F. End-Plate Material: Painted carbon steel.

G. Tie Rods and Nuts: Steel or stainless steel.

H. Plate Material: 0.031 inch thick before stamping; Type 304 stainless steel.

I. Gasket Materials: EPDM rubber.

J. Piping Connections: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

1. NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
2. NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.

K. Enclose plates in solid stainless steel removable shroud.

2.2 ACCESSORIES

A. Hangers and Supports:

1. Custom-built steel supports and saddles for mounting on floor.
2. Supports and saddles to ensure both horizontal and vertical support of heat exchanger. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Shroud: Stainless steel sheet.

C. Miscellaneous Components for Hot-Water Unit: Control valve, valves, thermometers, and piping. Include components fitted for electric control.

D. Pressure-Relief Valves: Bronze,, ASME rated and stamped.

1. Pressure-relief valve setting: 50 psig.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect heat exchangers in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1. Affix ASME International label.

B. Hydrostatically test heat exchangers to minimum of one and one-half times pressure rating before shipment.

C. Heat exchangers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.

B. Examine roughing-in for heat-exchanger piping to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HEAT-EXCHANGER, GENERAL

A. Equipment Mounting:

1. Install floor-mounted heat exchangers on cast-in-place concrete equipment bases. Install all heat exchangers level and plumb in accordance with manufacturer's recommendations. Install floor-mounted and wall-hung steam heat exchangers at sufficient height, using sufficient length supports, to achieve required steam and condensate pipe pitch. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 INSTALLATION OF GASKETED-PLATE HEAT EXCHANGER

A. Install wall-mounted gasketed-plate heat exchanger on custom-designed wall supports anchored to structure as indicated on Drawings.

B. Install floor-mounted gasketed-plate heat exchangers on cast-in-place concrete equipment base and fasten legs to base.

C. Install metal shroud over installed gasketed-plate heat exchanger in accordance with manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for steam and condensate piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties."

C. Maintain manufacturer's recommended clearances for tube removal, service, and maintenance.

D. Install piping adjacent to heat exchangers to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchangers.

E. Install shutoff valves at heat-exchanger inlet and outlet connections.

F. Install pressure-relief valves on heat-exchanger shells where a connection has been provided on shell. When no shell pressure-relief valve connection has been provided, install pressure-relief valve on shell outlet piping before any isolation valves.

G. Install pressure-relief valves on heat-exchanger tube outlet piping before any isolation valves.

H. Pipe pressure-relief valves, full size of valve connection, to floor drain.

I. Install vacuum breaker at heat-exchanger steam inlet connection.

J. Install hose end valve to drain shell.

K. Install thermometer on each heat-exchanger fluid inlet and outlet piping. Comply with requirements for thermometers specified in Section 230519 "Meters and Gauges for HVAC Piping."

L. Install pressure gauges on each heat-exchanger fluid inlet and outlet piping. Comply with requirements for pressure gauges specified in Section 230519 "Meters and Gauges for HVAC Piping."

3.5 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

B. Isolate heat exchangers from piping before flushing piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blind flanges in flanged joints to isolate equipment.

C. Flush heat-exchanger piping systems with clean water; then remove and clean or replace strainer screens before reopening flow to heat exchangers.

3.6 FIELD QUALITY CONTROL

A. Testing Agency, Owner: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency, Contractor: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections:

E. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Heat exchanger will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers.

END OF SECTION 235700

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SECTION 237343.16 - OUTDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes outdoor, semi-custom air-handling units that are factory assembled using multiple section components; including:

1. Unit casings.
2. Fan, drive, and motor section.
3. Coil section.
4. Air filtration section.
5. Dampers.
6. Roof curbs.
7. Intake and relief air openings.

B. Related Requirements:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC."
2. Section 230716 "HVAC Equipment Insulation."
3. Section 230923 "Direct Digital Control (DDC) System for HVAC."
4. Section 233113 "Metal Ducts."
5. Section 233300 "Air Duct Accessories."

1.3 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

    a. Include certified fan-performance curves with system operating conditions indicated.
    b. Include certified fan-sound power ratings.
    c. Include fan construction and accessories.
    d. Include motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include certified coil-performance ratings with system operating conditions indicated.
8. Include dampers, including housings, linkages, and operators.

A. Shop Drawings: For each outdoor, semi-custom air-handling unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of outdoor, semi-custom air-handling units, as well as procedure and diagrams.
4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Sample Warranty: For manufacturer's warranty.

C. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control reports.

E. Startup service reports.

F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.

2. Gaskets: One set(s) for each access door.
3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Entire Unit: Manufacturer's standard but not less than one year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

E. Structural Performance:

1. Casing Panels: Self-supporting and capable of withstanding positive/negative 8-inch wg internal static pressure, without exceeding a midpoint deflection of 0.0042 inch/inch of panel span.
2. Floor and Roof Panels: Self-supporting and capable of withstanding 300-lb static load at midspan, without exceeding a midpoint deflection of 0.0042 inch/inch.
3. Roof Panels: Self-supporting and capable of withstanding a static snow load of 30 lb/sq. ft., without exceeding a midpoint deflection of 0.0042 inch/inch.

F. Casing Leakage Performance: ASHRAE 111, Class 6 leakage or better at plus or minus 8-inch wg.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Carrier Global Corporation.

2. Trane.
3. YORK; brand of Johnson Controls International plc, Building Solutions North America.

B. Source Limitations: Obtain from single source from single manufacturer.

2.3 UNIT CASINGS

A. Frame: Modular and providing overall structural integrity without reliance on casing panels for structural support.

B. Base Rail:

1. Material: Welded structural steel.
2. Height: 6 inches.

C. Casing Joints: Hermetically sealed at each corner and around entire perimeter.

D. Double-Wall Construction:

1. Outside Casing Wall:

a. Material, Stainless Steel: Minimum 18 gauge thick.
b. Factory Finish: Provide manufacturer's standard finish.

2. Inside Casing Wall:

a. Material, Stainless Steel: Solid, minimum 18 gauge thick.

E. Floor Plate:
1. Material: Stainless steel, minimum 12 gauge thick.

F. Roof: Cross-broken and pitched with "C" caps over joints to provide watertight seal.

G. Piping Vestibule: Insulated with same insulation and thickness as casing, 30 inches deep by full width of piping connections.

H. Casing Insulation:

1. Materials: injected polyurethane foam insulation.
2. Casing Panel R-Value: Minimum R-11.
3. Insulation Thickness: 2 inches.
4. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

I. Static-Pressure Classifications:

1. For Unit Sections Upstream of Fans: Minus 6-inch wg.
2. For Unit Sections Downstream and Including Fans: 6-inch wg.

J. Panels, Doors, and Windows:

1. Panels:

    a. Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
    b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow
    c. Gasket: Neoprene, applied around entire perimeters of panel frames.
    d. Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 72 inches.

2. Doors:

    a. Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
    b. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
    c. Gasket: Neoprene, applied around entire perimeters of panel frames.
    d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 72 inches.

3. Locations and Applications:

    a. Fan Section: Doors.
    b. Coil Section: Panels.
    c. Access Section: Doors.
    d. Access Sections Immediately Upstream and Downstream of Coil Sections: Doors.
    e. Damper Section: Doors.
    f. Filter Section: Doors large enough to allow periodic removal and installation of filters.
    g. Access Sections Immediately Downstream of Filter Sections: Doors.
    h. Mixing Section: Doors.

4. Convenience Outlets: One 20-A duplex GFCI receptacle per location with junction box located on outside casing wall.

    a. Locations: Fan section.

2.4 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Fans: Centrifugal, rated according to AMCA 210; galvanized steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

a. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and two-piece, cast-iron housing with grease lines extended to outside unit and an L-50 rated life of 200,000 hours according to ABMA 11.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
5. Plenum Fan Arrays: Contained as defined in AHRI 430. Steel or aluminum frame with inlet cone and structural framing around each fan built into an array of multiple fans. Provide backdraft dampers at each fan to prevent short circuiting of flow if one fan is not operating.
6. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 2 inches.
7. Shaft Lubrication Lines: Extended to a location outside the casing.
8. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.

a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

1) Fabric Minimum Weight: 26 oz./sq. yd..
2) Fabric Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3) Fabric Minimum Service Temperature Range: Minus 40 to plus 200 deg F.

C. Drive, Direct: Factory-mounted, direct drive.

D. Motors:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
3. Efficiency: Premium efficient as defined in NEMA MG 1.
4. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size, so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

6. Mount unit-mounted disconnect switches on exterior of unit.

E. Variable-Frequency Motor Controller: Serving all fans combined in fan array.

1. Manufactured Units: Pulse-width modulated; constant torque and variable torque for inverter-duty motors.
2. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
3. Unit Operating Requirements:

a. Internal Adjustability:

1) Minimum Speed: 5 to 25 percent of maximum rpm.
2) Maximum Speed: 80 to 100 percent of maximum rpm.
3) Acceleration: 0.1 to 999.9 seconds.
4) Deceleration: 0.1 to 999.9 seconds.
5) Current Limit: 30 to minimum of 150 percent of maximum rating.

b. Self-Protection and Reliability Features:

1) Surge suppression.
2) Loss of input signal protection.
3) Under- and overvoltage trips.
4) Variable-frequency motor controller and motor-overload/overtemperature protection.
5) Critical frequency rejection.
6) Loss-of-phase protection.
7) Reverse-phase protection.
8) Motor-overtemperature fault.

c. Bidirectional autospeed search.
d. Torque boost.
e. Motor temperature compensation at slow speeds.

1) Panel-mounted operator station.
2) Historical logging information and displays.
3) Digital indicating devices.

f. Control Signal Interface: Electric.
g. Proportional Integral Directive (PID) control interface.
h. DDC system for HVAC Protocols for Network Communications: ASHRAE 135.

4. Line Conditioning:

a. Input line conditioning.
b. Output filtering.
c. EMI/RFI filtering.

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2.5 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with AHRI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. For multizone units, provide air deflectors and air baffles to balance airflow across coils.
4. Coils shall not act as structural component of unit.

B. Heating Coils:

1. Hot-Water Coils: Self-draining.

a. Piping Connections: Threaded, same end of coil.
b. Tube Material: Copper.
c. Fin Type: Plate.
d. Fin Material: Aluminum.
e. Headers:

1) Cast iron with drain and air vent tappings.
2) Seamless copper tube with brazed joints, prime coated.
3) Fabricated steel, with brazed joints, prime coated.
4) Provide insulated cover to conceal exposed outside casings of headers.

f. Frames: Channel frame, 0.0625-inch-thick, stainless steel.
g. Coil Working-Pressure Ratings: 200 psig, 325 deg F.
h. Coating: Corrosion-resistant coating.

2.6 AIR FILTRATION SECTION

A. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive.
4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

B. Side-Access Filter Mounting Frames:

1. Particulate Air Filter Frames: Match inner casing and outer casing material, and insulation thickness. Aluminum track.

a. Prefilters: Incorporate an integral 2-inch-thick track with same access as primary filter.
b. Sealing: Incorporate positive-sealing device to ensure seal between gasketed material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

2.7 DAMPERS

A. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with zinc-replated steel operating rods rotating in stainless steel sleeve bearings mounted in a single aluminum frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1-inch wgand 8 cfm/sq. ft.at 4-inch wg

B. Electronic Damper Operators:

1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
2. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
3. Operator Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
    c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
6. Size dampers for running torque calculated as follows:

    a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
    d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

7. Coupling: V-bolt and V-shaped, toothed cradle.
8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
9. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
10. Power Requirements (Two-Position Spring Return): 24 V.
11. Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.
12. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
13. Temperature Rating: Minus 22 to plus 122 deg F.
14. Run Time: 60 seconds.

C. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.

D. Combination Filter and Mixing Section:

1. Cabinet support members shall hold 2-inch-thick, pleated, flat, permanent or throwaway filters.
2. Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.

2.8 INTAKE AND RELIEF AIR OPENINGS

A. Provide hood, including moisture eliminator, over all unit intake and relief openings. Match material and finish of casing exterior.

2.9 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

E. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.

1. Standards:

a. ASTM B117 for salt spray.
b. ASTM D2794 for minimum impact resistance of 100 in-lb.
c. ASTM B3359 for cross-hatch adhesion of 5B.

2. Application: Immersion.
3. Thickness: 1 mil.
4. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.10 SOURCE QUALITY CONTROL

A. AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.

B. AMCA 301 or AHRI 260: Air-handling unit fan sound ratings shall comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data," or AHRI 260, "Sound Rating of Ducted Air Moving and Conditioning Equipment."

C. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

D. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

E. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.

F. Witnessed Casing Leakage Tests:

1. Pay for all expenses, for one representative designated by Owner, to travel to the factory to witness cabinet air-leakage testing on the specific assembled unit(s) prior to release for delivery to Project site.
2. If the unit(s) does not meet specified leakage requirements, perform factory modifications and retest. Do not release unit for shipment until tested leakage is measured to be within specified leakage and leakage testing report has been accepted by Owner's designated representative.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Unit Support: Install unit level on structural steel supports. Coordinate wall penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of steel supports with actual equipment provided.

1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

C. Do not operate fan system until filters (temporary or permanent) are in place.

D. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

E. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to air-handling unit, allow space for service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
7. Comb coil fins for parallel orientation.
8. Verify that proper thermal-overload protection is installed for electric coils.
9. Install new, clean filters.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.7 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

1. Instructor shall be factory trained and certified.
2. Provide not less than eight hours of training.
3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION 237343.16

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SECTION 238216.11 - HYDRONIC AIR COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hydronic heating and cooling air coils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
2. Include rated capacities, operating characteristics, and pressure drops for each air coil.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Modine Manufacturing Company.
2. Super Radiator Coils.
3. Trane.

B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.

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C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

D. Source Quality Control: Factory tested to 300 psig.

E. Tubes: ASTM B743 copper,

F. Fins: Aluminum,

G. Headers: Cast iron with drain and air vent tappings.

H. Frames: ASTM A666, Type 316 stainless steel, minimum 0.0625 inch thick for flanged mounting.

I. Coating: Corrosion-resistant.

1. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.
2. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.

a. Standards:

1) ASTM B117 for salt spray.
2) ASTM D2794 for minimum impact resistance of 100 in-lb
3) ASTM B3359 for cross hatch adhesion of 5B.

b. Application: Immersion.
c. Thickness: 1 mil.
d. Gloss: Minimum gloss of 60 on a 60-degree meter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Install stainless steel drain pan under each cooling coil.

1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.
2. Construct drain pans to extend beyond coil length and width and to connect to condensate trap and drainage.
3. Extend drain pan upstream and downstream from coil face.
4. Extend drain pan under coil headers and exposed supply piping.

D. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.

E. Straighten bent fins on air coils.

F. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 230923.11 "Control Valves," and other piping specialties are specified in Section 232116 "Hydronic Piping Specialties."

END OF SECTION 238216.11

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SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

B. Related Requirements:

1. Division 03 “Concrete” for cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, and light pole bases.
2. Division 40 “Process Interconnections” for SCADA, instrumentation, and process control equipment.
3. Division 22
4. Division 23
5. Division 43

1.3 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.

18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.
34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.
37. EVPE: Electric vehicle power export equipment.
38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
56. IR: Infrared.
57. IS: Intrinsically safe.
58. IT&R: Inspecting, testing, and repair.
59. ITE: Information technology equipment.

60. kAIC: Kiloampere interrupting capacity.
61. kcmil or MCM: One thousand circular mils.
62. kV: Kilovolt.
63. kVA: Kilovolt-ampere.
64. kVAr or kVAR: Kilovolt-ampere reactive.
65. kW: Kilowatt.
66. kWh: Kilowatt-hour.
67. LAN: Local area network.
68. lb: Pound (weight).
69. lbf: Pound (force).
70. LCD: Liquid-crystal display.
71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.
79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.
81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.
87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.

111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.
120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.
131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VFD: Variable-frequency drive. See VFC.
134. VOM: Volt-ohm-multimeter.
135. VPN: Virtual private network.
136. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
137. W: Watt, unit of real electrical power.
138. Wh: Watt-hour, unit of electrical energy usage.
139. WPT: Wireless power transfer.
140. WPTE: Wireless power transfer equipment.
141. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.
12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.

17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. GRS: Galvanized rigid steel conduit. See ERMC-S-G.
21. HDPE: HDPE underground conduit (thick wall).
22. HDPE-40: Schedule 40 HDPE underground conduit.
23. HDPE-80: Schedule 80 HDPE underground conduit.
24. IMC: Steel electrical intermediate metal conduit.
25. LFMC: Liquidtight flexible metal conduit.
26. LFMC-A: Aluminum liquidtight flexible metal conduit.
27. LFMC-S: Steel liquidtight flexible metal conduit.
28. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
29. LFNC: Liquidtight flexible nonmetallic conduit.
30. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
31. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
32. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
33. PVC: Rigid PVC conduit.
34. PVC-40: Schedule 40 rigid PVC conduit.
35. PVC-80: Schedule 80 rigid PVC Conduit.
36. PVC-A: Type A rigid PVC concrete-encased conduit.
37. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
38. RAC: Rigid aluminum conduit. See ERMC-A.
39. RGS: Rigid galvanized steel conduit. See ERMC-S-G.
40. RMC: Rigid metal conduit. See ERMC.
41. RTRC: Reinforced thermosetting resin conduit.
42. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
45. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
46. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.

15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.

65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."

    a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.

2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Duct-Bank: A protective underground system of raceways arranged in a matrix topology which is encased in concrete. Duct-banks can either be reinforced with rebar or not.
10. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
b. Concrete Box: A box intended for use in poured concrete.
c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
f. Device Box: A box with provisions for mounting a wiring device directly to the box.
g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
k. Hand-hole: A small underground enclosure with an access cover, designed to allow access inside to pull, splice or maintain underground cables. The enclosure is only big enough to allow a person’s hand/arm to reach in only.
l. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
m. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
n. Man-hole: A large underground secure concrete vault designed to house and protect un-grounded and grounded conductors and splices. The vault is large enough for a person to enter to perform electrical work, pull, splice and maintain underground cables.
o. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
p. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
q. Raised-Floor Box: A floor box intended for use in raised floors.
r. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
s. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
t. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.

u. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
v. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

11. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
12. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.

    a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.

13. Jacket: A continuous nonmetallic outer covering for conductors or cables.
14. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
15. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
16. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
17. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
18. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
19. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
20. Sheath: A continuous metallic covering for conductors or cables.
21. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
22. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.

c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

23. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.4 INTERPRETATION OF CONTRACT DOCUMENTS

A. If during performance of work, there is a conflict, error, or discrepancy between or among Contract Documents and laws and regulations, provide the higher performance standard unless otherwise directed by Engineer.

B. Priority of Documents: Figured dimensions govern over scaled dimensions, detailed drawings govern over general drawing, larger scale drawings take precedence over smaller scale drawings, change order drawings supersede original contract drawings, and contract drawings govern shop drawings.

C. In general, Drawings do not show conduit routing. Plan and route conduits in compliance with specifications and drawing details. Coordinate installation with other trades and actual supplied equipment.

D. Ductbank routing shown on electrical site plans is diagrammatic in nature and may not include interferences that may be present.

1.5 COORDINATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

B. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

1.6 PREINSTALLATION MEETINGS

A. Schedule Preconstruction Meeting and other Preinstallation Meetings in accordance with Project Meetings Section in Division 01.

1.7 SEQUENCING

A. Conduct and submit results of preliminary power system studies before submitting Product Data and Shop Drawings for electrical equipment.

B. Coordinate all work in accordance with Specification 013513.24Special Procedure for MOPO and Construction Sequence.

C. Coordinate installation work with other trades.

1.8 ACTION SUBMITTALS

A. Submit Division 26 equipment and materials as specified in each Section at one time and not piecemeal. For example, all low voltage motor control centers on a project are to be submitted under one submittal number. Submittals that do not comply will be returned disapproved.

B. Subject to Engineer’s approval, related items may be submitted together under one submittal. Contractor shall identify the multiple Sections included. For example, multiple Sections specify lighting fixtures and poles. A single submittal for lighting could be acceptable.

C. Electrical Installation Drawings:

1. Drawings in general do not show conduit routing other than major conduit and ductbank routes. Submit conduit layouts for exposed, concealed, and buried conduits.
2. Submit electrical room layouts using approved shop drawing dimensions for equipment.
3. Submit layouts at an appropriate scale for clarity.
4. Include type written conduit schedules for easy cross check.
5. Installation submittal drawing must be approved before concrete pours are made that will conceal conduits.

D. Training Plans: Submit instructional program outline for Engineer’s review and approval, where demonstration and/or training is specified.

1.9 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Engineer including, but not limited to, milestone dates for the following activities:

1. Submission of power system studies.

2. Submission of specified coordination drawings.
3. Submission of action submittals specified in Division 26.
4. Orders placed for major electrical equipment.
5. Arrival of major electrical equipment on-site.
6. Preinstallation meetings specified in Division 26.
7. Utility service outages.
8. Utility service inspection and activation.
9. Closing of walls and ceilings containing electrical Work.
10. Conduit/conductor schedule, wire/cable ID scheme, duct-bank layouts, duct-bank sections, underground rough-in sketches, equipment conduit windows, etc.
11. System startup, testing, and commissioning activities for major electrical equipment.
12. System startup, testing, and commissioning activities for emergency lighting.
13. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
14. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
15. Requests for special inspections.
16. Requests for inspections by authorities having jurisdiction.

B. Delegated Design Drawings: As indicated in individual Division 26 Sections.

C. Seismic Qualification Data: In accordance with Section 260011 “Facility Performance Requirement for Electrical” and individual Division 26 Sections.

D. Wind-Load Performance Data: In accordance with Section 260011 “Facility Performance Requirement for Electrical” and individual Division 26 Sections.

E. Qualification Statements: In accordance with individual Division 26 Sections.

1.10 CLOSEOUT SUBMITTALS

A. Record Documents: Submit documentation to accurately show completed installation. Include modifications to Contract Documents (one line power diagrams, equipment elevations, panel schedules, elementary control diagrams, riser diagrams, plans, conduit and ductbank routing, etc.) along with additional drawings or sketches created to convey completed installation.

1. Point-to-Point Connection Diagrams

a. General: Provide coordinated point-to-point (PTP) interconnection diagrams for each power, control, signal, instrumentation, and communications circuit furnished under this Contract or requiring connection to equipment furnished under other Divisions.
b. Drawing Format: Prepare diagrams using AutoCAD 2025. Provide one complete circuit or loop per 24-inch by 36-inch drawing. Use a consistent horizontal or vertical arrangement, divide drawings by device location, avoid overcrowding, and reserve space for future circuit data. Drawings shall remain legible when reduced to half size.
c. Standards: Prepare diagrams in accordance with ISA-5.4. Use symbols consistent with the Contract Drawings and symbol sheets. Instrumentation symbols shall

conform to ANSI/ISA-5.1 and shall be supplemented as required to show connection points, power sources, and operating details.

d. Submittal Milestones: Submit PTP diagrams in the following two phases:

1) Pre-Installation Submittal: Submit representative sample diagrams and complete, coordinated PTP diagrams for each system after receipt of applicable approved vendor submittals and before fabrication of control panels, pulling conductors or cables, making field terminations, or installing associated wiring. Submit five representative sample diagrams for CM review and acceptance of drawing format, equipment and device identification, conductor and cable identification methodology, and level of detail. Include samples for:

a) a motor with remote devices connected to a motor control center or starter;
b) a chemical system with a vendor control panel, remote power source, instruments, controls, and RTU;
c) a variable-frequency drive with motor, remote devices, control panels, PLC panels, and RTU;
d) an instrument connected to its local control panel; and
e) a sluice or slide gate with power and remote controls. Incorporate CM review comments into the complete PTP diagrams before beginning installation of the associated work.

2) Post-Installation Record Submittal: Upon completion of installation, testing, checkout, and startup, field-verify each PTP diagram against the installed work and submit final record PTP diagrams showing the complete as-installed configuration. Revise the diagrams to incorporate field modifications and final equipment and device tags, cable and conductor identifications, terminal assignments, power sources, protective devices, grounding and shield terminations, and I/O assignments. Correct discrepancies between the diagrams and installed work before submittal. Submit final record PTP diagrams before Substantial Completion and as part of the operation and maintenance manual submittal.

e. Diagram Content: Show all equipment and circuit components required for operation, including analog, digital, and discrete devices; relays; switches; starters; panels; terminal blocks; junction and pull boxes; intermediate terminations; and field-mounted components. Show circuit origins and destinations, terminal-strip designations, conductor and cable numbers, equipment and device tags, panel terminal-board numbers, computer input/output connections, and applicable Contract Drawing and shop-drawing references.

f. Power and Grounding: Trace each power source to its source panel, protective device, terminal block, and final utilization equipment, and identify the voltage, phase, circuit number, and protective-device rating, as applicable. Show equipment grounding conductors, grounding electrode conductor connections, instrument or signal reference grounds, isolated grounds, cable shields, and drain wires, as applicable. Identify each grounding termination point and distinguish between connections made at the source end, load end, both ends, or left unterminated. Show shield continuity through intermediate terminal blocks and junction boxes, and identify single-point shield grounding requirements. Do not use the same

symbol or designation for equipment grounding, isolated or reference grounding, and cable-shield grounding.

g. Locations and Functions: Identify device locations, including field, panel, auxiliary equipment, termination cabinet, local control panel, switchgear, motor control center, and panelboard locations. Provide circuit-function descriptions and clearly identify special operations, safety circuits, interlocks, and shutdown functions.

h. Identification and Tagging: Assign each PTP diagram a unique diagram number. Coordinate equipment, device, loop, and mnemonic designations with the P&IDs, loop diagrams, approved vendor submittals, equipment lists, I/O lists, and Section 407000A. Assign each multiconductor cable a unique cable identification number and identify each conductor, twisted pair, triad, or fiber within the cable by a unique conductor or circuit designation. Provide durable, permanent identification at both ends of each cable and conductor and at each accessible intermediate termination, including devices, equipment, terminal blocks, junction boxes, pull boxes, terminal cabinets, manholes, and handholes. Identification shown on the PTP diagrams, field labels, cable schedules, wire database, and record documents shall match. Use the project identification hierarchy for facility code, system code, tag type, tag number, and subcomponent, where applicable. Do not reuse an identification number for a different cable, conductor, device, or termination.

i. Coordination: Coordinate diagrams with related work under other Divisions and with vendor drawings. Resolve discrepancies before fabrication or installation.

j. Wire Database: Provide a Microsoft Access database correlating each wire identification number with the associated equipment and drawings. Configure the database to permit sorting and querying.

1) Database Fields: Include wire identification number; wire size and type; equipment tag at each termination; terminal strip and terminal position at each end; building identification code; process system code; shop drawing and page reference; and PTP diagram number.

2) Database Submittal: Submit five electronic copies on CD-ROM and seven hard copies for review and inclusion in the operation and maintenance manuals.

k. Wire Schedule: Sort by wire identification number, terminating equipment identification, and termination-point identification.

l. Equipment Schedule: For each equipment tag, identify the applicable PTP diagram, wire identification numbers, terminating equipment, terminal-strip and terminal identifications, and shop-drawing references. Sort by equipment tag, PTP diagram number, and wire identification number.

m. System Schedule: Sort by system code, equipment tag, and PTP diagram number.

B. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device as specified in each Division 26 Section.

1.11 DELEGATED DESIGN / PROFESSIONAL ENGINEERING SERVICES

A. When engineering services are specified to be provided by Contractor, retain a licensed professional engineer to perform the services. Engineer shall be licensed at the time services are

performed and licensed in the state in which project is located. If the state issues discipline specific licenses, Engineer shall be licensed in the applicable discipline. Engineer shall be experienced in the type of work being performed.

B. Engineering work shall be done according to the applicable regulations for professional engineers to include signing, sealing, and dating documents.

1.12 QUALIFICATIONS

A. Comply with Quality Assurance Articles within each Division 26 Section.

B. Electrical Contractor Minimum Requirements: Regularly engaged in the installation of industrial medium voltage systems for a minimum period of 10 years.

C. On Site Field Superintendent:

1. Minimum of 10 years of experience of industrial low and medium voltage projects of comparable size and complexity.
2. Be present (or designated substitute with minimum experience as above) during medium voltage cable pulling and testing, during medium voltage switching activity, and during medium voltage equipment change over or start-up activities.

1.13 MATERIALS AND EQUIPMENT

A. Provide new materials and equipment unless specifically noted otherwise.

B. NEMA enclosure types are listed on the Drawings and/or the specifications.

C. Electrical materials and equipment must be listed by Underwriter's Laboratories, Inc. (UL**)** or other National Recognized Testing Laboratory (NRTL) and bear the appropriate listing or classification marking. Equipment not bearing a UL certification shall be field or factor UL certified prior to acceptance and use.

D. Provide major electrical equipment by a single manufacturer, i.e. unit substations, switchgear, motor control centers, disconnect switches, transformers, panelboards, etc.

E. Variable frequency controllers, when provided as a stand-alone package with the driven equipment and therefore not included in a motor control center are not to be required to be by a single manufacturer.

1.14 HAZARDOUS AREAS

A. Drawings may indicate and define NEC hazardous classified locations.

B. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate Class and Division and in accordance with NEC Articles 500, 501, 502, and 503 as applicable.

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1.15 EQUIPMENT SIZE, HANDLING, AND STORAGE

A. Coordinate with equipment manufacturer shipping splits to permit safe handling and passage of equipment to final installation location.

B. Comply with manufacturer’s instructions for upright equipment orientation during transportation.

C. Protect equipment from mechanical injury, or exposure to moisture, chemicals, or corrosive gases. Do not store indoor rated electrical equipment outdoors.

D. Provide and energize temporary space heaters if required to control moisture during storage.

1.16 FIELD CONDITIONS

A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."

B. Service Conditions for Electrical Power Equipment: Besides conditions specified in Section 260011 "Facility Performance Requirements for Electrical," specified electrical power equipment must be suitable for operation under service conditions specified as usual service conditions in applicable NEMA PB series, IEEE C37 series, and IEEE C57 series standards.

1.17 ELECTRICAL SYSTEM TESTING AND SETTINGS

A. Test electrical systems and equipment in accordance with individual sections and Section 260800 “Commissioning of Electrical Systems”. This includes motors or other electrical equipment which are not specified in Division 26.

B. Set and adjust controls, timers, relays, adjustable trip units, protective devices, and other electrical components in accordance with manufacturers instructions and the approved power system study. Do not energize equipment without correctly setting adjustable components.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place sleeves for conduits and slots for electrical work prior to concrete pour.

B. Use approved shop drawings and equipment vendor templates to determine exact locations for stub-ups and terminating concealed conduit and place before floor slab pour.

C. Seal openings, sleeves, penetration and slots in accordance with Section 260544 “Sleeves and Sleeve Seals for Electrical Raceways and Cabling.”

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3.2 CUTTING AND PATCHING

A. Cut and patch in a workmanlike manner as required to install electrical work.

B. Modify concrete in accordance with Division 3 “Concrete.”

C. Do not cut joists, beams, girders, columns, or other structural members.

D. Patch surfaces to restore to original integrity (waterproof or fireproof as required) and appearance.

E. Core drill holes in concrete floors and walls as required. Prior to coring concrete, scan slab or wall using radar to locate and identify rebar and/or conduit and wiring. Locate cores to avoid cutting or drilling through rebar and/or conduits. Space conduits to not weaken structural integrity. Notify Engineer immediately if rebar is cut or upon becoming aware of discrepancies within area of work.

3.3 DEMOLITION AND DISPOSITION OF EQUIPMENT

A. Drawings showing removal of major mechanical and electrical equipment is not intended to show all components to be demolished. Not all piping, conduits, ducts, equipment, ancillary devices, etc. are shown. Field verify existing conditions prior to bid.

B. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to source and/or point of concealment including above accessible ceiling finishes. Wiring shall be removed.

C. Cut flush with slab, ceiling, or wall abandoned concealed conduit. Suitably plug conduits.

D. Repair and restore adjacent construction and finishes after demolition is complete.

E. Material and equipment indicated for removal or demolition is to become the Contractor’s property upon removal, unless noted otherwise. Removed material to be properly handled and disposed.

3.4 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Engineer for resolution of conflicting requirements.

3.5 FIELD QUALITY CONTROL

A. Field testing, startup services, and system functional testing may be provided by the Contractor, and/or the manufacturer’s factory-authorized service representative, and/or an independent testing agency. Provide testing and/or startup service as specified in the relevant section.

B. Comply with Section 260800 “Commissioning of Electrical Systems”.

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C. Submit Field Quality-Control Report as informational submittal within 14 days of each completed test or startup. Include within the report adjustments / as left settings.

3.6 CLEANING

A. Remove rubbish and debris from inside and around electrical equipment and enclosures.

B. Remove dirt, dust or concrete spatter from interior and exterior of equipment using brushes, vacuum cleaner, or clean lint-free rags. Do not use compressed air.

3.7 CLOSEOUT ACTIVITIES

A. Provide demonstration and training as specified in each section.

END OF SECTION 260010

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SECTION 260011 - FACILITY PERFORMANCE REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.

B. Related Requirements:

1. Section 260010 “Supplemental Requirements for Electrical” for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.3 FIELD CONDITIONS

A. Altitude:

1. Sea level to 1000 ft..

B. Ambient Temperature:

1. Average High of 85 degrees Farenheit.
2. Average Low of 22 degrees Farenheit.

C. Temperature Variation: Allow for thermal movements from the following differential temperatures:

1. Outdoor Ambient Temperature Differential: 120 degrees F.
2. Material Surface Temperature Differential: 180 degrees F.
3. Ground Surface Temperature Differential to 10 foot Depth.

D. Ground Water:

1. Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

E. Hazardous and / or Corrosive Environmental Conditions: As indicated on the Drawings.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260011

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SECTION 260505 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
2. Disposal of materials.
3. Storage of removed materials.
4. Identification of utilities.
5. Salvaged items.
6. Protection of items to remain as indicated on Drawings.
7. Relocate existing equipment to accommodate construction.

B. Related Sections:

1. Section 024119 “Selective Structure Demolition”: Removal of designated building equipment and construction.
2. Section 083113 “Access Doors and Frames”: Execution requirements for access doors and panels specified by this section.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of temporary work. Describe demolition removal procedures and schedule.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of capped conduits and equipment abandoned in place,.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with New York OSHA standards.

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1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.7 SEQUENCING

A. Sequence work in accordance with Section 013513.24 “Special Procedures for MOPO and Construction Sequence”.

1.8 SCHEDULING

A. Schedule work to coincide with new construction.

B. Cease operations immediately when structure appears to be in danger and notify Engineer/Engineer. Do not resume operations until directed.

1.9 COORDINATION

A. Conduct demolition to minimize interference with adjacent and occupied building areas.

B. Coordinate demolition work in accordance with the Sequence of Construction.

C. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.

D. Equipment, building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition.

E. Shut-down Periods:

1. Arrange timing of shut-down periods of in service panels with Construction Manager. Do not shut down any utility without prior written approval.
2. Keep shut-down period to minimum or use intermittent period as directed by Construction Manager.
3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 3 days in advance.

F. Identify salvage items in cooperation with Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.

B. Verify termination points for demolished services.

3.2 PREPARATION

A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.

B. Temporary egress signage and emergency lighting

3.3 REMOVAL AND DISPOSAL OF LEGALLY REGULATED MATERIALS

A. Material and equipment indicated to be removed and disposed of will become the Contractor's property. Dispose of material and equipment offsite, unless otherwise directed by the Owner. Provide the Owner with a receipt indicating the acceptable disposal of any legally regulated materials or equipment.

B. Assume that the ballasts in each existing lighting fixture contain PCB's, unless specifically marked with a label indicating "No PCBs." Remove ballasts from each lighting fixture and pack them in accordance with EPA PCB regulations. Ship ballasts in approved containers to an EPA approved recycling facility; pay all shipping, packaging and recycling costs.

C. Remove, package, ship and dispose of PCBs, mercury and PCB/mercury contaminated equipment, in accordance with all State and Federal regulations. Retain the services of a firm licensed and regularly engaged in the removal of PCBs and PCB contaminated equipment. Retain a firm licensed in the State or States in which the contaminated material is handled, shipped and disposed of. Pay all fees associated with the removal of the contaminated material and equipment. Submit documentation indicating acceptable disposal.

D. If PCB’s or mercury contaminated equipment are discovered that were not identified; cease work on or about the equipment and notify the Engineer immediately.

3.4 DEMOLITION

A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Engineer/Engineer before disturbing existing installation.

B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.

D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

E. Reconnect equipment being disturbed by renovation work and required for continue service to nearest available panel.

F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.

G. Install temporary wiring and connections to maintain existing systems in service during construction.

H. Perform work on energized equipment or circuits with experienced and trained personnel.

I. Remove, relocate, and extend existing installations to accommodate new construction.

J. Repair adjacent construction and finishes damaged during demolition and extension work.

K. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.

L. Clean and repair existing equipment to remain or to be reinstalled.

M. Protect and retain power to existing active equipment remaining.

N. Cap abandoned empty conduit at both ends.

3.5 EXISTING PANELBOARDS

A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.

B. Tag unused circuits as spare.

C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.

D. Remove existing wire no longer in use from panel to equipment.

E. Provide new updated directories where more than three circuits have been modified or rewired.

3.6 SALVAGE ITEMS

A. Remove and protect items indicated on Drawings to be salvaged and turn over to Owner

B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.7 REUSABLE ELECTRICAL EQUIPMENT

A. Carefully remove equipment, materials, or fixtures which are to be reused.

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B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.8 CLEANING

A. Remove demolished materials as work progresses. Legally dispose.

B. Keep workplace neat.

3.9 PROTECTION OF FINISHED WORK

A. Do not permit traffic over unprotected floor surface.

END OF SECTION 260505

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SECTION 260513 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cables and related cable splices, terminations, and accessories for medium-voltage (2001 to 35,000 V) electrical distribution systems.

B. Section applies to temporary and permanent feeders used on the project.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 DEFINITIONS

A. Jacket: A continuous nonmetallic outer covering for conductors or cables.

B. NETA ATS: Acceptance Testing Specification.

C. Sheath: A continuous metallic covering for conductors or cables.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.

B. Work plan for each medium voltage system interruption. Include as a minimum:

1. Description of work to be accomplished.
2. Identification of circuits and facilities areas affected.
3. Using the project one line power diagrams, indicate state of affected switches and circuit breakers and locations for temporary safety grounds.
4. Estimated shutdown duration.

C. Switching and testing plans for hot phase and rotation checks.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate location of each cable, splice, and termination.

B. Qualification Data: For Installer and testing agency.

C. Design Data: Cable pulling calculations (all MV cables at a min.), including conduit size and fill percentage, pulling tensions, cable sidewall pressure, jam probability, voltage drop, and ground wire sizing for each cable.

D. Source quality-control reports. Provide cable manufacturer’s certified test report for each cable reel.

E. Field quality-control reports.

F. Manufacturer’s cable warranty.

1.6 QUALITY ASSURANCE

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable. Cable splicer must have at least 80 hours of formal training and a minimum of 10 years experience.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Check for reels not completely restrained, reels with interlocking flanges or broken flanges, damaged reel covering or any other indication of damage. Do not drop reels from any height.

B. Unload reels using a sling and spreader bar. Roll reels in the direction of the arrows shown on the reel and on surfaces free of obstructions that could damage the cable.

C. Store cable on a solid, well drained location. Store unjacketed armored cable indoors. Cover cable reels with plastic sheeting or tarpaulin. Do not lay reels flat.

D. Seal cable ends with heat shrinkable end caps. Do not remove end caps until cables are ready to be terminated.

1.8 FIELD CONDITIONS

A. Interruption of Existing Electric Service: Submit detailed work plan for all interruptions involving medium voltage.

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1.9 WARRANTY

A. Manufacturer's Special Warranty: Warrant the cables against failures for a period of 20 years from the date of installation and remove and replace failed cables at manufacturer's expense during this warranty period.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2 and NFPA 70.

C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 CABLES

A. Description: Medium-voltage cable suitable for use in wet or dry locations, indoors or outdoors exposed to sunlight, in any raceway or underground duct, or directly buried. Sizes 1/0 AWG and larger may be installed in cable tray.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. General Cable; Prysmian Group North America.
2. Kerite Power Cable; Marmon Holdings, Inc.; Berkshire Hathaway Inc.
3. Okonite Company (The).

C. Cable Type: Type MV 105, UL listed, single conductor.

D. Conductor Insulation: Ethylene-propylene rubber.

1. Voltage Rating: 5 kV, as indicated on Drawings.
2. Insulation:

a. Rating: 133 percent insulation level.
b. BIL / Thickness:

1) 95 kV and 115 mils for 5 kV.

E. Operating Voltage: 4160V

F. Conductor: Copper.

G. Comply with UL 1072, AEIC CS8, ICEA S-93-639/ANSI/NEMA WC 74, and ICEA S-97-682.

H. Conductor Stranding: Compact round, concentric lay, Class B.

I. Shielding: Copper tape 5 mil minimum, helically applied over semiconducting insulation shield.

J. Overall Cable Jacket: Moisture, heat, abrasion, UV, and ozone resistant PVC jacket installed over the metallic shield.

K. Identification: Printing on outer jacket of cable to include manufacturer's name, voltage class, insulation type, insulation thickness, conductor size, UL listing, and manufactured date.

2.3 CONNECTORS

A. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.

B. Copper-Conductor Connectors: Copper barrel crimped, tin-plated connectors, closed end construction to prevent moisture migration, and meet UL 486 requirements. Provide two-hole lugs with NEMA spacing for conductors 250 kcmil and larger.

2.4 SOLID TERMINATIONS

A. Shielded-Cable Terminations: Comply IEEE 48, Class 1 requirements. Insulation class equivalent to that of cable. Current rating equal to or greater than the cable ampacity. Include shield ground strap for shielded cable terminations. Include rain skirt for outdoor locations. Cable compartment of outdoor metal clad switchgear are considered as outdoor locations.

1. TE Connectivity (TE) Raychem heat shrink HVT-Z Series.

2.5 SPLICE KITS

A. Description: For connecting medium voltage cables; type as recommended by cable or splicing kit manufacturer for the application.

1. TE Connectivity (TE) Raychem heat shrink HVS Series.

B. Standard: Comply with IEEE 404.

C. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, materials, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

2.6 ELECTRICAL GROUNDING BRAID

A. Conducting Metal Braid: Woven from 240 strands of 30 AWG tinned copper wires, capable of carrying fault current comparable to 6 AWG copper wire.

2.7 MEDIUM-VOLTAGE TAPES

A. Description: Electrical grade, insulating tape rated for medium voltage application.

B. Ethylene/propylene rubber-based, 30 mil splicing tape, rated for 130 degree C operation. Minimum 3/4 inch wide.

C. Silicone rubber-based, 12 mil self-fusing tape, rated for 130 degree C operation. Minimum 1-1/2 inches wide.

D. Insulating-putty, 125 mil elastic filler tape. Minimum 1-1/2 inches wide.

2.8 ARC-PROOFING MATERIALS

A. Description: Fire retardant, providing arc flash protection and limit damage to other cables that are in proximity.

B. Tape for First Course on Metal Objects: 10 mil thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

C. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, and compatible with cable jacket. 3M Scotch Fire-Retardant Electric Arc Proofing Tape 77 White or equal.

D. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1 inch wide. 3M Scotch Tape 77 Series of equal.

2.9 PULLING COMPOUNDS

A. Pulling compound shall be nontoxic, nonflammable, noncombustible and noncorrosive. Material shall be UL listed and compatible with cable insulation and jacket.

2.10 SOURCE QUALITY CONTROL

A. Test and inspect cables according to AEIC CS8 or ICEA S-97-682 before shipping.

B. Upon completion of factory tests, seal cable against entrance of water.

PART 3 - EXECUTION

3.1 GENERAL

A. Determine cutting lengths, reel arrangements and total lengths of cable required and furnish to cable manufacturer.

B. When temperature is below 50 degrees F, store cable reels at 70 degrees F for at least 24 hours before installation.

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3.2 INSTALLATION

A. Install cables according to IEEE 576.

B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches on the pull rope.

1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

C. Pull Conductors: Use a dynamometer and constant velocity power pulling. Velocity should not be less than 15-ft/min or more than 50-ft/min. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Use manufacturer approved pulling compound and lubricants.
2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways.
3. Do not use rope hitches for pulling attachment to cable.
4. Do not use steel fish tapes or steel pulling cables in PVC conduit runs.
5. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
6. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.
7. Pull cables from direction that requires the least tension.
8. Feed cables into raceway with zero tension and without cable crossover at raceway entrance.
9. Install heat shrinkable end caps on cable if cable cannot be terminated immediately after installation.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

F. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.

G. Route circuits within manholes to place different circuits on opposite sides of manholes where possible.

H. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

I. Install cable splices at pull points and elsewhere as indicated; use standard kits.

J. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.

K. Install separable insulated-connector as indicated on Drawings.

L. Arc Proofing: Arc proof medium-voltage cables in manholes, cable trays, cable vaults, pull boxes, switchgear, and other areas where multiple circuits are present and are not protected by individual conduits or barriers.

M. Use arc-proofing materials in accordance with manufacturer’s instructions.

N. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.
2. Wrap metallic cable components with 10 mil pipe-wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
5. Band arc-proofing tape with two layers of 1 inch wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.

O. Seal around cables passing through fire-rated elements according to Section 078413 "Penetration Firestopping."

P. Bond shields of shielded cable at terminations, splices, and separable insulated connector to the ground system. Maintain shield continuity and connectors to metal connection hardware at all connection points.

Q. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification. Complete marking and termination prior to energization.

3.3 FIELD QUALITY CONTROL

A. Notify Engineer in writing at least two weeks prior to scheduling any testing.

B. Tests and Inspections: Comply with requirements in Section 260010 “Supplemental Requirements for Electrical” and Section 260800 “Commissioning of Electrical Systems.”

C. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

A. Inspect and test cable installation in accordance with NETA Standard ATS for new cables or NETA Standard MTS for existing cables. Include the following:

1. Visual and mechanical inspection.
2. Shield continuity test.
3. Insulation resistance test.
4. Dielectric withstand test using Very Low Frequency (VLF).

B. When cables are spliced, perform shield continuity and insulation resistance test, prior to splicing, on each individual cable section and again on the entire length after the splice complete. Perform dielectric withstand, hot phasing, and rotation tests on the completed section.

C. Include the following on all cable test reports:

1. Cable identification / designation / type.
2. Cable length / termination types at each end.
3. Test conditions (tester name, environmental conditions, date of test), test results, and recommendations.

D. Medium-voltage cables will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.4 ACCEPTANCE TESTING – HOT PHASING AND ROTATION CHECKS

A. Correct phasing (A, B, C landed on terminals 1, 2, 3) and rotation (clock-wise) of existing and new medium voltage systems is the Contractor's responsibility. As the project progresses in phases, phasing and rotation checks are required whenever medium voltage cables are moved, spliced, re-landed, or newly installed. Electricians performing these energized activities must be qualified for this type of hazardous activity.

B. Hot phase check:

1. Each newly installed Switch.

C. Submit to Engineer in writing at least two weeks prior to scheduling any hot phase and rotation checks, the hot phasing and rotation plan.

D. Responsibilities:

1. Switching existing equipment: Owner.
2. Switching modified or new equipment: Contractor.
3. Absence of voltage testing, safety grounding, lockout / tagout: Contractor.

E. Perform all hot phasing and rotation checks in the presence of Engineer.

F. In the event of improper phasing or rotation, the appropriate circuit will be shut down and the Contractor will correct the problem at his expense.

END OF SECTION 260513

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Tray cable, Type TC.
3. Connectors and splices.

B. Related Requirements:

1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35 000 V.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
3. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

A. VFC: Variable-frequency controller. Used interchangeably with VFD.

B. VFD: Variable frequency drive. See VFC.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

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PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Stranding: Refer to CONDUCTOR APPLICATIONS Article in PART 3.

E. Conductor Insulation:

1. Type RHW-2: Comply with UL 44.
2. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 Type TRAY CABLE, TYPE TC-ER FOR VFC APPLICATIONS

A. Type TC-ER: Shielded, stranded, tinned copper cable with three symmetrical ground conductors, XLPE insulation, PVC outer jacket, designed for use as output cable to motor from VFCs.

1. Nexans AmerCable Type 37-108VFD Flexible TC-ER VFD Power Cable or equal.
2. Conduit sizing on Drawings are based on using this manufacturer. Increase conduit size as required to comply with NEC if different manufacturer is submitted.
3. Nexans AmerCable Data:

Circuit Conductor Size (AWG)	Grounding Conductors (x 3) Size (AWG)	Nominal Diameter (inches)	Nexans AmerCable Part Number
12	16	0.509	37-108-516VFD
10	14	0.522	37-108-308VFD
8	14	0.653	37-108-309VFD
6	12	0.737	37-108-310VFD
4	12	0.956	37-108-312VFD
2	10	1.103	37-108-314VFD
1	10	1.221	37-108-315VFD
1/0	10	1.447	37-108-316VFD

Circuit Conductor Size (AWG)	Grounding Conductors (x 3) Size (AWG)	Nominal Diameter (inches)	Nexans AmerCable Part Number
2/0	10	1.538	37-108-317VFD
4/0	8	1.883	37-108-319VFD

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Tin-plated copper.
2. Type:

    a. One hole with long barrels for No. 8 AWG to No. 4/0 AWG.
    b. Two holes with long barrels for 250 kcmil and larger.
    c. Locking spade for No. 10 AWG and smaller.

3. Termination: Compression for No. 8 AWG and larger.

D. Connectors:

1. Solderless pressure type (wirenuts) for No. 10 AWG and smaller.
2. Pre-filled with silicone-based sealant for exterior, wet, or corrosive locations.
3. Split bolt type for No. 8 AWG and larger splices.

E. Motor Terminations: Mechanical compression ring type, secured with bolt, nut and spring washer.

PART 3 - EXECUTION

3.1 CONDUCTOR APPLICATIONS

A. Wires and Cables: Copper; stranded, except for lighting and receptacle wiring which may be solid. Minimum size for power circuits: No. 12 AWG.

B. Nominal 480/277VAC Power Circuits: Single conductors in raceway. Type XHHW-2 for sizes up to 4/0 and Type RHW-2 for size 250 kcmil and larger.

C. Nominal 240/208/120V Power Circuits: Single conductors in raceway. Type XHHW-2.

D. Grounding Conductors: Refer to Section 260526 “Grounding and Bonding for Electrical Systems”.

E. Control and Fire Alarm Circuits: Refer to Section 260523 “Control-Voltage Electrical Power Cables”.

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

G. VFC Output Circuits: Type TC-ER with shield.

3.2 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Use of steel fish tapes and/or steel pulling cables in PVC conduit or raceways that terminate into energized enclosures is prohibited.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Do not splice service or feeder cables without prior written approval of Engineer.

C. Wiring at Outlets:

1. Install conductor at each outlet, with at least 6 inch of slack.
2. Form solid wire into loop to fit around device terminal screw. Do not overlap wire.

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3.4 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping" .

3.7 FIELD QUALITY CONTROL

A. and "Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance, and feeder conductors, and 480V power circuit conductors for compliance with requirements.
2. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 1000 V(dc) for 600 V rated cable for a one-minute duration. Minimum wire insulation resistance: 100 Megohms.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

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1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

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SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Category 6 balanced twisted pair cable.
2. Balanced twisted pair cable hardware.
3. Control-circuit conductors.
4. Instrumentation cable.
5. Termination products.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inches or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

E. RoHS compliant.

2.2 CATEGORY 6 BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Conductors: 100 ohm, No. 23 AWG solid copper.

D. Shielding/Screening: Screened and shielded twisted pairs (F/FTP).

E. Cable Rating: Plenum.

F. Jacket: Gray thermoplastic.

G. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.3 CONTROL-CIRCUIT CONDUCTORS

A. Individual Conductors: Stranded copper, Type XHHW-2, complying with UL 44 in raceway.

B. Multi-conductor Control Cable: NEC type TC, stranded copper, Type XHHW-2, insulated color coded conductors including ground wire, overall PVC jacket. Rated for cable tray or direct burial use and sunlight resistant. Number of conductors as indicated on Drawings.

C. Minimum Size: No. 14 AWG for 120V circuits, No. 16 AWG for circuits 50V and less.

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2.4 INSTRUMENTATION CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Belden.
2. Rockbestos-Suprenant Cable Corp.

B. Single or Multiple Paired Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC for 4-20mA process instrumentation signals and use under NEC Article 727.

1. One or Multi-pair, twisted, shielded, No. 16 AWG, stranded, tinned-copper conductors.
2. Voltage Rating: 300V.
3. Insulation: PVC.
4. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
5. Jacket: PVC with manufacturer's identification.
6. Standards: UL 1277 Type TC, UL 1581.
7. Single pair cable maximum overall diameter: 0.297-inches.

C. Triad (three conductor) Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC for instrumentation signals and use under NEC Article 727.

1. Three conductor, twisted, shielded, No. 16 AWG, stranded, tinned-copper conductors.
2. Voltage Rating: 300V.
3. Insulation: PVC.
4. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
5. Jacket: PVC with manufacturer's identification.
6. Standards: UL 1277 Type TC, UL 1581.
7. Triad cable maximum overall diameter: 0.311-inches.

2.5 INDUSTRIAL ETHERNET CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Rockwell Automation 1585-C8HB-S.

B. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e or Category 6 cable at frequencies up to 100 MHz *Ethernet/IP* compliant.

C. Conductors: 100-ohm, 22 AWG solid copper.

D. Shielding/Screening: Overall foil shield.

E. Cable Rating: 600V.

F. Jacket: PVC.

G. Standards: UL, UL PLTC, UL AWM 2570 80C 600V, TIA 568B.

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2.6 TERMINATIONS

A. Termination connectors for instrumentation and control conductors:

1. Tin plated copper.
2. Vinyl insulated.
3. Flanged spade / locking fork with upturned leg ends.
4. Crimp / compression installation.

B. Termination connector for industrial Ethernet cable: match conductor count, RJ45 type, intended for shielded cable. Rockwell Automation Bulletin 1585J or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or modified in this Section.

B. Comply with requirements in Section 260533.23 "Surface Raceways for Electrical Systems" for raceway selection and installation requirements for wireways as supplemented or modified in this Section.

C. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems" for raceway selection and installation requirements for boxes as supplemented or modified in this Section.

1. Outlet Boxes for Cables: No smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
2. Flexible metal conduit is not allowed.

D. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

E. Install manufactured conduit sweeps and long-radius elbows if possible.

F. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.

4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96 inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with requirements in Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for installation requirements and as supplemented or modified in this Section.

B. Instrumentation and Ethernet cables may not be spliced and are to be continuous from terminal to terminal.

C. Install instrumentation and Ethernet cabling in separate raceway from control or power wiring.

D. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

E. Separation from EMI Sources:

1. Separation between open instrumentation cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment as follows:

   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.

F. General Requirements for Telecommunications Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; cable cannot contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Do not splice cable between termination, tap, or junction points. Make cables continuous from terminal to terminal.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Grounding: Ground wire must be copper. Comply with IEEE C2. Demonstrate ground resistance.

G. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in this section unless otherwise indicated.
3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For instrumentation wiring, ground shield at one end only as recommended by instrument manufacturer and in accordance with Owner’s standard.

3.6 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers comply with UL 969 for label stocks, laminating adhesives, and inks.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260523

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.

B. Grounding and bonding materials and hardware.Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Insulated Grounding and Bonding Conductor: Copper conductor, 600V with insulation type matching the circuit phase conductors called for in Section 260519 “Low-Voltage Electrical Power Conductors and Cables”, green color.

B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Referenced Standards: Complying with one or more of the following:

a. Soft or Annealed Copper Wire: ASTM B3.
b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING MATERIALS AND HARDWARE

A. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

B. Ground Rods: Copper clad steel, 3/4-inch by 10-feet, sectionalized as required by Drawings.

C. Grounding Conduit Hubs: Malleable iron type.

D. Water Pipe Ground Clamps: Cast bronze saddle type.

E. Exothermic-welding Kits: CADWELD process or equal.

1. Manufacturer kits to include molds and powder recommended by kit manufacturer for materials being joined and installation conditions.
2. Welds used indoors in occupied buildings or confined space to be low emission type, CADWELD EXOLON or equal.

F. Ground Rod Test Wells: As detailed on the Drawings.

G. Ground Enhancement Material (GEM): Low-resistance, non-corrosive, carbon dust based material that improves grounding effectiveness.

1. Contains cement, which hardens when set to provide a permanent, maintenance-free, low-resistant grounding system that never leaches or washes away.
2. Suitable for installation in trenches or backfilling around ground rods.
3. Resistivity of no more than 20 ohm-cm in cured state. ERICO Part No. GEM25A or equal.

H. Bus Bars: Rectangular bar of annealed copper. As detailed on the Drawings.

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PART 3 - EXECUTION

3.1 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 10 AWG and smaller, and stranded conductors for 8 AWG and larger unless otherwise indicated.

B. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.

C. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

D. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

E. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

F. Underground Grounding Conductors: Install barecopper conductor, size as indicated on Drawings.

1. Bury at least 30 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

3.2 SELECTION OF CONNECTORS

A. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
2. Consult Engineer for resolution of conflicting requirements.

C. Special Techniques:

1. Grounding Electrode Conductors:

    a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
    b. Where conductors pass through floor slabs, walls, etc., install in conduit or sleeve.
    c. When conductors need to be installed in conduit for mechanical protection, use non-ferrous conduit to avoid a choke effect for fault currents.

2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

    a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
    b. Make connections with clean, bare metal at points of contact.
    c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
    d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
    e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
    f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

        1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
        2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
        3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

    g. Grounding and Bonding for Piping:

        1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
        2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
        3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

    h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

i. Grounding for Steel Building Structure: Install as indicated on Drawings.

1) Locate attachment points not subject to mechanical damage, but accessible for inspection.
2) Use exothermic weld process for wire sizes 1/0 AWG and larger. When wire size is smaller than 1/0 AWG, weld a pigtail of 1/0 AWG to structural steel then mechanically connect the two wires.

3. Grounding Separately Derived Systems:

a. Transformers: Bond neutral and ground with a bonding jumper at the equipment in accordance with NEC 250.102. Connect to the grounding electrode system via the electrode grounding conductor in accordance with NEC Table 250.66 or as indicated on the Drawings.
b. Generators and UPS: When indicated on the Drawings as a separately derived system, bond neutral and ground with a bonding jumper at the equipment in accordance with NEC 250.102. Connect to the grounding electrode system via the electrode grounding conductor in accordance with NEC Table 250.66 or a indicated on the Drawings.
c. Generator: Install grounding electrode(s) at generator location. Electrode must be connected to equipment grounding conductor and to frame of generator.

4. Grounding Underground Distribution System Components:

a. Comply with IEEE C2 grounding requirements.

5. Grounding and Bonding Manholes and Handholes: Install as indicated on Drawings. Bond exposed-metal parts to ground rod or grounding conductor. Grounding and Bonding of Raceways, Cable Trays, Boxes, and Enclosures:

a. Terminate metallic conduit into pressed steel boxes using double locknuts (same metal type as conduit) and insulated grounding bushings.
b. Terminate metallic conduit into metallic gasketed enclosures using Meyers grounding type conduit hubs.
c. Use insulated throat grounding bushings with lay-in type lugs to terminate metallic conduits containing equipment grounding conductors into sheet steel boxes.
d. Bond metallic electrical system components such as cable trays, supports, brackets, braces, boxes, etc. to the raceway system if they are not rigidly secured to and in contact with the raceway system or are subject to vibration and loosening.
e. Provide a bonding jumper across hinged metal panels or doors when electrical components in excess of 24 volts are mounted on the moveable panel.
f. Provide a grounding bushing at the end of metallic conduits that terminate in free air.
g. Provide 12 AWG insulated green wire bonding jumper for metal outlet boxes that contain receptacles. Connect wire from receptacle ground terminal to box using grounding screw.

6. Equipment Grounding:

a. Install insulated equipment grounding conductors with feeders and branch circuits.

b. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
c. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
d. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
e. Metallic Fences: Comply with requirements of IEEE C2.

1) Grounding Conductor: Bare copper, not less than 6 AWG.
2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
3) Barbed Wire: Strands must be bonded to grounding conductor.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

B. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:

a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω (ohms).
b. Power and Lighting Equipment or System with Capacity over 500 kVA: 5 Ω (ohms).

3.5 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260548 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following: channel support systems, conduit support hardware, and accessories.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 DELEGATED DESIGN SUBMITTALS

A. For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

B. Qualifications Statement: Submit qualifications for licensed professional.

1.5 QUALITY ASSURANCE

A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the jurisdiction of the project location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer, as defined in Section 014000 “Quality Requirements”, to design hanger and support system.

B. Surface-Burning Characteristics for Nonmetallic Channel Systems and Accessories: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Aluminum Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: 6063-T5 aluminum alloy.
3. Fittings and Accessories Material: 5052-H32 aluminum alloy.

B. Stainless Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.

C. Hot-dipped Galvanized Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Hot-dipped galvanized steel.

D. Nonmetallic Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: Ultraviolet resistant FRP.
3. Fittings and Accessories Material: Stainless steel, Type 316 or compatible non-metallic.

E. Accessories: Conduit clamps, straps, hangers, rods, backplates, anchors, nuts, washers, etc. to correspond with channel material as listed in the SELECTION Article. Use of galvanized steel components is only allowed with galvanized steel channel.

F. Threaded Rod: 3/8-inch diameter, minimum.

G. Expansion Anchors: 3/8-inch minimum diameter. Equal to “Kwik Bolt”, manufactured by McCullock Industries; “Wej it” manufactured by Wej it Expansion Products; or “Kwik-Bolt II” manufactured by Hilti Fastening Systems.

PART 3 - EXECUTION

3.1 SELECTION OF CHANNEL

A. Dry, indoor, conditioned, non-process space: Hot dipped galvanized steel.

B. Outdoor, process areas, or areas indicated on Drawings as “DUST”, “DAMP”, or WET”: Aluminum and/or stainless steel, depending upon load requirements.

C. Areas indicated on Drawings as “CORROSIVE”: Nonmetallic.

3.2 INSTALLATION

A. Comply with the following standards as applicable for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101: Standard for Installing Steel Conduits.
2. NECA NEIS 102: Standard for Installing Aluminum Rigid Metal Conduits.
3. NECA NEIS 105: Standard for Installing Metal Cable Tray Systems.
4. NECA NEIS 111: Standard for Installing Nonmetallic Raceways.

B. Provide vibration and seismic controls with hangers and supports in accordance with requirements specified in "Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Attach support systems only to structural components. Do not attach any electrical device, enclosure, raceway, supports, etc. to hand-rails, stair-wells or ladder-wells. Use concrete expansion anchors for attachment to concrete surfaces.

D. Provide a minimum of 1/2-inch clearance between wall and equipment when installing surface mounted panel boxes, junction boxes, conduit, etc.

E. Space conduit supports, other than for underground raceways, at no more than 8 foot intervals, and as required to obtain rigid construction.

F. Remove burrs and grind smooth sharp edges from channel support ends. Fit ends with plastic end caps.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

    a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

2. Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

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SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Conduits and fittings.

B. Products Installed, but Not Furnished, under This Section:

1. Section 260553 "Identification for Electrical Systems" for conduit identification labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260533.16 “Boxes and Covers for Electrical Systems” for conduit bodies, outlet and device boxes, pull boxes, and junction boxes.
4. Section 260533.23 "Surface Raceways for Electrical Systems” for wireways and auxiliary gutters.
5. Section 260529 “Hangers and Supports for Electrical Systems” for channel support systems and miscellaneous mounting components.

1.3 DEFINITIONS

A. Conduit: A structure containing one or more duct raceways.

B. Duct Raceway: A single enclosed raceway for conductors or cable.

C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project. Note some conduit types listed may not be used on the project. Refer to the Conduit Selection Table in PART 3. Indicate in the submittal, the areas where specific materials are used. If multiple

manufacturers of a given type of conduit or fittings are proposed, submit those cut sheets rather than stating “or equal”.

B. Conduit Layouts: For all Divisions required under the project scope of work conduits installed underground and concealed within buildings and structures. Show equipment, boxes, handholes, manholes, routing, materials, and sizing. Provide layouts at an appropriate scale for clarity. Submission of separate drawings for power, lighting and control for one area is acceptable. Provide schedule for easy cross check.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 TYPE ERMC-A DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Description: Rigid aluminum 6063 alloy conduit, elbows, couplings, and nipples per NEC Article 344.

B. Listing Criteria: UL DYWV - Rigid Nonferrous Metallic Conduit, including UL 6A.

C. Long radius elbows as indicated in Section 260543 “Underground Ducts and Raceways for Electrical Systems”.

D. PVC Coated Type: 40 mil PVC on exterior and 2 mil urethane on interior. (ERMC-A-PVC).

2.3 TYPE FMC DUCT RACEWAYS

A. Description: Flexible metal conduit per NEC Article 348.

B. Listing Criteria: UL DXUZ - Flexible Metal Conduit, including UL 1.

C. Material: Hot-dipped galvanize steel (FMC-S).

2.4 TYPE FMT DUCT RACEWAYS

A. Description: Flexible metal tubing composed of hot-dipped galvanized steel strips shaped into interlocking convolutions per NEC Article 360.

B. Listing Criteria: UL ILJW - Flexible Metallic Tubing, including UL 1652.

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2.5 TYPE LFMC DUCT RACEWAYS

A. Description: Liquidtight Flexible Metal Conduit, Type UA, per NEC Article 350.

B. Listing Criteria: UL DXHR – Liquid-tight Flexible Metal Conduit, including UL 360.

C. Material: Steel (LFMC-S).

D. Manufacturer: Sealtite®, Type UA, as manufactured by Anaconda, continuously interlocked flexible steel conduit with sunlight and chemical resistant PVC jacket.

2.6 FITTINGS FOR CONDUIT AND TUBING

A. General: Listed and labeled for type of conduit, location, and use.

1. ERMC-A: Use cast aluminum fittings.
2. ERMC-S: Use cast malleable iron fittings.

B. Listing Criteria as Applicable:

1. UL 514B – Conduit, Tubing, and Cable Fittings.
2. UL 1203 – Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
3. UL DWTT – Conduit Fittings.
4. UL FKAV – Electrical Metallic Tubing Fittings.
5. UL ILNR – Flexible Metallic Tubing Fittings.
6. UL DXAS – Liquid-tight Flexible Metal Conduit Assemblies.

C. Refer to Section 260533.16 “Boxes and Covers for Electrical Systems” for conduit bodies such as LB’s, T’s, and C’s.

D. Metal Fittings:

1. EMT Fittings: Die cast, rain and concrete tight, compression type. Set screw type not permitted.
2. RMC Fittings: Threaded type. Threadless fittings and split couplings are not permitted.
3. FMC Fittings: Malleable iron, zinc plated, insulated throat.
4. Fittings for PVC Coated Conduit: Minimum 40 mil thick PVC coating, with overlapping sleeves of one pipe diameter in length to protect threaded joints.
5. LFMC Fittings: Three-piece screw in type, malleable iron.
6. Expansion Fittings: Include flexible external bonding jumper.
7. FMT Bushings: Insulated.
8. Grounding and Bonding Hubs, Bushings, and Hardware:

    a. Grounding Hub: Meyers type.
    b. Locknuts: Cast steel or aluminum.
    c. Bushings: Insulated throat with lay-in type lugs.

E. Nonmetallic Fittings:

1. PVC Fittings: Comply with NEMA TC 3 and match conduit material.

2. LFNC Fittings: Dust-tight, liquid-tight, chemical resistant thermoplastic/nylon construction with tapered thread hub and neoprene O-ring gasket. Push-on fittings are prohibited.

F. Specialty Fittings:

1. Explosionproof Sealing Fitting: Crouse-Hinds EYS or equal.
2. Explosionproof Flexible Coupling: Crouse-Hinds ECGJH or equal.
3. Deflection/Expansion Fitting: OZ-Gedney Type DX or equal.
4. Expansion Coupling: Crouse-Hinds Type XJG with bonding jumper or equal.
5. Conduit Sealing Bushings: Refer to Section 260544 “Sleeves and Sleeve Seals for Electrical Raceways and Cabling”.

2.7 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT.

A. Description: Cold galvanizing compound, 95 percent zinc rich paint.

B. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

2.8 SOLVENT CEMENTS

A. Description: Solvent cement to join Type PVC duct raceways and fittings.

B. Listing Criteria: UL CCN DWTT; including UL 514B.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Refer to Appendix Table 260533.13-1 for conduit application requirements.

B. Minimum Raceway Size: 3/4-inch trade size.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following as applicable:

1. Relevant Article of NFPA 70.
2. NECA NEIS 101 – Standard for Installing Steel Conduits.
3. NECA NEIS 102 – Standard for Installing Aluminum Rigid Metal Conduit.
4. NECA NEIS 111 – Standard for Installing Nonmetallic Raceways.

5. NEMA FB 2.10 – Selection and Installation Guidelines for Fittings for Use with Non-Flexible Metallic Conduit or Tubing.
6. NEMA FB 2.20 – Selection and Installation Guidelines for Fittings for Use with Flexible Electrical Conduit and Cable.
7. NEMA FB 2.40 – Installation Guidelines for Expansion and Expansion/Deflection Fittings.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

a. Complete duct raceway installation before starting conductor installation.
b. Underground Installations: Refer to additional requirements in Section 260543 “Underground Ducts and Raceways for Electrical Systems”.
c. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 feet above finished floor.
d. Coordinate stub-up locations with approved shop drawings for equipment to position stub-up directly below appropriate section of motor control center, switchboard, or switchgear.
e. Provide a 4 inch thick concrete housekeeping pad at slab and grade penetrations. Provide a 45 degree, 3/4 inch chamfer at exposed edges.
f. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inches of changes in direction.
g. Maximum continuous conduit run: 300 feet. Reduce distance by 75 feet for each 90-degree elbow.
h. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
i. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
j. Support conduit within 12 inches of enclosures to which attached.
k. Drainage: Arrange conduit system to allow liquids such as water, condensation, etc. to drain away from equipment served. If conduit drainage is not possible, plug conduits using conduit seals.
l. Hazardous Areas: Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
m. Moisture Control: Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways using “Polywater” FST-250 Foam Duct Sealant or seal fitting at the following points:

1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2) Where an underground service duct raceway enters a building or structure.
3) Conduit extending from interior to exterior of building.
4) Conduit extending into pressurized duct raceway and equipment.

5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6) Where otherwise required by NFPA 70.

n. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
o. Do not install conduits within 2 inches of the bottom side of a metal deck roof.
p. Keep duct raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
q. Cut conduit perpendicular to the length. For conduits trade size 2 and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
r. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inches of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use. Use threaded cap.
s. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
t. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to trade size 1-1/4 and insulated throat metal bushings on trade size 1-1/2 and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Install Meyers grounding type hubs when conduits terminate at NEMA 3R, 4, and 4X gasketed enclosures.

2. Do not install aluminum duct raceways or fittings in contact with concrete or earth.
3. Protect metallic finish conduit installed in contact with concrete or below grade use PVC coated steel or aluminum where required, heat shrink tubing, or approved equivalent. Provide protection from 12 inches below bottom of concrete to not less than 6 inches above surface of concrete.
4. Rigid Metal Conduit (Type ERMC):

a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
b. The use of running threads is prohibited. Where such threads are necessary, use a three piece union.

5. PVC Coated Rigid Metal Conduit (Type ERMC-A-PVC and ERMC-S-PVC):

a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC-coated ERMC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on PVC-coated ERMC duct raceway.

c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.

6. Flexible Conduit Connections (Types FMC, LFMC, and LFNC):

a. Provide a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
b. Include adequate slack to allow for thermal expansion and mechanical vibration.
c. Orient outdoor flexible connections to provide drip loop to avoid accumulation of water at equipment connection points.

7. Non-Metallic Conduit (Type PVC):

a. Do not install Type PVC conduit where ambient temperature exceeds 122 degrees F. Conductor ratings must be limited to 75 degrees C except where installed in a trench outside buildings with concrete encasement, where 90 degrees C conductors are permitted.
b. Comply with manufacturer's published instructions for solvent welding and fittings.

8. Duct Raceways Embedded in Slabs:

a. Comply with spacing requirements as noted on Structural Drawings.
b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
c. Arrange duct raceways to ensure that each is surrounded by minimum of 1 inch of concrete without voids.

9. Stub-ups at Slabs: Arrange stub-ups so curved portions of bends are not visible above finished slab.

10. Stub-ups to Above Recessed Ceilings:

a. Provide EMT or ERMC for duct raceways.
b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

11. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:

a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG..

12. Duct Fittings: Use only fittings listed for use with each type of tubing or conduit and in accordance with specific fittings listed under PART 2.

a. ERMC-A-PVC: Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

13. Expansion-Joint Fittings: Install where necessary to compensate for thermal expansion and contraction and wherever conduits cross building or structure expansion joints.

14. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty.
15. Identification: Install identification tags at conduits in accordance with Section 260553 “Identification for Electrical Systems”.

D. Interfaces with Other Work:

1. Coordinate installation with other trades in advance of installation.
2. Restore walls, floor, and roof to original condition such as watertight, fire rating, smooth and/or painted finish after duct raceway penetration.
3. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.4 ATTACHMENTS

A. Table 260533.13-1: Conduit Selection Guidelines

Table 260533.13-1
Conduit Selection Guidelines

Raceway Type	Location / Application
EMT	Indoor air conditioned spaces in Administration / Office buildings including electrical rooms, mechanical rooms, control rooms, toilets, and offices.
ERMC-A	Indoor and outdoor applications, except where other types are listed. Exposed, non-corrosive areas. Concealed, non-corrosive areas. Under slabs in slab on grade construction / stub-ups. When installed underground or in contact with concrete, paint with two coats of bitumastic paint or use ERMC-A-PVC.
ERMC-A-PVC	Allowed for use in lieu of painting ERMC-A with two coats of bitumastic paint.
ERMC-S	Not used on this project.
ERMC-S-PVC	Not used on this project.
FMC	Flexible connections used in conjunction with EMT.

Table 260533.13-1 Conduit Selection Guidelines	
Raceway Type	Location / Application
FMT	Flexible connections to light fixtures in conjunction with EMT.
LFMC	Flexible connections used in conjunction with ERMC types.
LFNC-B	Flexible connections used in designated corrosive areas. Limited to 2-inch trade size.
PVC-40	Concrete encased duct banks. Embedded in concrete slabs or structures. Underground elbows are to be ERMC type.
PVC-80	Direct buried. Areas designated as corrosive. Protection of grounding electrode conductors. Protection of lightning conductors. Underground elbows are to be ERMC type.

END OF SECTION 260533.13

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SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Conduit bodies.
2. Metallic outlet boxes, device boxes, rings, and covers.
3. Nonmetallic outlet boxes, device boxes, rings, and covers.
4. Junction boxes and pull boxes.
5. Cover plates for device boxes.
6. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Listing Criteria as Applicable:

1. UL 514A – Metallic Outlet Boxes.
2. UL 514B – Conduit, Tubing, and Cable Fittings.
3. UL 514C – Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
4. UL 514D – Cover Plates for Flush-Mounted Wiring Devices.
5. UL BGUZ – Junction and Pull Boxes.
6. UL QCIT – Metallic Outlet Boxes.
7. UL QCMZ – Nonmetallic Outlet Boxes.

2.2 CONDUIT BODIES

A. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point.

B. Listed and labeled for type of conduit, location, and use. Refer to Section 260533.13 “Conduits for Electrical Systems” for conduit types and fittings used on the project.

C. Use mogul type (with rollers) for metal conduit bodies sizes 2-1/2 inch and larger by Appleton Electric.

2.3 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Outlet and Device Box Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover.

1. Outlet boxes do not include provisions to mount devices.
2. Device boxes include provisions to mount a device to the box.

B. Extension Ring Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

C. Pressed Steel Boxes: Hot dipped galvanized with hot-dipped galvanized tile rings. For use when recessed in walls or indoors exposed in non-process ceiling areas.

1. Lighting outlet boxes: 4-11/16 inch square, 2 1/8 inch deep, minimum.
2. Device boxes with electronics device (i.e. smart switch or receptacle, occupancy sensor, dimmer, etc.): Largest size for number of gangs required.

D. Cast Boxes: Type FD (deep) only. Type FS not permitted. Copper free aluminum. PVC coated when used with PVC coated conduits. Gasketed cover when used outdoors. Stainless steel screws for covers.

E. Explosionproof Type Box for Class 1, Division 1 Areas: Copper free aluminum. PVC coated when used with PVC coated conduits. Internal ground screw and O-ring. Pry notches on cover for bar or wrench.

F. Pedestal Device Boxes: Cast aluminum, polished finished. Used for laboratory bench receptacles.

G. Floor Boxes: Concrete tight. Number and type of devices as indicated on Drawings.

2.4 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Outlet and Device Box Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover.

1. Outlet boxes do not include provisions to mount devices.
2. Device boxes include provisions to mount a device to the box.

B. Only allowed in conjunction with PVC schedule 80 exposed conduit installations.

C. Type FD (deep) box only. Type FS (shallow) box not allowed.

2.5 JUNCTION BOXES AND PULL BOXES

A. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable. Boxes that contain terminals, relays, surge protective devices, or devices mounted on the cover are specified under Section 262716 “Electrical Cabinets and Enclosures”.

B. NEMA 12 Junction and Pull Boxes:

1. Material: Sheet steel, minimum 14 gauge, without knockouts.
2. Construction: Flanged box, galvanized with continuous weld seams that are ground smooth.
3. Cover: Gasketed, hinged, fastened with quick connect door clamp.

C. NEMA 4X/SS Junction and Pull Boxes:

1. Material: Type 316 stainless steel, minimum 14 gauge, without knockouts.
2. Construction: Flanged box, continuous weld seams that are ground smooth.
3. Cover: Gasketed, hinged, fastened with quick connect door clamp.

D. NEMA 4X/FRP Chemical Area Junction and Pull Boxes: When Drawings classify the area as CORROSIVE, ultraviolet resistant fiberglass reinforced plastic (FRP) with stainless steel hardware and gasketed covers.

E. NEMA 6/6P Junction and Pull Boxes: When Drawings call out for NEMA 6 (temporary submersion at limited depth) or NEMA 6P (prolonged submersion at limited depth), die cast aluminum or nonmetallic, coordinated with conduit material.

F. NEMA 7/4 Junction and Pull Boxes: When Drawings classify the area for Class 1, Division 1, Group D hazardous area, cast aluminum, cover gasket to meet NEMA 4 requirements, stainless steel hinged cover, stainless steel bolts. Crouse-Hinds Type EJB or equal.

2.6 COVER PLATES FOR DEVICES BOXES

A. Single Source: Obtain wall plates from same manufacturer of wiring device. Refer to Section 262726 “Wiring Devices” for requirements.

B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Flush Mounted Devices in Indoor Administrative Spaces: Includes offices, conference rooms, break rooms, restrooms, and control rooms.
3. Smooth, high impact thermoplastic or nylon, color to match wiring device.
4. Material for Flush Mounted Devices in Indoor Industrial Spaces: Includes electrical rooms, mechanical rooms, janitor closets, and indoor process areas. Type 302 (18-8) high nickel stainless steel.
5. Material for Surface Mounted Devices: Match box material.

2.7 HOODS FOR OUTLET BOXES

A. Description: Hood to mount to box for to create weatherproof while in use condition.

B. Wet-Location, Weatherproof Cover Plates (Hoods) for Switches and Receptacles: NEMA 250, complying with Type 3R, in-use weather-resistance, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Engineer for resolution of conflicting requirements.

B. Conduit bodies: Match associated conduit type.

C. Outlet boxes recessed in walls or indoors exposed in non-process ceiling areas: Pressed steel.

D. Exposed outlet and device boxes: Cast metal except where PVC-80 is used. Use PVC coated cast metal when conduit is PVC coated. Use non-metallic when PVC-80 is used.

E. Junction and pull boxes: Suitable for the location and conform to the NEMA enclosure ratings and material descriptions included on Drawings. Where no size is indicated, size in accordance with NEC Article 314.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall and the bottom or top of box should be placed at mortar joint. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
6. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
7. Set metal floor boxes level and flush with finished floor surface.
8. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
9. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
10. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
11. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

    a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    b. Provide gaskets for wallplates and covers.

12. Identification: Install labels and nameplates in accordance with Section 260553 “Identification for Electrical Systems”.

3.3 CLEANING

A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.4 PROTECTION

A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

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SECTION 260533.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Surface type raceways including wireways and troughs and auxiliary gutters.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Listing Criteria as Applicable:

1. UL 94 – Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
2. UL 870 – Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
3. UL CCN ZOYX – Wireway, Auxiliary Gutters and Associated Fittings.

2.2 WIREWAYS AND AUXILIARY GUTTERS

A. Metallic:

1. NEMA 12 Type: Painted steel, gasketed, hinged cover, stainless steel hardware. Square Duct as manufactured by Schneider Electric or equal.
2. NEMA 4X/SS Type: Stainless steel, Type 304, gasketed, hinged and clamped cover with drip lip, stainless steel hardware. Hoffman Bulletin F22 by nVent.

B. Nonmetallic:

1. NEMA 3R/FRP Type: Fiberglass, gasketed, hinged cover, stainless steel hardware. Hoffman Fiberglass Hinged-Cover Wiring Trough by nVent.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Auxiliary Gutters: Article 366 of NFPA 70.
2. Metal Wireways: Article 376 of NFPA 70.

C. Special Installation Techniques:

1. Install surface raceways or wireways and gutters as indicated on Drawings or when approved by Engineer.

3.2 CLEANING

A. Remove construction dust and debris from surface raceways before installing wires and again when installing covers.

3.3 PROTECTION

A. After installation, protect surface raceways from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.23

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SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Conduit sealing bushings.
4. Sleeve-seal systems.
5. Sleeve-seal fittings.
6. Grout.
7. Pourable sealants.
8. Foam sealants.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:

1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Cast-Iron Wall Sleeves:

1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral double waterstop. OZ-Gedney type WSK Thru Wall Floor Seal or equal for new installations with poured concrete.

C. PVC Molded Sleeves:General Characteristics: With nailing flange for attaching to wooden forms.

1. PE or PP Molded

D. Sleeves:

1. General Characteristics: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

E. Round, Galvanized-Steel, Sheet Metal Sleeves:

1. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:

1. General Characteristics:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness is to be 0.052 inch.
2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness is to be 0.138 inch.

2.3 CONDUIT SEALING BUSHINGS

A. General Characteristics: Malleable iron collar, one piece neoprene sealing ring, stainless steel hardware, designed for field assembly, to prevent passage of fluids and gases as conduits pass through walls and function as a sleeve-seal system. Rated for Class 1, Division 2 locations. OZ-Gedney CSB Series or CSM Series, or equal, depending upon application.

2.4 SLEEVE-SEAL SYSTEMS

A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

B. Options:

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.5 SLEEVE-SEAL FITTINGS

A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.6 GROUT

A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000 psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.7 POURABLE SEALANTS

A. Performance Criteria:

1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.

a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.8 FOAM SEALANTS

A. Performance Criteria:

1. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion cannot damage cables or crack penetrated structure.

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PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

   a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed .
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF CONDUIT SEALING BUSHINGS

A. Install where a sleeve-seal system or seal-fitting installation is required in an NEC Class 1, Division 2 hazardous location.

3.4 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

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SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Restraints - rigid type.
3. Restraints - cable type.
4. Restraint accessories.
5. Post-installed concrete anchors.
6. Concrete inserts.

B. Not all components specified in this Section are necessarily utilized on this project. Verify components needed per Drawings and Specifications.

C. Related Requirements:

1. Section 018829 “Seismic Performance Requirements” for submittals, performance requirements and installation.
2. Section 018839 “Wind Performance Requirements” for submittals, performance requirements and installation.
3. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definition, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
4. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
5. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: .

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.

2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
4. Surface Pattern: Smooth, ribbed, or waffle pattern.

2.2 RESTRAINTS - RIGID TYPE

A. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINTS - CABLE TYPE

A. Seismic- and Wind-Load-Restraint Cables: ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.

B. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. Cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.4 RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:

1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

C. Provide post-installed concrete anchors that have been prequalified for use in seismic and wind-load applications.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.

1. Undercut expansion anchors are permitted.

2.6 CONCRETE INSERTS

A. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.

B. Comply with MSS SP-58.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install seismic and/or wind restraint components in accordance with Division 01 requirements.

END OF SECTION 260548

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Identification products along with color and legend requirements.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260573 “Power System Studies” for arc flash study labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Note that not all products listed may be utilized on this project.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following where applicable:

1. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 feet above finished floor.

C. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed for conductors.

1. Color must be factory applied or field applied for sizes larger than 8 AWG.
2. Colors for 208Y/120 V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.

3. Colors for 240/120 V Circuits (Single Phase):

a. Phase A: Black.
b. Phase B: Red.
c. Neutral: White.

4. Colors for 240Δ/120 V Circuits (Three Phase, Four Wire, High Leg, Center Tap):

a. Phase A: Black.
b. Phase B: Orange (high leg).
c. Phase C: Blue.
d. Neutral: White.

5. Colors for 480Y/277 V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
d. Neutral: Gray.

6. Colors for DC Circuits:

a. Positive: Red.
b. Negative: Black.

7. Color for Equipment Grounding Conductors: Green.

B. Color-Coding for Phase- and Voltage-Level Identification, Over 1000 V: Use double colors listed for conductors.

1. Colors for 5 kV Rated Circuits:

a. Phase A: Black/Red.
b. Phase B: Red/Red.
c. Phase C: Blue/Red.

2. Colors for 15 kV Rated Circuits:

a. Phase A: Brown/Red.
b. Phase B: Orange/Red.
c. Phase C: Yellow/Red.

3. Color for Equipment Grounding Conductor (600V rated): Green.

C. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

D. Warning labels and nameplates/signs must include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

E. Equipment Identification and Source Nameplate:

1. Color: Black letters on a white field.
2. Material: See NAMEPLATES Article.
3. Equipment furnished under Divisions 26, 27, 28 and equipment control panels furnished under other Divisions must include equipment identification nameplates. Equipment includes, but is not limited to switchgear, switchboards, motor control centers, panelboards, transformers, disconnect switches, separately mounted motor controllers, transfer switches, control panels, and named enclosures or cabinets. Nameplate to match designation indicated on Drawings.
4. Power source must be identified at all applicable equipment. Nameplate may be separate from identification nameplate or information may be contained on one nameplate. For example, a local disconnect switch for a pump motor could have one nameplate reading “EFFLUENT PUMP NO. 4” for the identification nameplate and a second nameplate reading “FED FROM MCC-2”. Or a two-line nameplate combining the information for both identification and source.

F. Device Identification Labels:

1. Color: Black letters on a white field. In office areas only, black letters on a clear field.
2. Material: Self-adhesive type, machine generated, 1/4 inch high letters.
3. Devices to be labeled with panel and branch circuit number include receptacles, wall switches, lighting fixtures, photocells, emergency lights, exit lights, instruments, etc. For

example, a light switch powered from panelboard LP-2 and branch circuit 4 would have the label “LP-2/4” or “LP-2/CKT 4”.

2.3 NAMEPLATES

A. Material:

1. Engraved, engraved plastic (lamicoid).
2. Minimum size: Not less than 1/16 inch thick by 3/4 inch high by 2-1/2 inches wide.
3. Lettering: Upper case, 3/16 inch high minimum.

2.4 LABELS, BANDS, TUBES, AND SLEEVES

A. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

B. Heat-Shrink Preprinted Tubes (Sleeve Type): Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 degrees F. Comply with UL 224. Printed text is black, permanent, and waterproof.

2.5 TAPES

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inches wide; compounded for outdoor use.

C. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape must be permanent and may not be damaged by burial operations.
c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".

3. Detectable Tape:

a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
b. Width: 6 inches.
c. Overall Thickness: 5 mil.
d. Foil Core Thickness: 0.35 mil.

2.6 TAGS

A. Metal Tags: Embossed, Type 316 stainless steel, 0.01 inch thick, punched for use with tie fastener. Secure with 0.048 inch diameter stainless steel band fastened with compression wire clamps

B. Nonmetallic Preprinted Tags: Polyester or Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

2.7 CABLE TIES

A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 degrees F in accordance with ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 degrees F.
4. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Nameplates/Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

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3.2 SELECTION OF IDENTIFICATION PRODUCTS

A. Power-Circuit Conductor Identification, 1000 V or Less: For conductors at termination points and in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape if conductor is not factory colored to identify phase, neutral, and ground conductors. Use heat-shrink to identify circuit.

B. Power-Circuit Conductor Identification, More Than 1000 V: For conductors at termination points and in vaults, pull and junction boxes, manholes, and handholes, use heat-shrink. Use nameplate or nonmetallic tag secured with cable ties to indicate phase and indicate circuit designation.

C. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.

D. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with conductor designation.

E. Spare Conductors or Cables: Attach nonmetallic tags or self-adhesive labels to conductors and list source.

F. SCADA Systems, Communication Systems, Fire Alarm Systems or Other Auxiliary Electrical Systems Conductor Identification: For identification at terminations, provide heat-shrink preprinted tubes with conductor designation.

G. Conduit Identification: For designated identification as indicated on Drawings provide metal tags.

H. Pull Boxes and Junction Boxes, 24 inches by 24 inches and Larger: For voltage identification provide nameplates using 1 inch high minimum letters, white letters on red background.

I. Equipment Identification: For identification and source information provide nameplate(s) per COLOR AND LEGEND REQUIREMENTS Article.

J. Device Identification: For source and circuit information provide self-adhesive label per COLOR AND LEGEND REQUIREMENTS Article.

3.3 INSTALLATION

A. Install identification product in accordance with manufacturer’s instructions.

B. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Verify identity of item before installing identification products.

E. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

F. Apply identification devices to surfaces that require finish after completing finish work.

G. Apply wire markers so entire designation is clearly visible.

H. Install Arc Flash Labels in accordance with Section 250573 “Power System Studies”.

I. Identify the system voltage (e.g. 208/120 VOLTS, 480 VOLTS, 4160 VOLTS) at the covers of large pull boxes or junction boxes.

J. Install field device (instruments, receptacles, switches, etc.) labels.

K. Install equipment nameplates. Nameplate fastening requirements:

1. NEMA 12 Enclosures: Screw mounted using stainless steel screws.
2. Other Enclosure Types: Bonded using epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable.

L. Panelboard and Transformer Panel Assembly Identification:

1. Provide equipment identification nameplates as previously described.
2. Label branch circuit phase and neutral wires with associated pole number using self-adhesive labels or type written sleeve type labels.
3. Install typed as built circuit directory listing with unique load identification.

M. Install Tags. Fastening Requirements:

1. Secure metal tags using stainless steel ties.
2. Secure nonmetallic tags with UV-stabilized cable ties.

END OF SECTION 260553

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SECTION 260573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based study for:

1. Short circuit report.
2. Protective device coordination report.
3. Motor starting report.
4. Arc flash report.

B. Study encompasses the power distribution system of the Cedar Creek Water Pollution Control Plant. Facility is located at 3340 Merrick Rd, Wantagh, NY 11793.

C. Study includes the electric utility company's protective devices, power plant generators, service entrance equipment and distribution to the improvements at the Influent Pumping stations. All power distribution to that point whether existing or new is included. Equipment included, but not limited to:

1. Substations and distribution.
2. Switchgear, switchboards, and panelboards.
3. Motor control centers.
4. Variable frequency controllers.
5. Disconnect switches.
6. Transfer switches.
7. 480V control panels.

D. The local electric utility is PSEG-LI.

E. Obtain all data necessary to perform the study. Data included, but not limited to:

1. Up to date one-line diagrams.
2. Equipment data.
3. Cable sizes and lengths.
4. Existing protective device settings.
5. Electric utility information: available fault current, protective device equipment information and settings, X/R ratios, transformer impedances and ratings.

F. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 DEFINITIONS

A. Boundary, Arc Flash: When an arc flash hazard exists, an approach limit from an arc source at which the incident energy equals 1.2 cal/cm² (5 J/cm²).

B. Boundary, Limited Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

C. Boundary, Restricted Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

E. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

F. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

G. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

H. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

I. Preliminary Short Circuit Report: Report that includes the maximum available utility fault current, proposed equipment, and existing equipment to determine if new equipment may be released for manufacturing and existing equipment is adequate for the calculated short circuit levels.

J. Protective Device: A device that senses when an abnormal condition or current flow exists and then removes the affected portion of the circuit from the system.

K. SCCR: Short-circuit current rating.

L. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

M. Single-Line Diagram: See "One-Line Diagram."

N. Supplier: The person, firm or corporation identified as such to provide the power system study and means the Supplier or its authorized agent. See also Power Systems Analysis Specialist.

O. VFD: Variable frequency drive. Interchangeable with variable frequency controller.

1.4 ACTION SUBMITTALS

A. Supplier qualifications per Quality Assurance paragraph. Submit prior to starting study. Include the following:

1. Brief description of each qualifying study.
2. Name of owner of installation on which study was performed with address, telephone number, and contact person.
3. Date of study.
4. Any other information indicating the firm's experiences and ability to perform the work and business status.

B. Preliminary Power System Study Report. Report must be approved prior to release for manufacture of major electrical equipment including but not limited to switchgear, switchboards, distribution panels, and motor control centers. Fault data from the utility must be included and not assumed or submittal will be rejected.

C. Final Power System Study Report. Report must be approved prior to energization of new major electrical equipment. Revise study as required for changes during construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. If requested, Product Certificates: For power system study software, certifying compliance with IEEE 399, IEEE 1584 and NFPA 70E.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Final power system study updated with any changes made after equipment start-up.

B. Digital computer files with full read-write access of the complete power system model and library.

1.7 QUALITY ASSURANCE

A. Perform Study using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications:

1. Design computer program to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
2. Develop computer program under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
3. Complies with IEEE 399, IEEE 141, IEEE 242, IEEE 519, IEEE 1015, and IEEE 1584 as applicable to the project scope.

E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located and has regularly engaged in this electrical engineering study specialty for minimum of five years and has performed at least three projects of similar complexity to this project within the last three years. Perform all elements of the study under the direct supervision and control of this professional engineer. Specialist shall be professionally independent of the manufacturers, suppliers, and installers of the equipment under evaluation.

F. Power System Study Certification: Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

1.8 POWER SYSTEM STUDY MEETINGS

A. Supplier's professional engineer responsible for the study to attend a meeting with the Engineer and Owner at the Owner's facility up to and including three times.

B. Purpose of the three meetings are:

1. Initial meeting discusses the study's scope and the Owner's operational and maintenance requirements prior to the preliminary study submittal.
2. Second meeting discusses the preliminary study and its recommendations. Based on this meeting, the Owner may request modifications to the studies' recommended protective settings to reduce the arc flash hazard or meet other operational objectives.
3. Third and final meeting presents the final study and its recommendations.

C. Provide a minimum of three-week notice to the Owner and Engineer in advance of all projected meeting dates.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Acceptable Software:

1. SKM System Analysis, Inc.: Power*Tools.
2. Operation Technology, Inc.: ETAP (Electrical Transient Analyzer Program).
3. EasyPower, Inc.: EasyPower.
4. Or equal.

2.2 POWER SYSTEM STUDY REPORT GENERAL REQUIREMENTS

A. Except for one-line diagrams, standard 8 1/2-inch by 11-inch pages, with total pages numbered.

B. Electronic PDF format copy with electronic bookmarks for each section.

C. Signed and sealed by a professional engineer registered in the state in which the project is located.

D. Organized in the following order:

1. Executive Summary.
2. Short Circuit Analysis.
3. Short Circuit Computer Printout.
4. Protective Device Coordination.
5. Motor Starting.
6. Arc Flash Hazard Analysis.
7. Harmonic Analysis.
8. Utility Data.
9. Modeled One Line Diagrams.

E. Information on one-line diagrams, legible when printed at 11-inch x 17-inch. Show the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA), impedance, and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by the study.

F. Identifiers between the one-line diagram, short circuit study, coordination study, and arc flash study to be the same.

G. Include copies of correspondence with electric utility under utility data section of report. Correspondence to include names and contact information.

2.3 EXECUTIVE SUMMARY

A. Include summary of distribution system, information received from electric utility, major assumptions, adequacy of equipment to safely clear or close on any fault, identify problem areas and recommendations for resolving problem areas.

2.4 SHORT CIRCUIT

A. Comply with IEEE 399 and IEEE 551 (new 3002 series).

B. Include normal utility powered configuration, on-site generation configuration, and alternate modes of operation (i.e. alternate utility configuration, bus ties closed).

C. Include minimum and maximum possible fault conditions. Address three-phase bolted as well as ground fault conditions.

D. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.

E. Calculate short-circuit momentary duties and interrupting duties based on an assumed bolted three-phase short circuit at each high and medium voltage switchgear bus and controller, low voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. Include the X/R ratios, asymmetry factors, KVA and symmetrical fault-current in the short circuit tabulations. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.

F. Include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.

G. Identify available fault current at each bus and evaluate system elements including but not limited to equipment, protective devices, and cables.

H. Base current transformers' ratio and burden calculations on a 10 percent maximum ratio error per IEEE C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable IEEE error margins and recommend corrective action.

I. List momentary, interrupting, and/or withstand rating of all key elements of the distribution system along with the maximum available fault current in tabular form and clearly indicate the adequacy of the element with PASS / FAIL designation.

J. Short Circuit Computer Printout:

1. Calculations shall be in sufficient detail for easy review.
2. Back up calculations shall become part of the final report.

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2.5 PROTECTIVE DEVICE COORDINATION

A. Comply with IEEE 242 (new 3004 series).

B. Utilize results from the short circuit study and balance the competing objectives of protection and continuity of service for the system specified, considering the basic factors of sensitivity, selectivity and speed. Include all system protective devices in the coordination analysis, not just overcurrent protective devices. This includes, but is not limited to under and over voltage protective relays, frequency relays, differential relays and reverse power relays.

C. Show graphic indication of coordination between protective devices in the form of full color time-current coordination (TCC) plots with each protective device curve in a unique color for easy review.

D. Provide separate TCC plots for each mode of operation. Provide separate TCC plots for “normal” and “stand by” operation. Show maximum fault values in each case. Both power sources shown on one plot is unacceptable.

E. Provide separate TCC for phase over-current and ground fault.

F. Show no more than six devices on one TCC. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots to provide cross-reference. Designate each TCC with a unique identifier and include each TCC identifier and descriptive title in the study’s table of contents.

G. Include in each TCC the following as applicable:

1. TCC name and description.
2. One-line diagram.
3. Identifiers on one-line diagram and curves.
4. Significant motor starting characteristics.
5. Appropriate NEC protection points.
6. Appropriate ANSI/IEEE protection points.
7. Magnetizing inrush points of transformers.
8. Transformer damage curves.
9. Complete operating bands for low voltage circuit breaker trip devices and fuses.
10. Relay coil taps, time-dial settings and pickup settings.
11. Significant symmetrical and asymmetrical fault currents.
12. Power cable withstand curves.
13. Generator short circuit decrement and thermal limit curves.

H. Terminate device characteristic curve on TCC at a point reflecting the maximum symmetrical or asymmetrical fault current to which that device is exposed, based on the short circuit study.

I. Select each primary protective device for a delta-to-wye-connected transformer so the characteristic or operating band is within the transformer parameters; where feasible, include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults.

J. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults.

K. Separate protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity.

L. Optimize settings for breakers and relays to provide the most effective protection practicable for all modes and power sources.

M. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.

N. Provide tabulations of recommended settings for all protective devices. Where devices are existing, highlight any changes from the existing setting to the proposed recommended setting.

O. Provide all information required to program/set multifunction solid state relays.

2.6 MOTOR STARTING

A. Comply with IEEE 141 (new IEEE 3001 series) for recommended light flicker limits and IEEE 3002.7 for motor starting studies.

B. Provide motor starting study for all large electric drives (100 horsepower and larger). Include all operating modes.

C. Identify any concerns about voltage drop or power inrush limitations due to the starting of motors.

2.7 ARC FLASH HAZARD

A. Comply with IEEE 1584, NFPA 70, and NFPA 70E as applicable.

B. Utilize short circuit and protective device coordination results to provide arc flash hazard analysis. Perform calculations in accordance with IEEE 1584.

C. Calculate the incident energy levels at each faulted bus for each mode of operation and for both maximum and minimum fault currents.

D. Include calculations at line side and load side of main breakers, where applicable.

E. Provide tabular report for all modes and conditions and include “worst case” summary. Use the “worst case” to generate the arc flash labels. Include:

1. Fault location.
2. Arcing fault magnitude.
3. Protective device clearing time.
4. Duration of the arc.
5. Arc flash boundary.

6. Working distance.
7. Incident energy.
8. Electrode configuration.

F. Highlight any available incident energy over 40 cal/cm² and provide recommendations to mitigate the hazard.

G. Arc Flash Labels:

1. Machine printed, 4-inches x 4-inches (nominal), thermal transfer, high adhesion polyester.
2. Provide UV resistant laminate for outdoor labels.

H. Arc Flash Label Information:

1. Equipment name.
2. Identifier LINE or LOAD where equipment has potential different energy levels.
3. Arc flash hazard information: arc flash boundary and incident energy in cal/cm².
4. Shock hazard information: limited approach and restricted approach boundaries.
5. Personal Protective Equipment (PPE) requirements.
6. Study Supplier, project number, and date.

I. Provide arc flash label sample with preliminary report.

J. Do not be print the labels until equipment is energized and protective devices set according to the approved final protective device coordination study.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.

1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.

B. Gather and tabulate the required input data to support the power system study.

C. Field data gathering for existing systems shall be under direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

D. Data included, but are not limited to, the following:

1. Product data for overcurrent protective devices and existing settings.
2. Electrical power utility information. Information required may include:

    a. Available minimum and maximum three-phase fault current and X/R ratio.
    b. Available minimum and maximum single-line-to-ground fault current and X/R ratio.
    c. Service transformer voltage, kVA, and impedance ratings, winding configuration, and grounding method.
    d. Upstream protective device data.

3. Power sources and ties.
4. For switchgear, switchboards, panelboards, and motor control centers, ampacity and SCCR in amperes RMS symmetrical.
5. For transformers, kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
6. For reactors, manufacturer and model designation, voltage rating, and impedance.
7. For circuit breakers, trip units, and fuses, manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
8. For generators, short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For busways, manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. For motors, horsepower and NEMA MG 1 code letter designation.
11. Conductor sizes, lengths, number, conductor material, shield parameters for medium voltage cable, and conduit material (magnetic or nonmagnetic).
12. For relays, manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
13. For transfer switches, withstand and closing ratings (WCR) with time duration.
14. Derating factors.

3.2 FIELD QUALITY CONTROL

A. Do all testing and adjustment prior to the energization of new equipment.

B. Test existing adjustable protective devices in accordance with NETA MTS.

C. Test new adjustable protective devices in accordance with NETA ATS.

D. Adjust existing and new protective devices according to approved coordination study.

E. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

F. After successful testing and adjustment, install calibration sticker with Field Adjusting Agency name, employee initials, and date of calibration at each relay or protective device.

G. After energization, minor adjustments to settings may be required to commission the equipment.

H. Submit field report and list any changes made during field adjustment or commissioning for update for record submittal of study.

I. For adjustable breakers, install sticker listing final adjusted settings, i.e. LTPU, LTD, STPU, STD, INST, GFPU, and GFD.

3.3 ARC FLASH LABELING

A. After the field adjustment of relays and protective devices, apply arc flash study labels.

B. Apply arc flash labels on the front covers of the following equipment:

1. Substations and distribution transformers.
2. Medium voltage switches.
3. Switchgear, switchboards, and panelboards.
4. Motor control centers.
5. Variable frequency controllers.
6. Disconnect switches.
7. Transfer switches.
8. 480V control panels.

C. Apply arc-flash labels at each section for large equipment such as switchgear and motor control centers.

D. Install LINE and LOAD arc-flash labels as applicable.

E. Remove any previous arc flash study labels as applicable and install new labels under the direction of the Power System Analysis Specialist.

END OF SECTION 260573

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SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes procurement of the services of an Electrical Testing Firm Supplier (ETFS) to provide all materials, equipment, labor, and services required to achieve a fully commissioned electrical system.

B. The intent of the Section is to:

1. Provide electrical system construction planning.
2. Provide summary qualifications of the testing firm.
3. Summarize division of responsibility for electrical commissioning.
4. Define additional testing, inspections, and adjustments.

C. The following Division 26 Sections include testing and/or settings requirements:

1. Section 260513 “Medium-Voltage Cables”.
2. Section 260516 “Low-Voltage Electrical Power Conductors and Cables”.
3. Section 260523 "Control-Voltage Electrical Power Cables”.
4. Section 260526 “Grounding and Bonding for Electrical Systems”.
5. Section 260573 "Power System Studies”.
6. Section 261839 “Medium-Voltage motor Controllers”.
7. Section 262200 “Low-Voltage Transformers”.
8. Section 262413 “Switchboards”,
9. Section 262416 “Panelboards”.
10. Section 262505 “480V Control Panels”.
11. Section 262816 “Enclosed Switches and Circuit Breakers”.
12. Section 263600 “Transfer Switches”.

D. Other Divisions include electrical testing requirements for equipment with electrical components. These include:

1. Automation Equipment – Division 40.
2. Process Mechanical Equipment and Associated Motors – Divisions 40 through 46.

E. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 DEFINITIONS

A. Electrical Testing Firm Supplier (ETFS): The firm responsible for providing specialty and independent testing and adjustments of electrical systems on the project..

B. Low Voltage: 600 V and below.

C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.

D. Medium Voltage (MV): 601 V and above.

E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.4 MEETINGS

A. Conduct a project kickoff coordination meeting within two weeks after submitting the MV Master Project Plan. The purpose of the meeting is to discuss the ETFS's MV Master Project Plan, regarding installation and testing associated with the medium voltage system.

B. Hold meeting at Owner's designated location. Attendance to include representatives of the Owner, Engineer, Contractor (general, electrical, EFTS), and Equipment Manufacturer(s).

C. As MV system construction is done in phases, hold additional meetings as required during construction. The purpose of these meetings are to ensure MOPO and safety by proper planning of upcoming construction and testing activities.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For electrical testing firm supplier (ETFS) and personnel intended for the project.

B. Field Quality-Control Reports:

1. Table of contents / Executive summary.
2. Test procedures and equipment used, include calibration dates.
3. Test results that comply with requirements.
4. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
5. Typed test forms, no handwritten entries.

C. Certification that all relays on MV equipment have been adjusted to the power system study final approved setting.

D. Certification that all adjustable circuit breakers have been adjusted to the power system study final approved setting.

E. Certification that arc flash labels that correspond to the final approved power system study have been applied.

1.6 ACTION SUBMITTALS

A. MV Master Project Plan.

1. Submit, within 60 calendar days after Notice to Proceed, the MV Master Project Plan. Plan to include the following:

a. Informational submittal qualification data.
b. Detailed construction phasing for the MV system.
c. Required shutdowns and estimated durations.
d. Temporary power plans for MOPO.

B. Additional MV Project Plans.

1. Submit, no later than 30 calendar days prior to a requested MV system shutdown, a MV Project Plan for upcoming shutdown activities. Plan to include the following:

a. Shutdown and Re-Energization Switching Procedures. Shutdown Procedures will include areas intended to be shutdown, expected duration of shutdown, staffing, safety plans, one line diagrams showing associated breakers or switches with their status (opened, closed, racked out, temporary grounds) and lockout-tagout locations. Re-Energization Procedures will include same information as Shutdown Procedures, but also phasing and rotation check locations upon re-energization.
b. Failure to submit plan in a timely manner will cause the shutdown to be rescheduled.

C. Switchgear and Generator Test Plan.

1. Submit, no later than 30 calendar days prior to first equipment start-up, a plan for operational checks.

D. Power Monitoring / SCADA Verification Plan.

1. Submit, no later than 30 calendar days prior to substantial completion, the list of SCADA points to confirm. Confirmation of actual data (i.e. the breaker is open/closed; amps / volts / kVA readings are correct) is to be done when load is running.

1.7 QUALITY ASSURANCE

A. ETFS Qualifications: Corporately and financially independent testing organization, to provide unbiased test results, and is professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.. The ETFS, may be but is not required to be the same firm as the power system study supplier.

B. ETFS: Electrical Engineer Qualifications: Senior level electrical engineer, experienced in medium voltage industrial electrical systems with source transfer switchgear.

C. ETFS Electrical Technician Qualifications: NETA or ETT Certified Technician Level III or NICET Electrical Power Testing Level II Certification.

1.8 DIVISION OF RESPONSIBILITY

A. Electrical Contractor Responsibilities Include:

1. Routine insulation-resistance, continuity, and rotation checks prior to and in addition to manufacturer or EFTS testing.
2. Transformer voltage checks and adjustment of taps.
3. Phasing checks across tie breakers and transfer switches.
4. Motor rotation and ampacity checks, overload settings, field test reports.
5. Provide suitable and stable source of electrical power required for testing.
6. Coordination and scheduling with Owner, Engineer, Equipment Manufacturers/Suppliers, and ETFS.
7. Obtain the power system study. Engineer must review and approve study prior to placing any new equipment in service.

B. Equipment Manufacturer Responsibilities:

1. Installation checks and testing as listed per individual Section.

C. ETFS Responsibilities:

1. Installation checks and testing as listed per individual Section.
2. Switchgear and Generator commissioning as a system.
3. Verification of correct power monitoring on the SCADA system.
4. Setting and adjustments to protective devices and adjustable circuit breakers per the final approved power system study.
5. Installation of arc flash labels.
6. Final infrared testing as listed per individual Section of all new, relocated, or re-terminated equipment.

D. Additional Testing, Inspections, and Adjustments:

1. Infrared testing of non-modified equipment is not included / required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

A. Field testing and commissioning is intended to follow the latest revisions of NETA Standard ATS, ECS, and MTS as applicable unless otherwise modified in these Sections.

B. Site standard phase rotation is clockwise. That is when phases A, B, C are connected to terminals 1, 2, 3 the phase rotation will be clockwise. If phase rotation must be corrected, it should be done at the end device, i.e. the motor.

C. Where two in-house potential sources are present and may be connected, regardless of the safety interlocks provided, testing to verify correct phasing is required. Without checking this, one source may have clockwise rotation with a 123-ABC and the second source may have a clockwise rotation with a 123-BCA installation. A three-phase short would result if safety interlocks fail and these two sources are connected inadvertently. Hot phase testing is required at all two source locations. This includes the following equipment on this project:

1. Switchgear S1
2. Switchgear S3
3. Load Break Switch P1/P3
4. Load Break Switches P2/P4
5. Load Break Switches P5/P6.
6. Substation T1/T2
7. Switchboard RTU
8. MCC P-10
9. MCC P-11

3.2 FIELD QUALITY CONTROL

A. Verify electrical equipment and systems have been tested in compliance with Contract Documents.

B. Provide reports.

END OF SECTION 260800

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SECTION 261839 - MEDIUM-VOLTAGE MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes medium-voltage motor controller assembly and accessories.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260573 “Power System Studies” for motor starting.
4. Section 260800 “Commissioning of Electrical Systems” for startup and commissioning of medium-voltage motor control centers.
5. Section 400593.13 “Medium-Voltage Motor Requirements for Process Equipment” for motors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and rating of medium-voltage motor controller indicated.

1. Include descriptive bill of materials, literature, and catalog cut sheets of components and accessories.
2. Include time-current characteristic curves for power fuses and protective relays.
3. Include protective relay instruction manuals.
4. Include equipment installation manuals.

B. Shop Drawings:

1. Include a tabulation of installed devices with features and ratings.
2. Include dimensioned plans and elevations, showing dimensions, shipping sections, and weights of each assembled section. Elevations shall show major components, features, and mimic bus diagram.
3. Include a plan view and cross section of equipment base showing clearances, manufacturer's recommended workspace, and locations of penetrations for grounding and conduits. Show location of anchor bolts and leveling channels.

4. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, and location and size of each field connection.
5. Locate accessory and spare equipment storage.
6. Include single-line diagram.
7. Include control power wiring diagrams.
8. Include copy of nameplate.
9. Include ratings for the controller assembly:

    a. Voltage.
    b. Continuous current.
    c. Short-circuit current.
    d. BIL.

10. Include Power factor calculations for review.

11. Include relay settings.
12. Include interface data with monitoring or control network.
13. Include Wiring Diagrams: For each controller assembly include the following:

    a. Power, signal, and control wiring.
    b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
    c. Schematic control diagrams.
    d. Diagrams showing connections of component devices and equipment.
    e. Schematic diagrams showing connections to remote devices including connection details to the communications network.

C. Specification Compliance:

1. Include a copy of this specification confirming compliance with each paragraph. For deviations, provide detailed commentary to explain the deviation.

1.4 INFORMATIONAL SUBMITTALS

1. Indoor Installations:

    a. Dimensioned concrete base, outline of the medium-voltage motor controllers, conduit entries, and grounding equipment locations.
    b. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways, cable trays, busways and seismic anchors.
    c. Location of lighting fixtures, sprinkler piping and heads, ducts, and diffusers.

B. Qualification Data: For testing agency.

C. Seismic Qualification Data: Certificates, for each motor controller, accessories, and components, from manufacturer.

1. Certificate of compliance.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For medium-voltage motor controllers and accessories to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
3. “As-Built” shop drawings.
4. For each motor controller, a tabular listing including the following:

    a. Motor data including name, equipment tag, and nameplate full load current.
    b. “As-Left” settings for adjustable devices such as timers and protective relays.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. One non-contact audio-visual medium voltage tester with batteries, storage case and clamp stick adapter.

B. One set of three 10 foot grounding jumpers and storage bags.

C. One clamp stick with canvas storage bag.

D. One portable lifting device for transporting contactor outside its compartment.

E. One remote operator for controller isolation switch.

F. Touchup paint: half-pint container of paint matching the enclosure exterior finish**.**

G. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights (lamp and lens cap): Two of each type and color installed.
4. One dozen each of cover bolts, spring nuts and door fasteners.

5. Vacuum Contactor Bottles: Three of each size and type.
6. Surge Arrestors: Three of each size and type.
7. Protective Relays: One of each type.
8. Control Power Transformer: One of each size and type.
9. Power Cell: One of each size and type.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer’s instructions and Section 260010 “Supplementary Requirements for Electrical” for delivery, storage, and handling.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace medium-voltage motor controllers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to equipment manufacturer restrictions listed in Section 260010 “Supplemental Requirements for Electrical”, medium-voltage motor controllers from the following manufacturers are approved:

1. ABB - Limitamp.
2. Eaton - Ampgard.
3. Rockwell Automation - Allen-Bradley CENTERLINE 1500.
4. Schneider Electric - Square D Motorpact.
5. Siemens - SIMOVAC.

B. Source Limitations: Obtain each medium-voltage controller from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

A. Medium-voltage motor controller assembly, ANSI / NEMA rated, and UL labeled for installation on4.16 kV, 3 phase, 3 wire, 60 Hz, grounded distribution system.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

C. Comply with the following standards:

1. UL 347, Medium-Voltage AC Contactors, Controllers and Control Centers.

2.3 CONSTRUCTION

A. Free-standing, dead-front, front accessible only, assembly of vertical sections, each with motor starters as indicated on drawings, and bolted to form a rigid assembly.

B. Indoor Locations: NEMA Type 1A enclosure unless otherwise indicated on drawings.

C. Power Bus: Tin plated copper, ampacity rating as indicated on Drawings. Located in its own compartment for maintenance and extension. Bus short circuit current rating: 50 kA symmetrical for 2 seconds.

D. Ground Bus: Tin plated copper along the entire length of the assembly.

E. BIL: 60 kV.

F. Maximum Dimensions: As indicated on drawings.

G. Assembly Configuration:

1. Isolate and compartmentalize low-voltage circuits and devices, medium-voltage main power bus, and medium-voltage power cell compartment. Provide separate control compartment with doors.
2. Power and control circuits to enter assembly from either top or bottom for indoor enclosures and bottom only for outdoor enclosures.
3. Provide adequate termination space for stress cone installation of shielded medium-voltage cables of size indicated on Drawings.

H. Exterior Enclosure Finish: Factory-applied finish in manufacturer's standard color over a rust-inhibiting primer on treated metal surface.

I. Interior Enclosure Finishes:

1. Control and power cell compartment: high gloss white for easier visibility.
2. Unpainted steel parts, plated for corrosion resistance.

J. Printed circuit boards: Conformal coated.

K. When wires or buswork passes through holes or sections, add suitable guarding or grommets for close fit and to prevent cutting or chafing of insulation.

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2.4 MEDIUM-VOLTAGE CONTROLLERS

A. Product Description: NEMA Class E2 medium-voltage controller using power fuses and vacuum contactor in combination to provide motor control and short circuit protection.

B. Interrupting Rating: 50 kA rms symmetrical at nominal utilization voltage.

C. Isolation Switch:

1. Three-pole gang operated; non-load break quick-make quick-break type operated by an externally mounted handle to isolate power cell.
2. Size: As indicated on Drawings.
3. Electrically and mechanically interlocked with the vacuum contactor to prevent operation under load, and operating the switch with the door open.
4. Switch blades grounded in the off position.
5. Auxiliary contacts: 2 N.O., 2 N.C, unless otherwise indicated on Drawings.
6. Handle: padlocking provisions for 3 padlocks, and mechanically trapped key interlocking.
7. Viewing window in low-voltage compartment to confirm switch position.

D. Medium Voltage Fuses: As indicated in the ACCESSORIES Article.

E. Motor Type and Size: As specified in Section 400593.13 “Medium-Voltage Motor Requirements for Process Equipment”, horsepower rating as indicated on Drawings.

F. Motor Starting Method: Reduced Voltage Autotransformer, Non-Reversing (RVAT-NR), unless indicated otherwise on Drawings.

G. Contactor:

1. NEMA/ANSI type, drawout vacuum type, size 400A, unless indicated otherwise on Drawings.
2. Electrically held unless indicated otherwise on Drawings.
3. Vacuum contactor wear check.

H. Additional Features:

1. Blown power fuse indication.
2. Compression lugs and ground lugs for power terminations as shown on Drawings.
3. Infrared viewing window.

2.5 LOAD-BREAK SWITCH

A. Main load break switch for switching primary power source and feeder load break switch for switching other loads. Size and fusing as indicated on Drawings.

B. Mechanical interlock to prevent door opening when the switch is in closed, and to prevent closing the switch when the door is open.

C. A polycarbonate viewing window in the power cell door to view the position of the isolation handle.

D. Load-Break Switches are to be provided in motor control construction and match dimensions shown on the drawings.

2.6 INTEGRATED EQUIPMENT

A. Integrate the following equipment where shown on the Drawings.

B. Power Factor Correction Capacitors (PFCC): Installed by the MV Motor Controller manufacturer, furnished by motor manufacturer.

1. Kvar rating as shown on drawings and validated by submitted calculations.

2.7 ACCESSORIES

A. Surge Arresters: Comply with IEEE C62.11, distribution class, metal-oxide-varistor type, voltage rating as required for nominal system voltage and grounding configuration listed in SYSTEM DESCRIPTION Article; mount in incoming line compartment.

B. Medium Voltage Fuses:

1. Motor Application: Manufacturer selected. Provide R-rated, current-limiting fuses with 50 kA interrupting rating. Fuse to provide visual indication when blown.
2. Load-Break Switch Application: Manufacturer selected for transformer application to coordinate with transformer inrush and damage curve. For other applications refer to Drawings. Provide E-rated, current-limiting fuses with 50 kA interrupting rating. Fuse to provide visual indication when blown.
3. Control Power Application: Manufacturer selected.

C. Motor Protection and Management Relay:

1. Manufacturer, no exception: Schweitzer Engineering Laboratories; SEL-710 Motor Protection Relay.
2. Product Description: Motor protection, fault diagnostics, power metering, and communications functions, integrated into complete draw-out package.

a. Suitable for protection and management of three phase medium and large induction or synchronous motors and associated driven equipment, including high inertia, two speed and reduced voltage start motors.
b. Include communication interface and protocol with SCADA System per NETWORK COMMUNICATIONS Article. Include RJ45 communications jack.
c. Comprehensive motor protection plus voltage dependent overload curves, torque metering and protection, broken rotor bar protection.
d. HMI backlit display to view relay information and settings in direct sunlight, face-mounted keypad and setpoint navigation keys.
e. Provide input terminals for resistance temperature detector (RTD) or thermocouple inputs, and low-voltage analog inputs.
f. Provide input terminals for programmable digital inputs.
g. Provide terminals for programmable digital outputs.
h. Power supply: 120VAC.

i. Current input: 5A.

D. Controls and Devices:

1. Built-in test circuit to permit checkout of motor control when medium-voltage circuit is de-energized. Test circuit powered from 120 Vac external source via polarized plug connector, accessible only when low voltage door is open.
2. As indicated on Drawings, industrial duty.
3. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oil-tight type, 30 mm.
4. Indicating Lights: LED types; push-to-test. Color as indicated on drawings.
5. Selector Switches: Rotary type.

E. Control Power Transformers: 120 volt secondary, sized for additional load where indicated. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

F. Control and Secondary Wiring: 600V, tin-plated stranded copper, type SIS, flameproof, grouped together with harness or in ducts and secured to the structure. Minimum size No. 14 AWG for control and voltage circuits, minimum size No. 12 AWG for CT circuits. Terminated on 600V rated terminals and labeled at each termination point.

G. Instruments:

1. Instrument Transformers: Manufacturer selected for burden and accuracy per application and in compliance with IEEE C57.13.
2. Potential Transformers: Two-winding, encapsulated with primary and secondary fuses.
3. Current Transformers: Provide zero-sequence CT when ground fault protection is specified. Terminate CT winding in a screw type terminal on the CT housing and to shorting terminal blocks using ring type terminations. Output current: 5 amp.

2.8 NETWORK COMMUNICATIONS

A. Include interfacing hardware, cables, connectors, software, etc. for communication with SCADA system specified in Division 40.

B. Motor control will be via hardwired signal and digital communications signal.

C. Digital communication signal will utilize copper Ethernet cable using Modbus TCP/IPcommunications protocol. Communication between individual motor controllers and SCADA system will be in a star configuration.

D. Provide 24 V dc UPS / battery backup to allow ride-through control during plant generator start and transfer, up to 60 second power interruption.

2.9 IDENTIFICATION

A. Nameplates:

1. White background / black lettering.
2. All interior and exterior devices – 1/4-inch high lettering.
3. Master nameplates for equipment and section designations – 1-inch high lettering

B. Control wiring: heat-shrink or sleeve type typed wire markers, matching manufacturer's wiring diagrams at each termination point.

C. Warning signs on terminals that remain energized with power disconnect OFF.

D. Warning signs or indication at cubicles with a foreign voltage present (i.e. external voltage source for space heaters).

E. Phase (A, B, C) input and output power connections identified with labels.

2.10 SOURCE QUALITY CONTROL

A. Test and inspect equipment according to UL, NEMA, and manufacturer.

B. Factory inspection and witness.

1. Make completed controllers available for inspection at manufacturer's factory prior to packaging for shipment.
2. Allow witnessing of factory inspections and tests at manufacturer's test facility.
3. Include travel costs for two personnel (one Owner and one Engineer representative). Travel costs include, but are not limited to, sufficient days/nights necessary for transportation, lodging, meals, and expenses.
4. Notify engineer a minimum of two weeks prior to travel requirement.

C. Physical inspection:

1. Verify compliance with drawings and specifications.
2. Verify nameplates, labels, and identification.
3. Verify isolation barriers are present to protect personnel and equipment.
4. Verify bus and connections have proper clearance and torque.
5. Verify tightness of control and power wires.
6. Verify mechanical interlocks.

D. Electrical tests:

1. Perform functional and continuity checks.
2. Perform dielectric withstand test on buswork and power cable (phase-to-phase, phase-to-ground).
3. Perform I/O check and functionality operation per diagrams.
4. Test functionality of protective relays, meters, instruments, controls.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Upon delivery of controllers and prior to unloading, inspect equipment for damage:

1. Examine tie rods and chains to verify they are undamaged and tight, and that blocking and bracing are tight.
2. Verify that there is no evidence of load shifting in transit and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
3. Examine controllers for external damage, including dents or scratches in doors and sill, and termination provisions.
4. Compare controllers and accessories received with the bill of materials to verify that the shipment is complete. Verify that controllers and accessories conform to the manufacturer's quotation and shop drawings. If the shipment is not complete or does not comply with project requirements, notify the manufacturer in writing immediately.
5. Unload controllers, observing packing label warnings and handling instructions.
6. Open compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will have to cross section barriers to reach load or line lugs.

C. Pre-Installation Checks:

1. Verify removal of any shipping bracing after placement.

D. Verify that ground connections are in place and that requirements in Section 260526 “Grounding and Bonding for Electrical Systems” have been met.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s published instructions. Level and anchor equipment. Remove temporary lifting angles, lugs and shipping braces. Touch up damaged paint finishes.

B. Switch operating handles located above 79 inches above operating floor to have operating arm extension.

C. Install controllers plumb and level and with each section aligned properly.

D. Grout and caulk voids beneath equipment base.

E. Make electrical connections between equipment sections using connectors furnished by manufacturer.

F. Ground and bond controllers in accordance with Section 260526 “Grounding and Bonding for Electrical Systems”.

G. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

H. Maintain adequate clearance between medium-voltage power, low-voltage control, and communications wiring to avoid electro-magnetic interference.

I. Terminate medium-voltage cables according to Section 260513 “Medium-Voltage Cables”.

J. Tighten bolted connections and wiring connections using calibrated torque wrench or torque screwdriver per manufacturer’s written instructions.

K. Obtain the manufacturer’s services for the commissioning and startup work.

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify equipment by name designation and fed from source nameplates.
2. Identify field-installed conductors, interconnecting wiring, and components.

B. Install Arc Flash Labels in accordance with Section 250573 “Power System Studies”.

3.4 FIELD QUALITY CONTROL

A. Division of Responsibilities:

1. Provide installation and assist with all testing and startup activities.
2. Engage factory authorized service representative to assist in installation, inspection, testing, startup, and commissioning activities specified herein to active manufacturer’s warranty.
3. Engage a qualified testing agency as defined in this Section to perform activities defined in Section 260800 “Commissioning of Electrical Systems”.

B. General Requirements:

1. Perform inspection, testing, and startup activities recommended by and in accordance with manufacturer’s instructions, NETA ATS, and as specified herein. Perform testing and test methods in compliance with NFPA 70B. Provide materials and labor as necessary. Correct deficiencies, make adjustments, and retest until requirements are met. Provide written report for each field testing or service visit.

C. Visual and Mechanical Inspection:

1. Compare medium-voltage motor controller and motor nameplate data and confirm compatibility.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, and grounding.
4. Verify tightness of accessible bolted electrical connections. Use calibrated torque wrench.
5. Verify unit is clean.
6. Verify smooth operation of mechanical devices and correct operation of interlocks.

D. Electrical Tests:

1. Ratio and polarity tests on instrument transformers.
2. Ground resistance test.
3. Insulation resistance test (bus and switches).
4. Vacuum bottle integrity test.
5. Test protective parameters as recommended by manufacturer.
6. Verify correct input and output voltages, currents, and phase rotations.

E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each medium-voltage motor controller line-up.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform follow-up infrared scan of equipment, at 11 months after Substantial Completion.
3. Prepare a certified report identifying equipment checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Medium-voltage motor controllers will be considered defective if they do not pass tests and inspections.

3.5 STARTUP SERVICE

A. The following items must be complete prior to startup service:

1. Driven equipment installed and ready for loading.
2. Associated SCADA system installed and programmed.

B. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Field test hardwired discrete and analog connections and any digital communication signals connected to verify proper operation.

C. Make adjustments to medium-voltage motor controllers and connected devices for manual and automatic operation of the driven equipment to operate as a system as shown on the Contract Documents. Include:

1. Trip settings in accordance with approved power system study.
2. Programming parameters.
3. Timing relays.

D. Clear events memory after successful startup.

3.6 ADJUSTING

A. Adjust protective relays in accordance with the final approved submittal of Section 260573 “Power System Studies”.

B. Adjust motor starting and stopping parameters for RVSS controllers as needed by the driven load and Owner requirements.

C. Set field-adjustable time-delay relays and switches as needed by the driven load and Owner requirements.

3.7 DEMONSTRATION AND TRAINING

A. Engage a factory-authorized service representative to demonstrate correct operation, adjust settings, and maintain medium-voltage motor controllers to Owner.

B. Provide 8-hour man day[s] for instruction. Time instruction to cover all working shifts.

3.8 CLEANING

A. Remove rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION 261839

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SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of low voltage dry-type transformers:

1. Distribution type.
2. Transformer panel assemblies.
3. Drive-isolation type.

B. Related Requirements:

1. Section 260010 “Supplemental Requirements for Electrical” for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on project. Note this Section may include products not required for the project.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

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1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field-quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat in accordance with manufacturer's published instructions within enclosure of ventilated-type units, throughout periods during which equipment is not energized and when transformer is not in space that is continuously under normal control of temperature and humidity.

D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to equipment manufacturer restrictions listed in Section 260010 “Supplemental Requirements for Electrical, transformers from the following manufacturers are approved:

1. Eaton.
2. GE by ABB.
3. Siemens.
4. Square D by Schneider Electric.

B. Source Limitations: Obtain each type of transformer from single source from single manufacturer.

2.2 GENERAL REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with the following standards:

1. NEMA ST 20, Dry-Type Transformers for General Applications.
2. UL 1561, Standard for Safety Dry-Type General Purpose and Power Transformers.
3. US Department of Energy Efficiency Standards for Low Voltage Distribution Transformers.

B. General Description:

1. Dry type, two winding. Configuration, kVA, and voltage shown on Drawings.
2. Windings: Copper, unless noted otherwise herein.
3. Temperature Rise: 80 degrees C, unless noted otherwise herein.

C. Taps for transformers 15 kVA and larger: Full capacity, two 2.5 percent above and four 2.5 percent below.

D. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

E. Enclosures:

1. Indoor: NEMA 250, Type 1 or 2, ventilated. Standard enclosure type.
2. Outdoor and indicated as NEMA 3R on drawings: Indoor unit converted to Type 3R with manufacturer’s weather shielding accessory.
3. Outdoor and indicated as NEMA 4X on drawings: TENV, stainless steel enclosure. All stainless steel hardware. Manufacturer’s standard windings and temperature rise.

F. Special Options: Electrostatic shielding, K-Rated, harmonic-mitigating, or low sound level rating, where noted on Drawings.

G. Accessories:

1. Vibration isolators for transformers rated 112.5 kVA and higher.
2. Wall or ceiling brackets for wall or ceiling mount, where noted on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for transformers.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's published instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify the grounding electrode system is present and complies with Section 260526 "Grounding and Bonding for Electrical Systems". Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1 “Standard for Good Workmanship in Electrical Construction” and NECA 409 “Standard for Installing and Maintaining Dry-Type Transformers”.

B. Comply with manufacturer’s published instructions.

C. Install mounting brackets, concrete pads, hangers, and other supports prior to setting transformers in place.

D. Install transformers level and plumb. Install vibration isolators between transformer enclosure and supports in accordance with manufacturer’s instructions.

E. Anchor floor mounted transformer to concrete base. Remove shipping braces and adjust internal mounting bolts and hardware in accordance with manufacturer’s instructions.

F. Install flexible conduits to minimize vibration transmission.

G. Ground this separately derived system in accordance with Section 260526 “Grounding and Bonding for Electrical Systems”. Terminate all grounding and bonding conductors on a common equipment grounding terminal mounted inside the transformer enclosure. Do not allow grounding terminal bar to block ventilation openings.

H. Tighten electrical connectors and terminals in accordance with manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A-486B.

I. Identify transformers in accordance with Section 260553 “Identification for Electrical Systems”.

1. Identify equipment by name designation and fed from source with nameplates.
2. Color code wiring.
3. Identify branch circuit phase and neutral wires by circuit number at TPA.
4. Provide as built type panel directory at TPA.

J. Install Arc Flash Labels in accordance with Section 260573 “Power System Studies”.

3.3 FIELD QUALITY CONTROL

A. Perform checkout and testing activities recommended by and in accordance with manufacturer's instructions, NETA ATS, and as specified herein. Correct deficiencies, make adjustments, and retest until requirements are met.

B. Visual and Mechanical Inspection:

1. Compare equipment nameplate data with Drawings and Specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, and grounding.
4. Verify resilient mounts are free and shipping brackets are removed.
5. Verify unit is clean.
6. Inspect bolted electrical connections for high resistance using one of the following:

    a. A low-resistance ohmmeter.
    b. Calibrated torque wrench.
    c. Thermographic survey.

7. Verify as-left tap connections are as specified.

C. Electrical Tests:

1. Perform insulation-resistance tests for winding-to-winding and winding-to-ground.
2. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform follow-up infrared scan of transformers, at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Voltage Recording: Record transformer secondary voltage at each unit under loaded conditions for at least 48 hours of typical occupancy.

1. Submit summary written report.
2. Include the following for each transformer:

    a. Designation.
    b. Nominal secondary voltage.
    c. Existing tap setting.
    d. Available tap settings.
    e. Steady state maximum secondary voltage recorded.
    f. Steady state minimum secondary voltage recorded.
    g. Time period duration.

h. Graphical representation of voltage over time period.

3.4 ADJUSTING

A. Adjust tap settings when directed by Engineer.

3.5 CLEANING

A. Remove rubbish and debris from inside and around equipment. Vacuum clean interior.

END OF SECTION 262200

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SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Low voltage, dead front switchboards, components, and accessories.
2. Spares and spaces in equipment as indicated on the Drawings.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260573 “Power System Studies” for short circuit, coordination, and arc flash. The preliminary short circuit study submittal must be approved by the Engineer prior to review of the switchboard submittal.
4. Section 260800 “Commissioning of Electrical Systems” for startup and commissioning of switchboards.

1.3 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include descriptive bill of materials, literature, and catalog cut sheets of components and accessories.
2. Include time-current characteristic curves for overcurrent protective devices. Include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For each switchboard.

1. Include drawing index.
2. Include dimensioned plans and elevations, sections, and details, including required clearances and service space around equipment.
3. Indicate shipping sections, and weights of each assembled section. Show major components and features on elevations. Show locations for conduit entrances, anchor bolts, and leveling channels on plans.
4. Include assembly ratings including enclosure type, short circuit, voltage, current, and bus material.
5. Include tabulation of rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
6. Include cable terminal lug sizes.
7. Include wiring and schematic diagrams for power, signal, and control wiring.
8. Include nameplate information.
9. Where applicable, include busway connection details, key interlock schemes, sequence of operations, composite floor plans of close-coupled assemblies, and utility metering compartment details.

C. Installation Instructions: For switchboard and major component assembly.

D. Specification Compliance:

1. Include a copy of this specification confirming compliance with each paragraph. For deviations, provide detailed commentary to explain the deviation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Data: Certificates, for switchboards, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and accessories to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Routine maintenance requirements for switchboards and installed components.
b. Manufacturer's instructions for testing and adjusting circuit breaker trip settings.
c. Time-current curves, including selectable ranges for each type of overcurrent protective device. Include selectable ranges for each type of overcurrent protective device.
d. "As-Built" shop drawings incorporated during construction by manufacturer or Contractor. Provide drawings in AutoCAD native file format.
e. "As-Left" settings for adjustable devices such as timers and overcurrent protective devices.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Rating Plug and Trip Units: one of each size and type.
4. Indicating Lights (lamp and lens cap): Two of each type and color installed.
5. One dozen each of cover bolts, spring nuts and door fasteners.

B. Touchup paint: half-pint container of paint matching the enclosure exterior finish**.**

C. One full function portable solid state circuit breaker test set for calibration performance of circuit breaker microprocessor trip unit functions using secondary current injection testing. Include ground defeat cable for trip units to allow for primary current testing, if necessary.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with the following for delivery, storage, and handling:

1. Manufacturer's instructions.
2. Section 260010 "Supplementary Requirements for Electrical".
3. NECA 400 "Standard for Installing and Maintaining Switchboards".
4. ANSI/NEMA PB 2.1 "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less".

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1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace switchboards and accessories that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to equipment manufacturer restrictions listed in Section 260010 “Supplemental Requirements for Electrical”, switchboards from the following manufacturers are approved:

1. ABB.
2. Eaton.
3. Schneider Electric / Square D.
4. Siemens.

B. Source Limitations: Obtain switchboards from single source from single manufacturer.

C. Modifications or Additions to Existing Switchboards: Use original manufacturer for model series still in production; otherwise use original manufacturer or approved manufacturer with documented prior experience providing similar types of modifications.

2.2 GENERAL REQUIREMENTS

A. Low voltage switchboard assembly, free-standing, dead-front type, ANSI / NEMA rated, and UL 891 labeled for installation on low voltage electrical distribution system indicated on Drawings. General arrangement, alignment, ratings, and major components of switchboards are shown on the Drawings.

B. Fully rate main and feeder circuit breakers for the specified short circuit duty. Systems employing series ratings are unacceptable.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

D. Comply with the following standards as applicable:

1. NEMA PB 2, Dead-front Distribution Switchboards.
2. UL 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
3. UL 891, Switchboards, CCN WEVZ.
4. UL 1066, Power Circuit Breakers up to 1000 V AC and 1500 V DC Used in Enclosures.
5. UL 1449, Surge Protective Devices.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

F. Temperature: Design switchboards and devices for continuous operation at rated current with a 40 degrees Celsius ambient temperature.

2.3 SYSTEM DESCRIPTION

A. SWBD-RTU-BUS A & SWBRD-RTU-BUS B:

1. Front access only, front and rear aligned, individually sections for main breaker, and tie breaker, group mounted feeder sections. Eaton Pow-R-Line Xpert or equivalent.

2.4 CONSTRUCTION

A. Construct switchboard with required number of vertical sections bolted together to form a rigid assembly. Cover sides and rear with removable bolt-on covers. Form edges of front covers or hinged front panels. Provide adequate ventilation.

B. Align sections of switchboard as indicated on Drawings.

C. Provide switchboard assembly with adequate lifting means.

D. Indoor Enclosure: NEMA Type 1 enclosure unless otherwise indicated on drawings.

E. Maximum Dimensions: As indicated on drawings. Comply with NEC height limit of operating handles when switchboard is installed on 4-inch-high housekeeping pad.

F. Exterior Enclosure Finish: Factory-applied finish in manufacturer's standard color over a rust-inhibiting primer on treated metal surface.

G. Interior Enclosure Finishes:

1. Control and power cell compartment: high gloss white for easier visibility.
2. Unpainted steel parts, plated for corrosion resistance.

H. Barriers: Between adjacent switchboard sections.

I. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments. Use captive quarter turn fasteners.

J. When wires or buswork passes through holes or sections, add suitable guarding or grommets for close fit and to prevent cutting or chafing of insulation.

K. Where Drawings indicate space for future overcurrent protective devices, equip space with so only the overcurrent protective device is needed to be added. Include buswork, barriers, connections, protective device mounting hardware, doors/covers, etc. required.

L. Bus Systems:

1. Phase Bus Arrangement: A, B, C from front to back, top to bottom, and left to right when viewed from front of switchboard.
2. Phase and Neutral Bus: Tin plated copper, bolted joints, fully rated throughout the lineup. Tapered bus is not allowed. Braced for 65,000 A rms unless otherwise noted on Drawings. Full size neutral bus for four wire systems if indicated on Drawings.
3. Ground Bus: Minimum 1/4-inch by 2-inch, tin plated copper uninsulated ground bus, extended through each section.
4. Disconnect Links: Isolate neutral bus from incoming neutral conductors. Bond neutral bus to equipment ground bus for switchboards utilized as service equipment or separately derived systems.

M. Wiring/Terminations:

1. Instrument and Control Wire: Stranded copper, type SIS, bundled and secured with nylon ties. Minimum size No. 14 AWG.
2. Control Wire Terminations: Insulated locking spade terminals, except where saddle type terminals are provided integral to device. Current transformer secondary leads must connect to shorting type terminal blocks before connecting to another device.
3. Provide numbered terminal blocks for landing control wiring that leaves the switchboard.
4. Power Terminations: Mechanical type, suitable for 75 or 90 degrees C, copper or aluminum cable of the size indicated on Drawings.

N. Where Drawings indicate utility metering is required, provide separated barriered utility metering compartment complete with hinged sealable door, provisions for mounting utility's metering instruments, and in compliance with the specific utility requirements. Provide service entrance label and appliable service entrance features per NEC and local code requirements.

2.5 CIRCUIT BREAKERS

A. Circuit breakers 800 A frame and larger: 600 V, insulated-case type, listed and labeled to UL 489, 80 percent continuous ampacity, fixed mount, electrically operated. Temperature insensitive, true RMS, integral, fully adjustable solid state electronic trip unit with the following features:

1. Independently adjustable long-time pick-up and delay.
2. Independently adjustable short-time pick-up, delay, and I^2t settings.
3. Adjustable instantaneous pick-up.
4. Independently adjustable ground fault pick-up, delay and I^2t settings.
5. Trip mode targets for overload, short circuit and ground fault.
6. Long-time pick-up light.

B. Circuit breakers 400 A and 600 A frame: 600 V, molded-case type, listed and labeled to UL 489, 80 percent continuous ampacity rated. Temperature insensitive, true RMS, integral, fully adjustable solid state electronic trip unit with the following features:

1. Independently adjustable long-time pick-up and delay.
2. Independently adjustable short-time pick-up, delay, and I^2t settings.
3. Adjustable instantaneous pick-up.
4. Independently adjustable ground fault pick-up, delay and I^2t settings.
5. Trip mode targets for overload, short circuit and ground fault.

6. Long-time pick-up light.

C. Circuit breakers 250 A and 400 A frame: 600 V, molded-case type, listed and labeled to UL 489, 80 percent continuous ampacity rated. Temperature insensitive, true RMS, integral, fully adjustable solid state electronic trip unit with the following features:

1. Independently adjustable long-time pick-up and delay.
2. Adjustable instantaneous pick-up.
3. Independently adjustable ground fault pick-up, delay and I^2t settings.
4. Trip mode targets for overload, short circuit and ground fault.
5. Long-time pick-up light.

D. Circuit breakers 225 A frame and less: 600 V, molded-case type, listed and labeled to UL 489, 80 percent continuous ampacity rated. Thermal magnetic trip.

2.6 IDENTIFICATION

A. Signs and Nameplates: Engraved, laminated plastic, stainless steel screw attachment, background color and letters as noted herein.

B. Master Nameplate: Switchboard designation, service ratings, factory order number, and date (month/year) of manufacture. Lettering not less than 3/8-inch high, black background, white letters. Locate at top of switchboard section containing incoming feed.

C. Unit Compartment or Breaker Nameplates: Designation as indicated on drawings. Lettering not less than 3/8-inch high, black background, white letters.

D. Identify pilot devices and operators using legend plates or nameplates.

E. Identify internal components, corresponding to wiring diagrams.

F. Include warning labels on terminals that are energized with the power disconnect OFF.

G. Control Wire Identification: Typed sleeve type labels at each end, corresponding to wiring diagrams. Wiring less than six inches may be numbered at only one end. Identify foreign voltage control wiring with yellow wires.

2.7 SURGE PROTECTION

A. Integral Surge Protective Device: To protect input AC line from transients.

1. By switchboard manufacturer, factory installed, with integral disconnect.
2. Type 2.
3. SCCR: Equal to SCCR of switchboard.
4. Performance and Features: Comply with Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits”.

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2.8 INSTRUMENTATION AND METERING

A. Current Transformers: 600 V, 5 A secondary, bar or window type, single secondary winding and secondary shorting device and in compliance with IEEE C57.13. Burden and accuracy shall be consistent with connected metering and relay devices.

B. Control Power Transformers: Two winding type, 120 Vac secondary, sized for additional load where indicated. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure. Mount in separate compartments for units larger than 3 kVA.

C. Digital Metering (Power Monitors): Provide as indicated on Drawings. Schneider Electric PowerLogic PM5000 Series or equal for basic multi-functioning metering and power quality analysis. Locate top of power quality meter cubicle at 60-inches from bottom of switchboard, plus or minus 6-inches.

2.9 ADDITIONAL FEATURES

A. Key interlocks as indicated on Drawings.

B. Energy-reducing maintenance switch with local status indication LED pilot light for circuit breakers rated 1200 A and higher.

2.10 NETWORK COMMUNICATIONS

A. Digital communication signal will utilize copper Ethernet cable using Modbus TCP/IP communications protocol.

2.11 SOURCE QUALITY CONTROL

A. Test and inspect equipment according to UL, NEMA, and manufacturer.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Upon delivery of switchboard and prior to unloading, inspect equipment for damage.

B. Examine areas and surfaces to receive switchboard, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

C. Verify that ground connections are in place and that requirements in Section 260526 “Grounding and Bonding for Electrical Systems” have been met.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturer's published instructions, comply with the following:

1. NECA NEIS 400 – Standard for Installing and Maintaining Switchboards.
2. NEMA PB 2.1 – General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less.

C. Provide equipment housekeeping pads as detailed on the Drawings.

D. Bolt switchboard floor sills directly to finished floor or equipment pad. Make structure level, plumb, and secure. Use 1/2-inch (minimum) anchor bolts. Provide necessary hardware and shims.

E. Remove temporary lifting angles, lugs, and shipping braces. Touch up damaged paint finishes.

F. Conduit entering or leaving switchboard from underground is to be stubbed up into section in which the conductors are to be terminated. Likewise, when conduits enter the top of the switchboard, enter the corresponding section. Do not enter the switchboard from the side unless approved in writing by the Engineer.

G. Grounding and Bonding:

1. Bond equipment ground bus to grounding electrode system as shown on Drawings.
2. Bond all conduits including stub-ups to the equipment ground bus.

H. Install conduits to prevent water from entering enclosure. Seal voids around conduit stub-ups.

I. Neatly group field installed interior wiring by circuit using plastic tie wraps. Support circuit groups to avoid stress at terminations.

J. Make wiring interconnections between shipping splits. Install bus splice plates.

K. Tighten bolted connections and wiring connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Obtain the manufacturer's services for the commissioning and startup work.

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems".

1. Identify equipment by name designation and fed from source nameplates.
2. Identify field-installed conductors, interconnecting wiring, and components.

B. Install Arc Flash Labels in accordance with Section 260573 "Power System Studies".

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3.4 FIELD QUALITY CONTROL

A. Division of Responsibilities:

1. Provide installation and assist with all testing and startup activities.
2. Engage factory authorized service representative to assist in installation, inspection, testing, startup, and commissioning activities specified herein to active manufacturer's warranty.
3. Engage a qualified testing agency as defined in this Section to perform activities defined in Section 260800 "Commissioning of Electrical Systems".

B. General Requirements:

1. Perform inspection, testing, and startup activities recommended by and in accordance with manufacturer's instructions, NETA ATS, and as specified herein.
2. Perform testing and test methods in compliance with NFPA 70B.
3. Optional NETA ATS tests are not required unless specifically called for in this specification or the manufacturer's instructions.
4. Provide materials and labor as necessary.
5. Correct deficiencies, adjust, and retest until requirements are met.
6. Provide written report for each field testing or service visit.

C. Visual and Mechanical Inspection:

1. Confirm equipment and devices conform to approved shop drawings.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, and grounding. Adjust compartment doors as required.
4. Verify tightness of accessible bolted electrical connections. Use calibrated torque wrench.
5. Verify unit is clean.
6. Verify smooth and correct operation of mechanical devices: circuit breakers, interlocks, etc.

D. Electrical Tests:

1. Insulation resistance test of bus, phase to phase and phase to ground after disconnecting devices sensitive to test voltage.
2. Check polarity and continuity of metering and relaying circuits.
3. Test ground connections for continuity and resistance.
4. Test protective devices and equipment as recommended by manufacturer.
5. Verify correct input and output voltages, currents, and phase rotations.

E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform follow-up infrared scan of equipment, at 11 months after Substantial Completion.
3. Prepare a certified report identifying equipment checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Switchboards will be considered defective if they do not pass tests and inspections.

3.5 STARTUP AND COMMISSIONING SERVICE

A. Engage a factory-authorized service representative to perform startup and system commissioning service to verify complete and correct operation of sensing devices, alarms, indicating devices, and communication to plant SCADA system.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Field test hardwired discrete and analog connections and any digital communication signals connected to verify proper operation locally and at the plant SCADA system.

B. Adjust protective devices in accordance with the final approved submittal of Section 260573 “Power System Studies”.

3.6 DEMONSTRATION AND TRAINING

A. Engage a factory-authorized service representative to demonstrate correct operation, adjust settings, and maintain switchboards to Owner.

B. Provide 8-hour man day[s] for instruction. Time instruction to cover all working shifts.

3.7 CLEANING

A. Remove rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION 262413

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch circuit panelboards.
3. Load centers.
4. Circuit breakers.
5. Accessories and special construction.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits” for performance requirements of factory installed SPDs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on project. Note this Section may include products not required for the project.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.

4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include Internet link for electronic access to downloadable PDF of coordination curves.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer’s written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

B. Warranty documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to equipment manufacturer restrictions listed in Section 260010 “Supplemental Requirements for Electrical”, panelboards from the following manufacturers are approved:

1. Eaton.
2. GE by ABB.
3. Siemens.
4. Square D by Schneider Electric.

B. Source Limitations:

1. Obtain new panelboards from single source from single manufacturer.
2. Obtain retrofit disconnecting and overcurrent protective devices from existing panelboard manufacturer or subsequent responsible manufacturer, to maintain overall UL listing of panelboard.

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2.2 GENERAL REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with the following standards as applicable:

1. NEMA PB 1, Panelboards.
2. UL 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
3. UL 50E, Enclosures for Electrical Equipment, Environmental Considerations.
4. UL 67, Standard for Panelboards, CCN QEUY.
5. UL 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
6. UL 1449, Surge Protective Devices.

C. Ratings:

1. Ratings are indicated on the Drawings.
2. Series rated panelboards are prohibited. Circuit breakers must be fully rated for the short circuit rating listed for the panelboard.

D. Construction:

1. NEMA12 enclosure, unless noted otherwise on Drawings. See ACCESSORIES AND SPECIAL CONSTRUCTION Article for enclosures other than NEMA 12.
2. Copper equipment grounding bar, separate and distinct from neutral bar.
3. Conductor Lugs:

    a. Mechanical type.
    b. Size suitable for indicated conductor sizes.
    c. Neutral (when present) and ground lug quantity equal to each pole in panelboard.

4. Where Drawings indicate space for future circuit breaker, equip panelboard with bus bars, blank covers, and mounting hardware so only the future breaker need be provided.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearance between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

2.3 POWER PANELBOARDS

A. Manufacturer’s power distribution panelboard using molded-case bolt-on circuit breakers, where available. Drawing designation using “PP” or “DP”.

B. Doors: Hinged cover or door-in-door trim when available. Secure door with flush keyed lock and catch, except doors over 36 inches in height to use a vault-type latch with tumbler lock and 3-point catch. All locks keyed alike.

C. Bus: Tin-plated copper.

2.4 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Manufacturer's lighting and appliance panelboard using molded-case bolt-on circuit breakers.

B. Doors: Door-in-door construction with concealed hinges; secured with flush keyed lock and catch, except doors over 48 inches in height to use a vault-type latch with tumbler lock and 3-point catch. All locks keyed alike.

C. Bus: Tin-plated copper.

2.5 LOAD CENTERS

A. Manufacturer's load center using molded-case plug-on circuit breakers.

B. Load center type construction when indicated on Drawings.

C. Doors: Concealed hinges secured with flush latch with tumbler lock; keyed alike.

2.6 CIRCUIT BREAKERS

A. Molded case, manufactured by panelboard manufacturer.

B. Plug-in or bolt-on as listed in associated panelboard Article.

C. Configuration, frame size, trip, and special features such as GFCI (Class A trip, 4-6 mA) or GFI (Class B trip, 30 mA) as shown on Drawings.

D. Provide breaker lugs to accommodate wire sizes shown on Drawings.

E. Multi-pole breakers to have common trip. Do not convert single pole breakers to multi-pole using handle ties, use multi-pole breaker.

F. Thermal-Magnetic Circuit Breakers:

1. Inverse time-current element for low-level overloads.
2. Instantaneous magnetic trip element for short circuits.
3. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

G. Electronic Trip Circuit Breakers:

1. RMS sensing.
2. Field-replaceable rating plug or electronic trip.
3. Adjustable trip functions as indicated on Drawings.

2.7 ACCESSORIES AND SPECIAL CONSTRUCTION

A. Accessories such as breaker lockout devices or key interlocks are indicated on the Drawings.

B. Integral Surge Protective Device:

1. By panelboard manufacturer, factory installed.
2. Type 2.
3. SCCR: Equal to SCCR of panelboard where installed.
4. Performance: Comply with Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits”.

C. Electronic Grade:

1. Integral SPD.
2. Neutrals: 200 percent rated.

D. NEMA 3R Enclosure:

1. Material: galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s published instructions.

B. Reference Standards for Installation: Unless more stringent requirements are specified in Contract Documents or manufacturer’s published instructions, comply with the following:

1. ANSI/NEMA PB 1.1 – General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
2. NECA NEIS 407 – Standard for Installing and Maintaining Panelboards.

C. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind panelboard.
2. Mount back box plumb and level, and surface or flush mount as indicated on Drawings.
3. Mount surface-mounted panelboards to supports to allow a minimum of 1/2 inch air space between the box and the mounting surface.
4. Mount flush-mounted panelboards with front cover uniformly flush with wall finish and mating with back box.
5. Mount top of trim 72 inches above finished floor unless otherwise indicated.

E. Install circuit breakers not already factory installed. Rearrange circuit breakers to correspond to panel schedules shown on Drawings.

F. Tighten bolted connections and wiring connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

G. Install filler plates in unused spaces.

H. Plug abandoned or unused entry holes.

I. Do not leave cut off wires at breakers, neutral bar terminal, or ground bar terminal.

J. Identify panelboards in accordance with Section 260553 "Identification for Electrical Systems".

1. Identify equipment by name designation and fed from source nameplates.
2. Identify pole numbers.
3. Color code wiring.
4. Identify branch circuit phase and neutral wires by circuit number.
5. Provide as built typed panelboard directory.

K. Adjust circuit breakers with adjustable trips in accordance with the final approved submittal of Section 260573 "Power System Studies".

L. Install Arc Flash Labels in accordance with Section 260573 "Power System Studies".

3.3 FIELD QUALITY CONTROL

A. Perform checkout and testing activities recommended by and in accordance with manufacturer's instructions, NECA 407, and as specified herein. Correct deficiencies, make adjustments, and retest until requirements are met.

B. Visual and Mechanical Inspection:

1. Compare equipment nameplate data with Drawings and Specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, and grounding.
4. Verify unit is clean.
5. Verify breakers operate smoothly.

C. Electrical Tests:

1. Perform insulation resistance test on buswork in accordance with manufacturer's instructions.

2. Verify correct voltage and phasing at each panelboard.
3. Verify load currents are balanced across the three phases.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of panelboard connections for new or modified panelboards.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform follow-up infrared scan of panelboards, at 11 months after Substantial Completion.
3. Prepare a certified report identifying panelboard checked and describing results of scanning. Include a notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.4 CLEANING

A. Remove rubbish and debris from inside and around equipment. Vacuum clean interior.

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SECTION 262505 – 480V CONTROL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes industrial control panels with the following features:

1. Enclosure.
2. Main circuit breaker.
3. Motor controllers.
4. Control and monitoring devices.
5. Accessories.
6. Identification.

B. Related Requirements:

1. Section 260010 “Supplemental Requirements for Electrical” for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 “Facility Performance Requirements for Electrical” for seismic-load, wind-load, acoustical, and field conditions applicable to Work specified in this Section.
3. Division 26 for electrical work.
4. Division 27 for communications wiring.
5. Division 40 for process automation requirements.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. GFCI: Ground-fault circuit interrupter.

C. MCCB: Molded-case circuit breaker.

D. MCP: Motor circuit protector.

E. NEC: National Electrical Code.

F. RVSS: Reduced voltage soft start.

G. RVAT: Reduced voltage autotransformer start.

H. SCCR: Short-circuit current rating.

I. SPD: Surge protective device.

J. UL: Underwriter’s Laboratories.

K. VFC: Variable frequency motor controller. See VFD.

L. VFD: Variable frequency drive. Used interchangeably with the term VFC.

1.4 ACTION SUBMITTALS

A. Product Data: For each control panel.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each control panel.

1. Include dimensioned plans, elevations, sections, and details.
2. Bill of materials with part numbers, cross-referenced to plans.
3. Nameplate schedule.
4. Conduit entrance locations and mounting details.
5. Power and control schematics.
6. Certification for compliance with UL 508A.
7. Identification per NEC 409.110.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, from manufacturer.

B. Startup reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following if applicable:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

5. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
6. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Control fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than two of each size and type.
2. Power fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than three of each size and type.
3. Corrosion Inhibitor: Equal to 100 percent of total number of control panels. (One spare per panel.)

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store control panels indoors in clean, dry space with uniform temperature to prevent condensation. Protect control panels from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside enclosures and install temporary electric heating, with at least 50 W per enclosure.

1.10 FIELD CONDITIONS

A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace control panels that fail in materials or workmanship within specified warranty period.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for control panels clearances between control panels and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

E. Comply with NEMA ICS 6: Industrial Control and Systems: Enclosures.

F. Comply with UL 1203 for control panels located in hazardous (classified) locations.

G. Comply with NFPA 70.

H. Comply with UL 508A.

I. Complete and fully functional control to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. Include manufacturer’s recommended safety devices to protect operators. All control devices, unless specified otherwise, mounted in the Control Panel.

J. The control panel shall operate on a power supply of 480 volts, 3-phase, 60 hertz unless otherwise noted.

K. Control panel consists of a main circuit breaker, motor circuit protector (MCP) and motor controller for each motor, and a 120-volt control power transformer (fused on primary and secondary) along with other devices specified. Mount all control components in one common enclosure.

L. Operation of motors will be manually or automatically. Stager control of multiple motors to prevent simultaneous motor starting.

M. All electronic control equipment (i.e. controllers, isolators, signal boosters, transmitters, PLC's, etc.) shall be as specified in Division 40.

N. Control panels containing PLC’s shall contain UPS or battery ride-through for the PLC in accordance with Division 40 specifications.

O. SCCR: Control panels with main breakers of 125 amps or less shall have SCCR of 35kA, unless specifically noted elsewhere.

2.2 ENCLOSURES

A. Enclosures: Surface-mounted, dead-front cabinets rated for environmental conditions at installed location. Unless noted elsewhere, NEMA rating shall be NEMA 4X, Type 316 stainless steel, minimum 14 gauge.

B. Construction: The door shall be mounted via continuous stainless steel hinged and provided with a pad-lockable vault type 3-point latch. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Door(s) shall be interlocked with main circuit breaker and provided with pad-locking provision.

C. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

D. Operating handle for main circuit breaker: flange mounted.

E. Outdoor enclosures shall be provided with sun shields. Install sun shields on fronts, sides, and tops of enclosures subject to direct and extended sun exposure.

F. Provide additional temperature control if required to meet UL temperature rating of internal components. If forced air ventilation is required, the enclosure shall be pressurized. Air filters shall be of commercially available types and sizes.

G. All operating control and instruments shall be securely mounted on the exterior door. All controls and instruments shall be clearly labeled to indicate function. All exterior mounted equipment shall be NEMA 4X.

H. Print storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment.

I. Where the project has multiple control panels, suggest including a table of SCCR requirements for the paragraph below – design engineer to perform short circuit calculations to confirm.

2.3 COMPONENTS

A. Main Breaker: Thermal-magnetic air circuit breaker, Schneider Electric/Square D PowerPact Type BG (125 amp frame, 35kAIC) or equal.

B. MCP: Molded case motor circuit protector with adjustable magnetic trip only, Schneider Electric/Square D “Mag-Gard” or equal.

C. Motor Controller:

1. Full Voltage Motor Starting: Open frame, across-the-line, NEMA-rated magnetic motor starter, Schneider Electric/Square D Class 8536 or equal. Solid state overloads with Class 10/20 selectable tripping. Submersible motors shall use Class 10 trip curve.

D. Overload relays shall be self-powered solid-state type and provide the following features: tamper guard over trip adjustment setting, ambient insensitive, harmonic immunity, phase loss and phase unbalance protection, manual reset, and push-to-test.

E. Overload reset buttons shall be mounted on dead front door.

F. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel.

G. SPD: The control panel shall be provided with a surge protective device (SPD) rated for 100kA per mode for the incoming power. SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker.

H. Control Power Transformer: 480-120V CPT, fused on primary and secondary sides, capacity as required.

2.4 CONTROL DEVICES AND ACCESSORIES

A. Control Operators and Indictors:

1. Heavy duty type, full size (30.5mm), NEMA 4X or 7 as required.
2. Each motor shall include Hand-Off-Auto selector switches to permit override of automatic control and manual actuation of shutdown.

B. Indicating Lights:

1. LED, full size (30.5mm), full voltage and push-to-test type.
2. Indicators shall be provided for individual motor run and an indicator for each failure condition.

C. Elapsed Time Meters (ETM):

1. Six (6) digit, non-reset elapsed time meter to indicate the total running time of each motor in "hours" and "tenth of hours". Series T50 as manufactured by the ENM Company or equal.
2. Provide an ETM for each motor.

D. Failure Alarm Horn and Beacon Light:

1. Alarm horn: weatherproof rated with gasket (Federal Signal Corporation, Cat. #350 or equal) for NEMA 4X applications.
2. Alarm beacon: Red lens and solid-state flasher (Ingam Products Inc. LRX-40 or equal) for NEMA 4X applications.
3. All lift station pump control panels shall include alarm horn and light for summary alarm condition.

4. Silence and reset pushbuttons shall also be furnished. A common failure reset pushbutton shall be provided to reset the alarm conditions (reset shall occur only if fault condition has been cleared).

E. Relays:

1. Control relays shall be 10 amp rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum), with LED indicators to show relay status, relays shall be manufactured by Potter Brumfield or equal.
2. Timing relays shall be solid state, with pin (octal) and bases, relays shall be T-series as manufactured by Diversified Electronics Inc. or equal.
3. Intrinsically safe relays shall be solid state type with 5 amp output contacts, suitable for use on 120 volt, 60 hertz power supply and shall be Factory Mutual approved for devices in Class 1, Division 1 hazardous atmospheres. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

F. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.

G. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by Divisions 40, 26 and as shown on the Drawings.

H. Alternators shall be provided to sequence lead/lag motors, alternators shall be 008-120-13SP or 009-120-23AP as manufactured by Sta-con, or equal.

I. A phase monitor shall be provided for the control panel, monitors shall be model SUA-440-ASA as manufactured by Diversified Electronics Inc., or equal.

J. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter, selected by the manufacturer, to protect internal components of control panel from corrosion for up to one year.

K. Breather assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

2.5 WIRING

A. Power and control wire shall be 600 Volt class, Type MTW insulated stranded copper and shall be of the sizes required for the current to be carried, but not smaller than No. 14 AWG. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover.

B. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.

C. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks.

D. Terminal blocks shall be 600 Volt heavy duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal.

E. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.

F. All signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 40.

G. An 8-inch (minimum) clear space within the enclosure shall be provided horizontally along the entire top and bottom of the control panel. A 4-inch (minimum) clear space within the enclosure shall be provided vertically along the entire sides of the control panel. No devices, terminals, etc. shall be installed within this space, the space shall be provided for field conduit and wiring access only.

2.6 IDENTIFICATION

A. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.

B. The control diagrams and overload tables shall be laminated to the inside of the door except where door space is limited the laminated documents shall be in the print storage pocket.

C. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved black letters with a white background.

D. All control panels shall be provided with two nameplates located on the exterior door. The first nameplate shall identify the control panel name. The second nameplate shall identify the power source.

E. Where applicable provide a nameplate which reads as follows "CAUTION - THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE." Letters shall be black on a high visibility yellow background.

F. Each terminal at terminal blocks shall be individually labeled.

G. Incoming phase conductor terminals shall be clearly identified. All wiring within the control panel shall be color coded or coded using electrical tape in sizes where colored insulation is not available. The following coding shall be used.

System	**Wire**	**Color**
Incoming line voltage	Phase conductors	Black
	Ground	Green
	Neutral (as required)	Gray
Internal control voltage	AC	Red
Internal control voltage	DC	Blue
External source	All	Yellow

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2.7 FACTORY TESTS

A. Inspect and test control panel for correct operation. Test each circuit for continuity, short circuits, and ground faults.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Inspect anchorage, alignment, grounding, and clearances.

D. Compare equipment nameplate data for compliance with Drawings and Specifications.

E. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

F. Motor Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

G. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 STARTUP SERVICE

A. Complete startup checks according to manufacturer’s written instructions.

B. Verify motor running protection is appropriate for actual motors installed.

C. Test control panel with all field wiring connected. Set adjustable set points and time delays for proper operation of equipment. Adjust as required.

D. Perform infrared inspection of panel interior during periods of maximum possible loading. Remove all necessary covers prior to the inspection. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.

E. Prepare test and inspection reports.

F. Install a set of legible “as built” control panel drawings (11x17 or 8.5 x 11), in the storage pocket.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment.

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END OF SECTION 262505

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes receptacles, toggle switches, cover plates, and cord and plug sets.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on project. Note this Section may include products not required for the project.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with the following standards and UL Category Control Number (CCN) listing criteria as applicable:

1. UL 20, Standard for General-Use Snap Switches, CCN WMUZ.
2. UL 498, Standard for Attachment Plugs and Receptacles, CCN RTRT.
3. UL 894, Standard for Safety Switches for Use in Hazardous (Classified) Locations.
4. UL 943, Standard for Ground-Fault Circuit-Interrupters (Class A), CCN KCXS.
5. UL 1010, Standard for Safety Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
6. ANSI/NEMA WD 6 for dimensional requirements for receptacles and plugs rated up to 60A and 600V.
7. NEMA WD 1 for colors.
8. Federal Specifications:

    a. FS W-S-896 for switches.
    b. FS W-C-596 for receptacles.

C. Device Color:

1. White: Devices located in administrative office areas, conference rooms, break rooms, restrooms, and control rooms.
2. Gray: Devices located in electrical rooms, mechanical rooms, process areas, and outdoors.

D. Wall Plate Color: For non-metallic covers, match device color.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 INDUSTRIAL SPECIFICATION GRADE RECEPTACLES, 125V, 20A

A. Duplex Receptacles, 125V, 20A

1. Manufacturers or equal:

    a. Arrow-Hart (Eaton), 5362 Series.
    b. Hubbell, 5362 Series.
    c. Leviton, 5362 Series.

2. Description: Heavy duty, industrial, specification grade, two-pole, three-wire, and self-grounding, NEMA 5-20R.

B. Duplex Weather-Resistant Receptacles, 120V, 20A. Drawing Designation: WP.

1. Hubbell, HBL5362WR Series or equal.
2. Description: Heavy duty, industrial, specification grade, weather-resistant, two-pole, three-wire, and self-grounding, NEMA 5-20R.

C. Duplex GFCI Receptacles, 125V, 20A. Drawing Designations GFCI.

1. Manufacturers or equal:

a. Hubbell GF5362SG Series.
b. Arrow-Hart (Eaton) TWRSGF20 Series.
c. Leviton GFTR2-3L Series.

2. Description: Extra heavy duty, industrial, specification grade, tamper-resistant, weather resistant, ground-fault circuit-interrupter receptacle, two-pole, three-wire, and self-grounding, NEMA 5-20R.

a. Integral GFCI with “Test” and “Reset” buttons.
b. Three LED indicators: power solid green, GF/trip solid red, ending of life flashing red.

2.3 HAZARDOUS (CLASSIFIED) LOCATION DEVICES

A. Hazardous (Classified) Locations Receptacles and Switches. Drawing Designation: XP.

1. Enclosure Rating: NEC Hazardous Area Class I, Divisions 1 and 2, Groups C and D (NEMA 7) and wet locations.
2. Receptacle Description: Explosion-proof factory sealed, pin and sleeve receptacle, 20A, for use at 125 or 250V, two wire, 3 pole.

a. Complete with cast box and matching plug.
b. Appleton Contender CPS152 Series with matching cover and CPP plug or equivalent by Crouse-Hinds.
c. With optional GFCI if noted on Drawing.

3. Switch Description: Explosion-proof factory sealed, control station switch, 20A, for use at 120/277V, single pole.

a. Complete with cast box.
b. Appleton Contender EDS Series or equivalent by Crouse-Hinds.

2.4 INDUSTRIAL SPECIFICATION GRADE TOGGLE SWITCHES, 120/277V, 20A

A. Manufacturers as listed below or equal.

1. Arrow-Hart (Eaton), 1220 Series.
2. Hubbell, HBL1220 Series.
3. Leviton, 1220 Series.

B. Description: Extra heavy duty, industrial, specification grade, switch, 120/277V, 20A, toggle action, flush mounting, quiet type.

1. Single pole, double pole, three-way, or four-way, as indicated on Drawings.

2.5 WALL PLATES

A. Match gang configuration as indicated on Drawings.

B. Obtain wall plates from same manufacturer as wiring device.

C. Plate-Securing Screws: Metal with head color to match plate finish.

D. Material for administrative offices, conference rooms, break rooms, restrooms, and control rooms: Smooth, high impact thermoplastic or nylon.

E. Material for flush mounted devices in electrical rooms, mechanical rooms, and indoor process areas: Type 302 (18-8) high nickel stainless steel.

F. Material for surface mounted device plates: Same material as box.

G. WP Receptacle Cover Plates: In-use weather-resistant, heavy duty die-cast aluminum with lockable cover.

H. WP Switch Cover Plates: Weatherproof switch cover, listed to UL514D, non-metallic UV-resistant, operable without opening cover, lockable.

1. Arrow-Hart (Eaton) S2983 or equal.

2.6 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices in accordance with NFPA 70, manufacturer’s instructions, and listing for each device.

B. Install switch and receptacle outlets flush with finished wall for new wall construction and where existing wall is stud and sheetrock construction.

C. Drawings show the general location of devices unless dimensioned. Adjust and coordinate location to avoid piping or other obstructions.

D. Use of one GFCI receptacle to protect downstream conventional receptacles is prohibited.

E. Device Mounting Heights (as measured to the center of the device box):

1. Switches and occupancy sensors: 48 inches AFF, located on strike side of door.

2. Wall receptacles, unless otherwise noted on Drawings:

    a. Process areas and shops: 36 inches AFF.
    b. Administration office areas: 18 inches AFF.
    c. Corridors and hallways: 18 inches AFF.
    d. Electrical and mechanical rooms: 18 inches AFF.
    e. Restrooms: 18 inches AFF.
    f. Above counters: 8 inches above countertop or at backsplash level.
    g. Exterior walls: 24 inches AFG.

3. Where walls are unplastered brick or masonry, adjust mounting height above so one horizontal edge of device box lines up with a horizontal joint in the masonry.

F. Device Boxes:

1. Install correct size and type box for the device(s) and location, allowing for adequate space for conductors, connectors, clamps, devices, and barriers, where required.
2. Install boxes level, plumb, and secure. Do not install boxes back-to-back in walls.

G. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install wiring devices after all wall preparation, including painting, is complete.

H. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. Provide adequate length of free conductors at boxes for devices without pigtails. Pigtailing existing conductors is permitted, provided the box is large enough.

I. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Make equipment grounding conductor connections and splices so removal or disconnection of any wiring devices does not interrupt continuity of the branch circuit equipment grounding conductor.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw. Do not overlap conductors.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

J. Orientation and Arrangement:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
2. Group adjacent switches under single, multi-gang wall plates.

K. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

3.2 IDENTIFICATION

A. Label receptacles and switches with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

B. Label receptacles that are non-GFCI type but GFCI protected, such as from a GFCI circuit breaker, with a label “GFCI Protected”.

3.3 FIELD QUALITY CONTROL

A. Verify correct operation of GFCI receptacles using GFCI tester.

B. Verify correct voltage and phasing at receptacles.

1. Use receptacle circuit tester for NEMA 5-20R receptacles. Use voltmeter for other receptacles.
2. Use phase sequence meter for three phase receptacles.

C. Correct deficiencies found and reverify.

D. Prepare field quality report certifying verification of correct installation.

END OF SECTION 262726

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

    a. Control circuits.
    b. Motor-control centers.
    c. Panelboards.
    d. Switchboards.
    e. Enclosed controllers.
    f. Enclosed switches.

B. Related Requirements:

1. Section 260010 “Supplemental Requirements for Electrical” for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 “Facility Performance Requirements for Electrical” for seismic-load, wind-load, acoustical, and field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.

4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
5. Coordination charts and tables and related data.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.

3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.
4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, time delay.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with [15] <Insert number> percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay.
2. Feeders: Class L, time delay .
3. Motor Branch Circuits: Class RK5, time delay, time delay.
4. Large Motor Branch (601-4000 A): Class L, time delay.
5. Power Electronics Circuits: Class J, high speed.
6. Other Branch Circuits: Class RK1, time delay.
7. Control Transformer Circuits: Class CC, time delay, control transformer duty.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

B. Related Requirements:

1. Section 260010 “Supplemental Requirements for Electrical” for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 “Facility Performance Requirements for Electrical” for seismic-load, wind-load, acoustical, and field conditions applicable to Work specified in this Section.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Fuse Pullers: for each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to Section 260548.16 "Seismic Controls for Electrical Systems" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL or a NRTL if approved by the Owner and/or Engineer, and marked for intended location and application.

D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

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2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

C. MCCBs shall be equipped with a device for locking in the isolated position.

D. Lugs shall be suitable for 167 deg F rated wire.

E. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

F. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

G. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

H. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

I. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

J. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

K. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

L. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.6 MOLDED-CASE SWITCHES

A. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

B. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs:

    a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
    b. Lugs shall be suitable for 167 deg F rated wire.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.

2.7 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint or Owner approved color and paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X 316 stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 12.
2. Outdoor Locations: NEMA 250, Type 4X, stainless steel, type 316.
3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel, type 316
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4, fiberglass reinforced polymer.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 with cover attached by Type 316 stainless steel bolts.

3.3 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.

e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare an Initial and Follow-up report:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

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3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges to values indicated on the Drawings.

END OF SECTION 262816

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SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes nonautomatic transfer switches rated 600 V and less.

B. Related Requirements:

1. Section 260010 “Supplemental Requirements for Electrical” for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 “Facility Performance Requirements for Electrical” for seismic-load, wind-load, acoustical, and field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch,power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer-authorized service representative.

B. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Features and operating sequences, both automatic and manual.
b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Member company of NETA.

a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 110.

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. Short-time withstand capability for 0.5 seconds.

G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

J. Neutral Terminal: Solid and fully rated unless otherwise indicated.

K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed shrinkable sleeve markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via rear access.

L. Enclosures: General-purpose NEMA 250, Type 12, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ASCO Power Technologies.
2. Eaton.
3. Russelectric, Inc.

B. Comply with Level 2 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: Hard-drawn copper, 98 percent conductivity.
6. Main and Neutral Lugs: Mechanical type.
7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
8. Connectors shall be marked for conductor size and type according to UL 1008.

D. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

E. Electric Nonautomatic Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

2.3 NONAUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ASCO Power Technologies.
2. Eaton.
3. Russelectric, Inc.

B. Manual and Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either

direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.

C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

D. Pilot Lights: Indicate source to which load is connected.

E. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.

1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."

F. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching.
3. Conductor Connectors: Suitable for use with conductor material and sizes.
4. Material: Hard-drawn copper, 98 percent conductivity.
5. Main and Neutral Lugs: Mechanical type.
6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
7. Connectors shall be marked for conductor size and type according to UL 1008.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for optional standby systems. Include results of test for the following conditions:

a. Overvoltage.
b. Undervoltage.
c. Loss of supply voltage.
d. Reduction of supply voltage.
e. Alternative supply voltage or frequency is at minimum acceptable values.
f. Temperature rise.
g. Dielectric voltage-withstand; before and after short-circuit test.
h. Overload.

i. Contact opening.
j. Endurance.
k. Short circuit.
l. Short-time current capability.
m. Receptacle withstand capability.
n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

1. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
3. Provide workspace and clearances required by NFPA 70.

B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.

C. Identify components according to Section 260553 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

E. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."

F. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.

G. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."

H. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with Drawings and Specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, grounding, and required clearances.
    d. Verify that the unit is clean.
    e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
    f. Verify that manual transfer warnings are attached and visible.
    g. Verify tightness of all control connections.
    h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

    i. Perform manual transfer operation.
    j. Verify positive mechanical interlocking between normal and alternate sources.
    k. Perform visual and mechanical inspection of surge arresters.
    l. Inspect control power transformers.

        1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
        2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
        3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

    a. Perform insulation-resistance tests on all control wiring with respect to ground.
    b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
    c. Verify settings and operation of control devices.
    d. Calibrate and set all relays and timers.
    e. Verify phase rotation, phasing, and synchronized operation.
    f. Perform automatic transfer tests.
    g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   a. Check for electrical continuity of circuits and for short circuits.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

B. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

C. Transfer switches will be considered defective if they do not pass tests and inspections.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

END OF SECTION 263600

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SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. System smoke detectors.
2. Device guards.
3. Addressable interface device.

B. Related Requirements:

1. Section 271513 "Communications Copper Horizontal Cabling" for cables and conductors for fire-alarm systems.
2. Section 233300 “Air Duct Accessories” for duct smoke detector for fire-alarm systems.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations for additional equipment.
7. Include updated input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system as applicable.
    c. Locate detectors according to manufacturer's written recommendations.

13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals are approved by authorities having jurisdiction prior to submitting them to Engineer.
2. Shop Drawings prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

1.5 DELEGATED-DESIGN SUBMITTAL

A. For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.

3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

g. Manufacturer's required maintenance related to system warranty requirements.
h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
2. Detector Bases: Quantity equal to one percent of amount of each type installed, but no fewer than one unit of each type.
3. Keys and Tools: One extra set for access to locked or tamperproofed components.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation by personnel certified by NICET as fire-alarm Level II technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.10 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components:

1. Components compatible with, and operate as an extension of, existing system.
2. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice or horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided are listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Existing fire-alarm signal initiation remain in place and additionally for:.

1. Duct smoke detectors.

B. Existing fire-alarm signal actions will continue to remain active.

C. Existing supervisory signal initiation will remain.

D. Exsting system trouble signal initiation by existing devices and actions will remain.

E. Existing System Supervisory Signal Actions to remain.

2.3 SYSTEM SMOKE DETECTORS

A. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address accessible from fire-alarm control unit and able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor has multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.
7. Remote Test Switch: listed for use with duct smoke detector.

2.4 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

2.5 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control/monitoring equipment as necessary to extend existing control/monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

2. Install remote test switches in accessible locations, clearly labeled and identified.

E. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways: installed in Conduit.

B. Exposed Conduit: painted red enamel.

3.4 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install updated framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests witnessed by authorities having jurisdiction.

B. Perform tests and inspections.

C. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.11

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SECTION 310515 - SOILS AND AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Soils: Soil materials and topsoil materials.
2. Aggregates: Coarse aggregate materials and fine aggregate materials.

B. Related Sections:

1. Section 312000 “Earthwork.”
2. Section 312333 “Trenching and Backfilling”
3. Section 312500 “Erosion and Sedimentation Control.”
4. Section 321123 “Aggregate Base Courses.”
5. Section 329219 “Seeding.”
6. Section 329200 “Turf and Grasses.”

1.3 ACTION SUBMITTALS

A. Quality Control Testing: Submit conformance testing performed by a certified independent laboratory engaged by Contractor for all fill materials. Verify maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria at least 72 hours prior to importing or placing any fill. Perform additional conformance testing at a minimum frequency of 1 per every 2000 cubic yards or change in material.

1.4 INFORMATIONAL SUBMITTALS

A. Materials Source: Submit name and location of imported materials suppliers.

B. Source’s Certificate: Certify materials meet or exceed specified requirements.

C. Material Test Reports: For each soil and aggregate material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D1557.
3. Test Reports: Submit any test reports required by this Section to the Engineer.

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1.5 QUALITY ASSURANCE

A. Furnish each subsoil and topsoil material from single source throughout the Work, unless an alternate source is approved by the Engineer.

B. Furnish each coarse and fine aggregate material from single source throughout the Work, unless an alternate source is approved by the Engineer.

C. Perform Work according to NYSDOT Standard Specifications and Standard .

D. Quality Control and Quality Assurance consists of laboratory conformance testing of samples supplied from each coarse and fine aggregate source and quality control during installation.

1. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

E. Maintain one copy of each standard affecting Work of this Section on Site.

1.6 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Common Fill:

1. Approved imported fill material that is composed of durable soil free of roots, vegetative matter, debris, organic matter, topsoil, loam, waste, highly micaceous silt, frozen soil, or other deleterious and/or objectionable materials.
2. Does not contain stones larger than 6 inches in largest diameter.
3. Maximum of 50 percent passing the No. 200 sieve.
4. Maximum liquid limit of 60 percent.
5. Maximum plasticity index of 30 percent.
6. Maximum dry density of at least 95 pounds per cubic foot (pcf) as determined by ASTM D1557.
7. Does not contain more than 5 percent organic or deleterious material.
8. Does not contain granite blocks, broken concrete, masonry rubble, or other similar materials and with physical properties such that it can be readily spread and compacted during filling.

B. Select Common Fill:

1. As specified above for common fill, except contains no stones larger than 2 inches in largest diameter.

C. Structural Fill:

1. Consist of mineral soil free of organic material, loam, debris, frozen soil or other deleterious material which may be compressible, or which cannot be properly compacted,
2. Liquid Limit: 50 percent maximum.
3. Plasticity Index: 10 percent maximum.
4. Maximum Dry Density: 95 pcf minimum, as determined by ASTM D1557.
5. Meets the following gradation for Sieve Size and Percent Fines by Weight:

a. 3-inch: 100.
b. No. 4: 20 to 70.
c. No. 40: 5 to 35.
d. No. 200: 0 to 10.

2.2 TOPSOIL MATERIALS

A. Topsoil shall be in accordance with the requirements in the New York Standards and Specifications for Erosion and Sediment Control. Topsoil shall be fertile, friable, loamy, debris-free natural topsoil typical of topsoil of the locality and shall be obtained from a well-drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter and shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than 6 percent nor more than 20 percent, by weight, of fine-textured stable organic material; not less than 20 percent fine-textured material passing the No. 200 sieve; not more than 15 percent clay; and less than 10 percent gravel. Topsoil shall be relatively free of stones greater than 1-1/2 inches in diameter, trash, debris, noxious weeds, and other objectionable material. Topsoil containing soluble salts greater than 500 parts per million shall not be used. Topsoil shall be uniformly placed and graded to the depth in accordance with the following:

Table 4.7 - Topsoil Application Depth

Site Conditions	Intended Use	Minimum Topsoil Depth
1. Deep sand or loamy sand	Mowed lawn	6 in.
	Tall legumes, unmowed	2 in.
	Tall grass, unmowed	1 in.
2. Deep sand or loamy sand	Mowed lawn	5 in.
	Tall legumes, unmowed	2 in.
	Tall grass, unmowed	none
3. Six inches or more: silt loam, clay loam, loam, or silt	Mowed lawn	4 in.
	Tall legumes, unmowed	1 in.
	Tall grass, unmowed	1 in.

B. Topsoil (Type S3): Conforming to New York State Department of Transportation standard.

2.3 COARSE AGGREGATE MATERIALS

A. Coarse Aggregate - Crushed Stone: Natural stone; free of clay, shale, organic matter; conforming to New York State Department of Transportation standard.

1. Coarse Aggregate Designation: No. 57.

B. Coarse Aggregate- Dense Graded Aggregate (DGA)

1. DGA shall conform to the gradation requirements of virgin stone meeting the specifications of NJDOTSS Section 901.10.01:

Sieve Size	Percent Finer by Weight
1 1/2-in	100
3/4-in	55 to 90
No. 4	25 to 50
No. 50	5 to 20
No. 200	3 to 10

C. Coarse Aggregate - Screened Gravel: Natural stone; hard, durable, rounded, or sub-angular particles of proper size and gradation, and shall be free from sand, loam, clay, excess fines, and other deleterious materials; to the following limits:

1. Percent Passing per Sieve Size:

a. 5/8- inch100 percent.
b. 1/2-inch (: 40 to 100 percent.
c. 3/8-inch: 15 to 45 percent.
d. No. 10 : 0 to 5 percent.

D. Coarse Aggregate - Pea Gravel: Natural stone; free of clay, shale, organic matter; graded according to ASTM C136; to the following limits:

1. Percent Passing per Sieve Size:

a. 1/2- inch100 percent.
b. 3/8-inch : 90 percent.
c. No. 4: 30 percent.
d. No. 8 : 10 percent.
e. No. 16 : 5 percent.

2.4 FINE AGGREGATE MATERIALS

A. Fine Aggregate - Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter; graded according to ASTM C33; within the following limits:

1. Percent Passing per Sieve Size:

a. No. 495 to 100.
b. No. 880 to 100.
c. No. 1650 to 85.
d. No. 3025 to 60.
e. No. 5010 to 30.
f. No. 1002 to 10.

2.5 SOURCE QUALITY CONTROL

A. Subsoil Material - Testing and Analysis: Perform in accordance with ASTM D1557.

B. Topsoil Material - Testing and Analysis: Perform in accordance with ASTM D1557.

C. Coarse Aggregate Material - Testing and Analysis: Perform according to ASTM D1557.

D. Fine Aggregate Material - Testing and Analysis: Perform according to ASTM D1557.

E. When tests indicate materials do not meet specified requirements, change material and retest.

F. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXCAVATION - SOILS

A. Excavate subsoil and topsoil from areas designated by Engineer as specified in Section 312000 “Earthwork” and Contract Drawings. Strip topsoil to full depth of topsoil in designated areas.

B. Remove all excavated materials from site.

3.2 EXCAVATION - AGGREGATES

A. Coordinate excavation of aggregate materials from on-site locations designated by Engineer as specified in Section 312000 “Earthwork.”

B. Remove all excavated materials from the site.

3.3 STOCKPILING

A. Stockpile materials on site at locations indicated on Drawings.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate different soil and aggregate materials with dividers or stockpile individually to prevent mixing. Prevent intermixing of soil types or contamination.

D. Stockpile topsoil 8 feet high maximum.

E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

F. Cover stockpiles with plastic tarp to maintain proper moisture control.

G. Stockpile unsuitable and/or hazardous materials on impervious liner and cover to prevent erosion and leaching, until disposed of.

3.4 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface back to original grade and to prevent free standing surface water.

END OF SECTION 310515

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SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparation

2. Temporary erosion and sedimentation control

3. Existing utilities
4. Clearing and grubbing.
5. Topsoil stripping.
6. Site improvements.
7. Disposal of surplus and waste materials
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015639 “Temporary Tree and Plant Protection” for temporary protection of existing vegetation.
2. Section 312500 “Erosion and Sedimentation Controls” for temporary protection of erosion and sedimentation.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than one percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed roadways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises as directed by the Engineer.

C. Utility Locator Service: Notify One Call for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earthwork."

1. Obtain approved borrow soil material off-site.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

C. Call Local Utility Line Information service not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than five days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer’s written permission.

D. Excavate for and remove underground utilities indicated to be removed.

E. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024119 "Selective Demolition".

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

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SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dewatering System.
2. Surface Water Control System.
3. Monitoring Wells.
4. System Operation and Maintenance.
5. Dewatering Effluent Disposal.

1.2 REFERENCES

A. Storm Water Pollution Prevention Plan (SWPPP)

B. ASTM standards applicable to piping, equipment and other items required for a complete dewatering system

1.3 DEFINITIONS

A. Dewatering System:

1. System of wells, well points, sumps, ejectors, pumps, power supply, effluent treatment equipment and equipment designed by Contractor, submitted to and approved by the Engineer prior to dewatering, that will effectively dewater the site as required herein. Adequate observation wells shall be included in the dewatering system to verify drawdown levels inside the excavation area and monitor groundwater levels outside the limits of the excavation near adjacent structures.

B. Dewatering includes the following:

1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering, excavations and trenches.
2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations and trenches.
3. Disposing of removed water.

C. Construction Dewatering:

1. Controlling groundwater levels, hydrostatic pressures and controlling surface water, such that excavation required on the Contract Drawings can be performed to required depths in substantially dry and stable conditions.

D. Surface Water Control: Removal of surface water within open excavations.

1.4 SYSTEM DESCRIPTION

A. Provide dewatering and surface water control systems to permit Work to be completed on dry and stable subgrade.

B. Provide monitoring wells and monitoring equipment to obtain meaningful observations of conditions affecting excavation, adjacent structures, and adjacent water wells.

C. Furnish standby equipment stored at Project site and ready for immediate use upon failure of dewatering equipment.

1.5 PERFORMANCE REQUIREMENTS

A. The Contractor's attention is directed to:

1. Special Notices:

   a. Protection of Water Resources and the Environment
   b. Department of Environmental Facilities (DEF) Environmental Management System (EnvMS) Requirements – Soil Erosion and Sediment Control Activities.

2. General Clause 14.

B. The Contractor shall design, provide, install, operate, maintain and remove the Dewatering System as necessary to:

1. Lower and maintain groundwater levels and hydrostatic pressures to 2 feet below the prevailing excavation level or to a point no higher than 2 feet above the top of an impermeable stratum, if the subgrade is in the impermeable stratum. Groundwater levels shall be lowered for a time period as necessary to ensure adequate factor of safety for the constructed structure.
2. Maintain stability of sides and bottoms of excavations.
3. Control and remove seepage and surface water into excavations.
4. Relieve hydrostatic pressures in confined water bearing strata below excavation to eliminate risk of uplift or other instability of excavation.
5. Prevent damage to adjacent properties, buildings, structures, utilities, and facilities from construction operations.
6. Prevent loss of fines, development of quick condition, or softening of foundation subgrade.
7. Allow subsequent work to be safely performed and not result in damage to adjacent properties, buildings, structures, utilities and other work.

C. The method of dewatering and control of water both inside and outside the excavation shall be selected by the Contractor who shall be solely responsible for the location, arrangement and depth of any system(s) selected to accomplish the work. The Contractor shall construct

protective works as necessary to dewater, cut off porous zones of fill and direct the flow of water from whatever source away from the excavations and adjacent areas. Protective works shall include slurry methods, grouting, clay seepage plugs, toe drains with appropriate filters, deep wells, wellpoints, sumps, dikes, ditches and all supporting features as required, but not specifically shown on the Contract Drawings, to permit construction in the dry.

D. Dewatering Effluent Disposal

1. The Contractor shall manage and dispose of effluent generated during dewatering activities in accordance with SWPPP.
2. Dewatering effluent shall not be discharged to the sanitary sewer.
3. The Contractor shall provide appropriately sized settling tanks, basins, or other devices to remove suspended solids form the dewatering effluent; and control effluent discharge rates as required by the SWPPP.

    a. Sampling of the tank, basin or other device effluent and measurement of discharge flow rates shall be as required by disposal/discharge criteria.
    b. The tanks, basins or other devices shall be provided with an overflow collection system or other safeguards to prevent accidental release of dewatering effluent.
    c. Routine inspection of the tanks, basins or other devices shall be carried out daily to ensure that their integrity is being maintained, and that all valves or openings are properly locked out to avoid accidental discharge
    d. Settling tanks, basins or other devices shall be cleaned frequently to prevent excess deposition of solids which could overflow. Removed solids shall be classified and disposed of in accordance with applicable codes, rules and regulations.

4. The Contractor shall provide appropriately sized oil/water separators to remove hydrocarbons, grease and other floatable materials from the dewatering effluent prior to discharge.
5. The Contractor shall provide treatment for, or remove from the site to an approved disposal facility, all dewatering effluent that exceeds any limit set for discharge.

    a. Classification and disposal shall be the responsibility of the Contractor.
    b. No separate payment will be made for treatment or disposal of such effluent.

1.6 SUBMITTALS

A. Section 01 33 00 “Submittal Procedures”: Requirements for submittals.

B. Review of the Dewatering System by the Engineer shall not in any way relieve the Contractor from full responsibility for the complete and adequate design and performance of the dewatering system to provide the necessary Construction Dewatering.

C. Dewatering and Excavation Plan: A Dewatering and Excavation Plan shall be submitted to the Engineer at least 30 calendar days prior to the commencement of the dewatering work and, at a minimum, shall include the following:

1. Description and profile of geology, soil, and groundwater conditions.
2. Detailed description of the Dewatering and Monitoring System installation including procedures for operation and maintenance of equipment, and description of emergency procedures to follow when problems arise
3. Design calculations demonstrating the adequacy of the proposed Dewatering System, including depth to groundwater at excavation limits.
4. Calculations and requisite technical data on well screens and filter materials and gradations to demonstrate the adequacy of proposed systems to prevent the pumping of fines.
5. Working drawings showing the Dewatering System to be used. Working Drawings shall include:

    a. Arrangements, locations and depths of the Dewatering System
    b. A complete description of equipment and materials to be used and the procedure to be followed in installation, operation and maintenance in relation to the proposed sequence of excavation, foundation construction and backfilling.
    c. Layout and depth of monitoring wells, piezometers and flow measuring devices for system performance measurement.
    d. Location and size of sumps, ditches and water discharge lines, including their relation to water disposal points
    e. The proposed locations of points of effluent treatment equipment, effluent flow equalization tanks and discharge of water.
    f. Proposed types and locations of proposed surface water control

6. Standby equipment and standby power supply.
7. Discharge details, metering, and reading schedules and the details of the settling tank and oil/water separator
8. Methods to be used for drilling, construction, and development of wells and piezometers.
9. Permits and Notifications

    a. List of permits required
    b. List of agencies having jurisdiction to be notified.
    c. Schedule for obtaining permits
    d. Schedule for the notification of agencies having jurisdiction.

10. The dewatering and Excavation Plan shall be prepared by a Professional Engineers registered in the State of New York.

D. Product Data: Submit data for each of the following:

1. Dewatering Pumps: Indicate sizes, capacities, priming method, motor characteristics.
2. Pumping equipment for control of surface water within excavation.

E. As-built Submittals: During installation of the dewatering system and prior to the start of Construction Dewatering, submit as-built conditions of the Dewatering System. As-built data are to include but are not limited to:

1. Plans and sections showing as-built locations, and surveyed elevations of the Dewatering System and its components.

2. Drawings to indicate changes made to the original Working Drawings to accommodate field conditions and to comply with design standards.
3. Details of installation including dimensions and materials used, description and drawings of all installations, all procedures, soil strata encountered and logs of soil samples.

F. Field Reports: As specified in Field Quality Control article.

G. The Contractor shall be responsible for compliance with all dewatering permit requirements once construction dewatering begins.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and depths of capped wells and piping abandoned in place.

1.8 QUALITY ASSURANCE

A. Comply with authorities having jurisdiction for the following:

1. Drilling and abandoning of wells used for dewatering systems.
2. Water discharge and disposal from pumping operations.

B. Obtain permit as required.

C. Perform Work in accordance with all applicable Federal, State and Municipal codes, rules and regulations including revisions to date.

1.9 QUALIFICATIONS

A. The dewatering work shall be performed by a specialty subcontractor specializing in and having experience installing and operating dewatering systems in similar subsurface conditions for at least 5 years.

B. The Contractor may perform the dewatering work if he has experience conforming to the above requirements..

C. The Contractor shall assume sole responsibility for dewatering and surface water control systems and for loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations.

D. Design, install, and monitor operation of dewatering under direct supervision of Professional Engineer registered in the State of New York having experience in the design of this Work

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1.10 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.11 SEQUENCING

A. Sequence work to obtain required permits before start of dewatering operations.

B. Sequence work to install and test monitoring systems a minimum of one (1) week before testing and operating dewatering systems.

C. Sequence work to install and test dewatering systems a minimum of one (1) week before starting excavation.

1.12 COORDINATION

A. Coordinate work to permit the following construction operations to be completed on dry stable substrate.

1. Excavation for structures.
2. Trenching for utilities

B. Coordinate the operation of his dewatering system with existing and proposed construction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and equipment used in the Dewatering System shall adhere to accepted industry standards and be in good operating condition and able to perform satisfactorily over the required duration of construction dewatering.

B. Back up equipment for the Dewatering System shall be identical to the primary equipment and shall be available in operating condition at all times

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Construction Dewatering is required to protect foundation subgrades and to maintain dry conditions for construction. The Contractor shall maintain a continuous and completely effective Dewatering System as required during the duration of construction.

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B. The Contractor shall be prepared to modify the dewatering system and methods as required by actual field conditions encountered during construction, at no additional cost to the Owner.

C. The Contractor shall measure water levels periodically in observation wells installed adjacent to nearby structures to ensure drawdown outside the excavation is within permissible limits specified in the Dewatering and Excavation Plan.

D. Surface areas adjacent to the excavation shall be graded and/or curbed to prevent flow of surface water into the excavation.

3.2 EXAMINATION

A. Conduct additional borings and investigations to supplement subsurface investigations as required to complete dewatering system design.

B. Locate underground piping, conduit, and other structures.

3.3 PREPARATION

A. Protect existing adjacent buildings, structures, and improvements from damage caused by dewatering operations.

3.4 TESTING

A. The Contractor is responsible for monitoring his dewatering efforts to determine if the project requirements are being met. The Contractor shall provide observation wells and other means to monitor the dewatering as detailed in the Dewatering and Excavation Plan.

B. Readings to determine the quantity of fines in the dewatering effluent shall be made a minimum of once every two weeks.

3.5 MONITORING WELLS

A. Install monitoring wells at locations indicated in the Dewatering and Excavation Plan.

B. Test each monitoring well point to verify installation is performing properly.

C. Install piezometers, calibrate, and test for proper operation.

D. Protect monitoring wells from damage by construction operations.

E. Maintain accessibility to monitoring wells continuously during construction operations.

F. Maintain monitoring wells until groundwater is allowed to return to normal level.

3.6 DEWATERING SYSTEM

A. Install dewatering system in accordance with the Dewatering and Excavation Plan.

B. Locate system components to allow continuous dewatering operations without interfering with installation of permanent Work and existing public rights-of-way, sidewalks, and adjacent buildings, structures, and improvements.

C. Drill wells in sizes and to depth indicated. Provide temporary surface casing when required to stabilize soil while advancing well.

D. Test wells for proper water flow through well screen and pumping rate for dewatering system operation. Repeat development until well meets performance requirements.

E. Cover and seal top of well until pump is installed.

F. Install pumps in accordance with manufacturer's instructions.

G. Connect pumps to discharge header. Install valves to permit pump isolation.

3.7 SURFACE WATER CONTROL SYSTEM

A. Provide ditches, berms, and other devices to divert and drain surface water from excavation area.

B. Divert surface water and seepage water within excavation areas into sumps and pump in accordance with requirements of the Dewatering and Excavation Plan.

C. Control and remove unanticipated water seepage into excavation.

D. Direct surface water to minimize surface erosion, ponding and softening of slopes and berms, including haul roads and equipment working stations.

E. Curbs shall be maintained and, where necessary, extended across intersections, curb cuts and defective curb sections. Surface cracks in the adjacent streets are to be sealed and re-sealed as necessary. Should adjacent settlement occur during the work, curbs shall be raised or water-tight mounds shall be installed as directed by the Engineer to prevent flow into the site.

3.8 SYSTEM OPERATION AND MAINTENANCE

A. The Dewatering System shall provide for an uninterrupted flow of pumped water and shall be maintained and pumped as necessary to drawdown and maintain the groundwater levels as specified. Unless otherwise specified, pumping shall maintain those depressed levels until the permanent under drainage system has been installed, tested, accepted and is operational or until the permanent structure is capable of withstanding hydrostatic pressures as determined by the Engineer.

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B. The Contractor shall furnish, operate and maintain sufficient drainage and pumping facilities to dewater the site and its underlying soil. Dewatering operations shall operate in such a manner so that the excavation can proceed while maintaining stable slopes and the designed lateral support for the perimeter support of excavation walls, without disturbing the bearing subgrades for the structure. The ground water level as measured in monitoring wells shall be lowered and maintained at least two feet below the prevailing excavation level, or it shall be lowered to a point no higher than 2 feet above the top of impermeable stratum if the subgrade is in the impermeable stratum.

C. The dewatering system shall be installed and operated in such a manner as to avoid the movement of fines or loss of ground below the bearing level and shall not influence the stability of surrounding areas. Well points and deep wells shall be properly sanded in and sumps shall be sheeted and provided with proper filter material.

D. A sufficient number of monitoring wells shall be installed and water levels read by the Contractor, at least weekly, to demonstrate that the goals of the Dewatering System are being met. Water level readings shall be submitted within 24 hours to the Engineer. If applicable, the Contractor may make use of existing observation wells as shown on the Contract Drawings.

E. Open pumping with sumps and ditches resulting in boils, loss of fines, softening of the ground or instability of slopes will not be permitted.

F. Provide 24-hour supervision of dewatering system by personnel skilled in operation, maintenance, and replacement of system components.

G. Conduct daily observation of dewatering system and monitoring system. Make required repairs and perform scheduled maintenance.

H. Fill fuel tanks before tanks reach 25 percent capacity.

I. Start emergency generators at least twice each week to check operating condition.

J. When dewatering system cannot control water within excavation, notify the Engineer and stop excavation work.

1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.

K. Modify dewatering and surface water control systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.

L. Correct unanticipated pressure conditions affecting dewatering system performance.

M. Do not discontinue dewatering operations without Engineer’s approval.

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3.9 DEWATERING EFFUENT DISPOSAL

A. Discharge dewatering effluent in accordance with the requirements of the Dewatering and Excavation Plan, and the SWPPP.

3.10 SYSTEM REMOVAL

A. Remove dewatering and surface water control systems after dewatering operations are discontinued.

B. Repair damage caused by dewatering and surface water control systems or resulting from failure of systems to protect property.

3.11 FIELD QUALITY CONTROL

A. Survey existing adjacent buildings, structures, and improvements as indicated in the Dewatering and Excavation Plan to detect movement in comparison to original elevations during dewatering operations. Notify the Engineer immediately of measured movement.

B. Submit initial installation reports including the following:

1. Installation and development reports for well points and pumps.
2. Installation and baseline reports for monitoring wells and piezometers.
3. Initial dewatering flow rates.

C. Submit weekly monitoring reports including the following:

1. Dewatering flow rates.
2. Piezometer readings.
3. Maintenance records for dewatering and surface water control systems.

END OF SECTION 312319

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SECTION 312333 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes delegated design of trench excavation and support, backfilling, and compaction.

B. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork” for materials used as backfill and for sheeting and bracing.
2. Section 310519.13 “Geotextiles for Earthwork” for subsurface drainage geotextiles.
3. Section 312000 “Earthwork” for related earthwork activities.
4. Section 312319 "Dewatering" for dewatering and drainage.
5. Section 312500 “Erosion and Sedimentation Controls” to prevent erosion, sedimentation, and contamination of adjacent properties.
6. Section 329119 “Landscape Grading” for filling of topsoil over backfilled trenches to finish grade elevation.
7. Section 329200 “Turf and Grasses.”
8. Section 331116 “Site Water Utility Distribution Piping” for water piping and bedding from building to utility service.
9. Section 333100 “Sanitary Sewerage Piping” for sanitary sewer piping and bedding from building to utility service.
10. Section 334100 “Storm Utility Drainage Piping” for storm sewer piping and bedding from building to utility service.
11. Section 334600 “Subdrainage” for building perimeter drainage, filter aggregate, filter fabric, and granular cover.
    Section 335100 “Natural-Gas Distribution” for gas piping and bedding from building to utility service.

1.3 DEFINITIONS

A. Percent Compaction: Means at least the stated percentage of maximum density as determined by ASTM D1557, Method D.

1.4 ACTION SUBMITTALS

A. Submit proposed method of backfilling and compaction prior to start of Work.

1.5 DELEGATED DESIGN SUBMITTALS

A. Submit method of trench excavation and support, where necessary, including design of sheeting and bracing with calculations signed and sealed by qualified professional engineer responsible for their preparation.

B. Qualifications Statement: Submit qualifications for licensed professional.

1.6 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For material excavated from trench for re-use as backfill, by a qualified testing agency.

1.7 QUALITY ASSURANCE

A. Comply with following regulations:

1. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1926 Subpart P.

B. Professional Engineer Qualifications: Licensed Professional Engineer experienced in design of specified Work and licensed in the jurisdiction of Project location; having a minimum of 5 years' experience in design and construction of trench excavation and support.

C. Provide excavation, trenching, related sheeting, bracing, and related materials to comply with requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) Where conflict exists between OSHA and State regulations, more stringent requirements apply.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store excavated materials according to Section 312500 "Erosion and Sedimentation Control" to prevent erosion of soil type materials and contamination of adjacent water sources.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Section 310515 "Soils and Aggregates for Earthwork" for soil and aggregate materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine that erosion and sedimentation controls are in place and comply with project requirements and authorities having jurisdiction.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Where excavation activities occur across active vehicular or pedestrian circulation paths, use temporary controls specified in Division 01 to maintain circulation during operations required by this Section. Maintain temporary controls for each day circulation paths are restricted.

B. Coordinate work of this Section with materials specified in other Sections of Division 31 and 32.

C. Identify required lines, levels, contours, and datum locations.

D. Protect features to remain-in-place including benchmarks, existing structures, fences, sidewalks, paving, curbs, etc. from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCH EXCAVATION

A. Trench excavation includes material of every description and substance encountered.

B. Cut rigid and flexible pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.

C. Strip and stockpile topsoil from grassed areas crossed by trenches.

1. At Contractor's option when required, topsoil may be disposed of and replaced with approved topsoil of equal quality.

D. While excavating and backfilling is in progress, maintain traffic and protect utilities and other property.

E. Excavate trenches to indicated depths and in widths sufficient and of practical minimum for pipe laying, bracing, and pumping and drainage facilities.

F. Accomplish excavation and dewatering by methods preserving undisturbed state of subgrade soils. Excavate trench by machinery to or just below designated subgrade, if material remaining in trench bottom is no more than slightly disturbed.

1. Remove subgrade soils that become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods and replace with screened gravel fill acceptable to the Engineer at Contractor's expense.

G. Use care when working in clay and organic silt soils, which are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 12 inches of depth.

H. Where pipe is to be laid in screened gravel bedding, excavate trench by machinery to normal depth of pipe, provided material remaining in trench bottom is no more than slightly disturbed.

I. Where pipe is to be laid directly on trench bottom, manually perform final excavation, providing a flat-bottom, true to grade upon undisturbed material. Make bell holes required by project conditions.

3.4 DISPOSAL OF MATERIALS

A. Stack excavated material without excessive surcharge on trench bank or obstructing free access to hydrants and gate valves. Avoid inconvenience to traffic and abutters. Segregated excavated material for use in backfilling as specified below.

B. All excavated material shall be removed from work site.

C. Should conditions make it impracticable or unsafe to stack material adjacent to trench, haul and store material at a location provided for temporary storage before permanent off-site disposal.

3.5 SHEETING AND BRACING

A. Provide and maintain sheeting and bracing required by Federal, State, or local safety requirements to support sides of excavation and prevent loss of ground which could endanger personnel, damage, adjacent structures, or delay the work.

1. Engineer may order additional supports placed at Contractor’s expense if it is determined that at any point sufficient or proper supports have not been provided. Provide sufficiency of supports even with compliance of such order. Take care to prevent voids outside of sheeting; if voids are formed, immediately fill and ram them.

B. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support trench sides, take care in placing and moving the boxes or supporting bracing to prevent pipe movement, disturbance of pipe bedding, or screened gravel backfill.

1. Rigid Pipe Installation (such as R.C., V.C., A.C.): Raise that portion of box extending below mid-diameter above this point prior to moving box ahead to install next pipe. Perform to prevent separation of installed pipe joints due to box movement.
2. Flexible Pipe Installation (such as PVC): Do not allow trench boxes, moveable sheeting, shoring, or plates to extend below mid-diameter of pipe. As trench boxes, moveable sheeting, shoring, or plates are moved, place screened gravel to fill voids created. Re-compact screened gravel and backfill to provide uniform side support for pipe.

C. Engineer may give permission to use steel sheeting in lieu of wood sheeting for entire job wherever sheeting use is necessary. Include cost for use of sheeting in bid items for pipe, including full compensation for driving, bracing, and later removal of sheeting.

D. Carefully remove sheeting and bracing in manner to not endanger construction of other structures, utilities, or property, whether public or private. Immediately refill voids left after withdrawal of sheeting using sand by ramming with tools especially adapted to that purpose and watering or otherwise directed by the Engineer.

E. No payment will be given for sheeting, bracing, or other support during progress of the work. No payment will be given for sheeting left in trench for Contractor's convenience.

F. Leave sheeting driven below mid-diameter of pipe in place from driven elevation to at least 12 inches above top of pipe.

3.6 TEST PITS

A. Excavation of test pits may be required for purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.

B. Backfill test pits as soon as desired information has been obtained. Maintain backfilled surface appropriate for travel until resurfaced.

3.7 EXCAVATION BELOW GRADE AND REFILL

A. Drain trench completely and effectively be in-the-dry, whatever the nature of unstable material encountered or groundwater conditions.

B. If excavating below grade through error or for their own convenience, through failure to properly dewater the trench, or disturbs subgrade before dewatering is sufficiently complete, the Engineer may direct Contractor to excavate below grade as set forth in following Paragraph, where work shall be performed at Contractor's own expense.

C. If material at trench bottom consists of fine sand, sand and silt or soft earth which may work into the screened gravel, even with effective drainage, remove subgrade material to extent directed. Refill excavation with a 6 inch layer of coarse sand or a mixture graded from coarse sand to fine pea stone to form a filter layer preserving voids in pipe gravel bed. Obtain composition and gradation of gravel shall be approval by the Engineer prior to placement. Place screened gravel in 6 inch layers thoroughly compacted up to normal grade of pipe. If directed by the Engineer, use bank-run gravel for refill of excavation below grade.

D. Subsurface Drainage Geotextile: Non-woven filter fabric as specified in Section 310519.13 "Geotextiles for Earthwork" may be substituted for filter layer, if approved by the Engineer.

3.8 BACKFILLING

A. Begin backfilling as soon as practicable after laying and jointing pipe and continue expeditiously. Place bedding gravel of specified type for pipe installed up to 12 inches over the pipe.

B. Typical Trench Dam: A low permeability trench dam or bulkhead cutoff of clay or other low permeability material shall be constructed in the trench as directed, to interrupt unnatural flow of groundwater after construction is completed. The low permeability trench dam shall be effectively keyed into the trench bottom and sidewalls. Provide at least one clay or other low permeability trench dam in pipe bedding between each manhole where directed or every 300 feet, whichever is less.

1. The low permeability trench dam material is to conform to the following properties:

    a. 100% passing the 1-inch Sieve
    b. Minimum 40% passing the 200 Sieve

c. Liquid Limit: 30% Min.
d. Plasticity Index: 10% Min.
e. Hydraulic Conductivity $<1 \times 10^{-7}$ cm/sec

C. Where pipes are laid cross-country, fill remainder of trench with common fill material in layers not to exceed 12 inches and mounded 6 inches above existing grade or as directed by the Engineer. Where a loam or gravel surface exists prior to cross-country excavations, remove, conserve and replace it to full original depth as part of the work under pipe items. Where necessary, remove excess material during clean-up process, so that ground may be restored to its original level and condition.

D. Where pipes are laid in streets, backfill remainder of trench up to a depth of 12 inches below bottom of specified permanent paving with select common fill material in layers not to exceed 12 inches and thoroughly compacted. Use bank-run gravel for subbase layer of paving and compact in 6 inches layers.

E. To prevent longitudinal pipe movement, do not dump backfill material into trench and then spread, until selected material or screened gravel has been placed and compacted to a level at least 12 inches over the pipe.

F. Bring backfill up evenly on all sides. Thoroughly compact each layer of backfill material by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping to 95 percent compaction according to ASTM D1557 or 98 percent according to ASTM D698. If rolling, use a suitable roller or tractor being careful to compact fill throughout full width of trench.

G. Do not compact by puddling or water jetting.

H. Use hand or pneumatic ramming with tools weighing at least 20 pounds for compacting in confined areas. Spread and compact material in layers not exceeding 6 inches thick, an uncompacted loose measurement.

I. Use granular fill material as backfill around structures. Spread and compact specified backfill under and over pipes connected to structures.

J. Do not place bituminous paving in backfill. Do not use frozen material under any circumstances.

K. Broom and hose-clean road surfaces immediately after backfilling. Employ dust control measures throughout construction period.

3.9 RESTORING TRENCH SURFACE

A. Where trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate backfill and maintain surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore ground level.

B. In and adjacent to streets, use 12 inches of trench backfill below specified initial pavement consisting of compacted bank-run gravel. If Contractor wants to use material excavated from trench as gravel subbase for pavement replacement, take samples at intervals not to exceed 500

feet of material and test by an independent testing laboratory at Contractor’s expense. Use only materials approved by the Engineer.

C. Restore surface of driveways or other areas which are disturbed by trench excavation to a condition at least equal to that existing before work began.

D. In areas where pipeline passes through grassed areas, remove and replace sod or loam and seed surface at Contractor's own expense.

END OF SECTION 312333

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SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silt Fences.
2. Construction Entrances.
3. Site Stabilization

B. Related Sections:

1. Section 310515 “Soils and Aggregates for Earthwork.”
2. Section 311000 “Site Clearing.”
3. Section 329200 “Turf and Grasses”

1.3 ACTION SUBMITTALS

A. Submit, within 10 days after award of Contract, technical product literature for all commercial products.

1.4 CLOSEOUT SUBMITTALS

A. Section 017700 “Closeout Procedures”: Requirements for submittals.

1.5 QUALITY ASSURANCE

A. Be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to offsite areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment off site are to be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the Owner will be considered.

B. Sedimentation and erosion control measures are to conform to the requirements of the New York Standards and Specifications for Erosion and Sediment Control.

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PART 2 - PRODUCTS

2.1 AGGREGATE, AND SOIL MATERIALS

A. Coarse Aggregate (Crushed Stone): as specified in Section 310515 “Soils and Aggregates for Earthwork”.

2.2 SILT FENCE

A. Sediment fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as “Envirofence” by Mirafi Inc., Charlotte, NC or equal.

B. Include a drawstring in the top portion of the fence for added strength.

C. Posts: Constructed of hardwood with minimum diameter thickness of 1.5 inches (38 mm).

D. Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings), or 1/32 inch diameter soft aluminum wire.

2.3 PLANTING MATERIALS

A. Seeding and Soil Supplements: , as specified in Section 329200 “Turfs and Grasses”.] Furnish according to New York Standards and Specifications for Erosion and Sediment Control standards.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.

B. Verify gradients and elevations of base or foundation for other work are correct.

3.2 SILT FENCE

A. Position sediment fences as indicated on the Drawings and to prevent off site movement of sediment produced by construction activities as directed by the Engineer. Areas beyond limits of silt fence shall be undisturbed or stabilized.

B. Dig trench approximately 6 inch wide and 6 inch deep along proposed fence lines.

C. Drive stakes, 10 feet on center (maximum) at back edge of trenches. Drive stakes 2 feet (minimum) into ground.

D. Hang filter fabric on posts carrying to bottom of trench with about 4 inches of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.

E. Backfill trench with excavated material and tamp.

3.3 Install pre-fabricated silt fence according to manufacturer's instructions.CONSTRUCTION ENTRANCE

A. Construct entrance with minimum of 6 inch of course aggregate at all points of ingress/egress.

B. Width: Minimum 20 feet, increased as needed for typical construction vehicles.

C. Minimum Length: 50 feet(where soils are course grained) minimum and as shown on Contract Drawings.

D. Install filter fabric below aggregate.

E. Maintain entrance throughout construction, adding more aggregate or increasing length as needed.

3.4 SITE STABILIZATION

A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.

B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.

C. stockpile sides at 2: 1 or flatter.

D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.

1. During non-germinating periods, apply mulch at recommended rates.

E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.5 CLEANING

A. Section 017300 “Execution” and 017700 “Closeout Procedures”: Requirements for cleaning.

B. When sediment accumulation in sediment structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.

C. Do not damage structure or device during cleaning operations.

D. Do not permit sediment to erode into construction or site areas or natural waterways.

E. Clean channels when depth of sediment reaches approximately one-half channel depth.

F. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner and in accordance with

all local, state, and federal regulations. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Drawings.

G. When Work is completed and with the written authorization of the Engineer, remove all sediment and erosion control devices and restore areas to original conditions.

3.6 PROTECTION

A. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.

B. Do not permit construction traffic over paving for 7 days minimum after finishing.

C. Protect paving from elements, flowing water, or other disturbance until curing is completed.

END OF SECTION 312500

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SECTION 321123 - AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aggregate subbase.
2. Aggregate base course.

B. Related Sections:

1. Section 312000 "Earthwork" for preparation of site for base course. and compacted fill under base course.
2. Section 312333 “Trenching and Backfilling”
3. Section 321216 "Asphalt Paving" for Binder and finish asphalt courses.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Initial aggregate test reports.

B. Materials Source: Name of aggregate materials suppliers.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work according to NYSDOT Standard Specifications.

C. Maintain one copy of NYSDOT Standard Specifications on site.

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PART 2 - PRODUCTS

2.1 MATERIALS

A. Subbase Aggregate: NYSDOT Subbase Course, Type I, conforming to NYSDOT Standard Specifications 304 and 733-04

1. Percent Passing per Sieve Size:

Sieve Size		Percent Passing by Weight
3 inches	(75 mm)	100
2 inches	(50 mm)	90 to 100
1/4 inches	(6.3 mm)	30 to 65
No.40	(0.425 mm)	5 to 40
No. 200	(0.075 mm)	0 to 10

2. Composition: hard durable particles or fragments of:

a. Stone
b. Slag
c. Gravel
d. Sand
e. Stone dust

B. Crushed Stone, ¾ Inch: Crushed stone conforming to NYSDOT Standards Specifications Section 703-02; graded type.

1. Percent Passing per Sieve Size:

Sieve Size		Percent Passing by Weight
1 inches	(25.0 mm)	100
3/4 inches	(19 mm)	90 to 100
1/2 inches	(12.5 mm)	20 to 55
3/8 inches	(9.5 mm)	0 to 15
No.4	(4.75 mm)	0 to 5

2. Composition: hard durable particles of:

a. Stone
b. Gravel
c. Sand
d. May contain:

1) Silt
2) Clay
3) Stone dust

C. Fine Aggregate:

1. Screenings.
2. Angular sand.
3. Crushed recycled concrete fines.
4. Or other finely divided mineral matter.
5. Portion passing the No. 40 sieve either non-plastic or have a liquid limit less than 25 and a plasticity index less than 5.

2.2 INITIAL TESTS

A. Perform all of the following tests on the proposed material to demonstrate that it meets all specified requirements when furnished. Submit the initial test results to the Engineer for approval prior to commencement of construction.

1. Sieve Analysis including 0.02 mm material.
2. Liquid limit and plasticity index.
3. Moisture-density relationship.
4. Wear Resistance to Degradation (ASTM C131/C131M).
5. Weight per cubic meter of Slag.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Clean the underlying course or subgrade of all foreign substances prior to constructing the subbase base course(s).

B. Do not construct base/subbase course(s) on underlying course or subgrade that is frozen.

C. Prepare the surface of the underlying course or subgrade to meet specified compaction and surface tolerances.

D. Correct ruts or soft yielding spots in the underlying courses.

E. Correct areas having inadequate compaction, and deviations of the surface from the specified requirements:

1. Loosen and remove soft or unsatisfactory material and add approved material
2. Reshape to line and grade,
3. Recompact to specified density requirements.

F. For cohesion-less underlying courses or subgrades containing sands or gravels:

1. Stabilize the surface prior to placement of the base course(s):

a. Mix aggregate into the underlying course
b. Compact by approved methods.
c. Do not allow traffic or other operations to disturb the finished underlying course

d. Maintain underlying course until the base course is placed.

G. Verify that the underlying surface has been inspected, gradients and elevations are correct.

3.2 AGGREGATE PLACEMENT

A. Gravel road/surface only: Install geotextile fabric over subgrade according to manufacturer's instructions.

1. Lap ends and edges minimum 6 inches.
2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.

B. Place aggregate equal thickness layers to total compacted thickness within ½ inch of the thickness indicated on the drawings.

1. Maximum lift Compacted Thickness: 8 inches .
2. Minimum lift Compacted Thickness: 4 inches .

C. Level and compact the base and subbase course to within ½ inch of the thickness indicated.

D. Degree of Compaction:

1. Compact aggregate lifts to 95 percent of laboratory maximum dry density.
2. Except as noted below, degree of compaction is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557.
3. Degree of compaction for material having more than 30 percent by weight of their particles retained on the ¾ inch sieve will be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

E. Maintain optimum moisture content of material as necessary to achieve the specified degree of compaction.

3.3 ERECTION TOLERANCES

A. Maximum Variation from Flat Surface: 1/2 inch measured with 10 foot straight edge.

B. Maximum Variation from Thickness: 1/4 inch.

C. Maximum Variation from Elevation: 1/2 inch.

3.4 FIELD QUALITY CONTROL

A. Field Density Measurements: Measure field density in accordance with ASTM D1556/D1556M.

B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

C. Frequency of Tests: One test for every 1000 square yards of each layer compacted aggregate or as directed by the Engineer.

END OF SECTION 321123

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SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving base course, binder course, and wearing course.
5. Asphalt paving overlay for existing paving.

B. Related Requirement:

1. Section 312213 “Rough Grading”: Preparation of site for paving and base.
2. Section 312323 “Fill”: Compacted subbase for paving.
3. Section 321123 “Aggregate Base Courses”: Compacted subbase for paving.
4. Section 312000 “Earthwork.”
5. Section 312333 “Trenching and Backfilling.”

1.3 ACTION SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Product Data:

1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.

C. Manufacturer's Certificate: Certify all materials meet or exceed the requirements of New York Department of Transportation Standard Specifications .

1.4 QUALITY ASSURANCE

A. Obtain materials from same source throughout.

B. Tests:

1. Perform all of the following tests on the proposed material to demonstrate that it meets all specified requirements when furnished. Submit the initial test results to the Engineer for approval prior to commencement of construction.

    a. Sieve Analysis including 0.02 mm material.
    b. Liquid limit and plasticity index.
    c. Moisture-density relationship

C. Wear Resistance to Degradation (ASTM C131/C131M)

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum 5 years documented experience.

1.6 AMBIENT CONDITIONS

A. Do not place asphalt mixture between November 1 and March 1.

B. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

A. Performance / Design Criteria:

1. Paving: Design for parking areas, access drives, and heavy duty commercial vehicles and service vehicles.
2. Asphalt pavement materials, production, placement, and compaction shall conform to the applicable requirements of the latest edition of the New York State Department of Transportation Standard Specifications, Construction and Materials, unless otherwise indicated in the Contract Documents.
3. All pavement thicknesses referred to herein and on the drawings are compacted thicknesses. The Contractor shall place sufficient mix to ensure that the specified thickness of pavement is provided.
4. Construct pavement to the lines, grades, elevations, cross slopes, and compacted thicknesses indicated on the Drawings. Finished pavement shall provide positive drainage.

B. Asphalt Materials:

1. Asphalt Binder: Performance-Graded (PG) asphalt binder conforming to NYSDOT Standard Specifications Section 702 and AASHTO M320. Provide the following performance grade, as indicated for the pavement application:

a. PG 64S-22: Heavy-duty pavement, access drives, and pavement subject to regular commercial, maintenance, and plant service vehicles.
b. PG 64V-22: Pavement subject to frequent heavy trucks, slow-moving heavy vehicles, loading/unloading operations, or concentrated truck maneuvering.

2. Tack Coat: Provide diluted or straight asphalt emulsion tack coat conforming to NYSDOT Standard Specifications Sections 407 and 702.

a. Apply tack coat between successive asphalt pavement courses.
b. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.
c. Application rates shall conform to NYSDOT Standard Specifications Section 407.

3. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt paving. Use of RAP in asphalt mixtures shall conform to NYSDOT Standard Specifications Sections 401 and 404 and the approved mixture design.
4. Oil: In accordance with NYSDOT Standards.

C. Aggregate Materials:

1. Aggregate used in asphalt paving mixtures shall conform to the applicable requirements of NYSDOT Standard Specifications Sections 401, 404, and 703.
2. Coarse Aggregate: ASTM D692; crushed stone, gravel, or blast furnace slag.
3. Fine Aggregate: ASTM D1073; natural sand or sand manufactured from stone, gravel, or blast furnace slag.
4. Mineral Filler: ASTM D242; finely ground mineral particles, free of foreign matter.

D. Aggregate Subbase: Specified in Section 321123 ”Aggregate Base Courses”.

2.2 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Asphalt Paving Mixtures: Designed in accordance with NYSDOT standards.

1. Base Course: NYSDOT 37.5 Base Course
2. Binder Course: NYSDOT 19.0 Binder Course
3. Wearing Course: NYSDOT 9.5 Top Course

2.3 ACCESSORIES

A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

B. Use Type 1 sealant rated 50 percent extension at 0 degrees F for other climates.

C. Sealant: ASTM D6690, Type II; hot applied type.

2.4 SOURCE QUALITY CONTROL

A. Submit proposed mix design of each class of mix for review prior to beginning of Work.

B. Test samples in accordance with NYSDOT Standard Specifications Sections 401 and 404 and NYSDOT Materials Procedures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.

B. Verify compacted subgrade and subbase is dry and ready to support paving and imposed loads.

1. Proof roll subbase in minimum two perpendicular passes to identify soft spots.
2. Remove soft subbase and replace with compacted fill as specified in Section 312323.

C. Verify gradients and elevations of base are correct.

D. Finished excavation and grading shall be uniformly smooth, well compacted, and free from irregular surface changes. The finished surface shall not be more than 0.10 feet above or below the new grade.

E. Verify gutter drainage grilles, manhole frames and inlets are installed in correct position and elevation.

F. The contact surfaces of castings and other structures shall be painted with a tack coat.

3.2 DEMOLITION

A. Saw cut and notch existing paving as indicated on Drawings.

B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.3 INSTALLATION

A. Subgrade Preparation:

1. Clean the underlying course or subgrade of all foreign substances prior to constructing the subbase base course(s).
2. Do not construct base/subbase course(s) on underlying course or subgrade that is frozen.
3. Prepare the surface of the underlying course or subgrade to meet specified compaction and surface tolerances.

4. Correct ruts or soft yielding spots in the underlying courses
5. Correct areas having inadequate compaction, and deviations of the surface from the specified requirements:

    a. Loosen and remove soft or unsatisfactory material and add approved material.
    b. Reshape to line and grade
    c. Recompact to specified density requirements

6. For cohesion-less underlying courses or subgrades containing sands or gravels:

    a. Stabilize the surface prior to placement of the base course(s):

        1) Mix aggregate into the underlying course
        2) Compact by approved methods
        3) Do not allow traffic or other operations to disturb the finished underlying course
        4) Maintain underlying course until the base course is placed

7. Verify that the underlying surface has been inspected, gradients and elevations are correct.

B. Subbase/Base Preparation:

1. Place aggregate equal thickness layers to total compacted thickness within ½ inch of the thickness indicated on the drawings.

    a. Maximum lift Compacted Thickness: 6 inches
    b. Minimum lift Compacted Thickness: 3 inches

2. Level and compact the base subbase course to within ½ inch of the thickness indicated.
3. Degree of Compaction:

    a. Compact aggregate lifts to 95 percent of laboratory maximum dry density
    b. Except as noted below, degree of compaction is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557.
    c. The degree of compaction of material having more than 30 percent by weight of their particles retained on the ¾ inch (19.0 mm) sieve will be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T180 Method D and corrected with AASHTO T224.

4. Maintain optimum moisture content of material as necessary to achieve the specified degree of compaction.

C. Tack Coat:

1. Apply tack coat in accordance with NYDOT Standards.
2. Coat surfaces of manhole catch basin frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

D. Double Course Asphalt Paving:

1. Place asphalt binder course within 24 hours of applying primer or tack coat.
2. Place binder course to thickness indicated on Drawings.
3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
4. Place wearing course to thickness indicated on Drawings.
5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

E. Asphalt Paving Overlay:

1. Apply tack coat to existing paving surface at rate recommended by geotextile fabric manufacturer.
2. Install geotextile fabric in accordance with manufacturer's instructions to permit asphalt saturation of fabric. Lap fabric edge and end joints 4 inches.
3. Place wearing course thickness indicated on Drawings.
4. Compact overlay by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
5. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

F. Joints:

1. Joints between old and new pavements, or between successive sections or lanes, shall be carefully made to ensure a proper bond for the full depth of the course. Joints shall be formed by cutting back the previous section to expose the full depth of the course. A tack coat shall be applied at all joints.
2. Joints adjacent to curbs, or adjoining pavement shall be formed by carrying back sufficient hot material to fill and space left uncovered by the paver. The joint shall then be set up with rakes to a sufficient height to receive full compression under the rollers.
3. Joints shall be given a seal coat after rolling is complete.
4. Broom and tack coat edges of existing pavement and base course with emulsified or cutback asphalt. Trim loose edges of existing pavement. Brook and tack coat all edges with emulsified or cutback asphalt.

G. Rolling and Compaction

1. Compaction shall be started immediately after spreading. Rollers shall be types approved by the Engineer. Rolling shall be a continuous process, and all parts of the pavement shall receive uniform compaction.
2. All pavement thicknesses referred to herein are compacted thicknesses. The Contractor shall place sufficient mix to ensure that the specified thickness of pavement occurs wherever called for.
3. After the paving mixture has been properly spread, initial compaction shall be obtained by the use of power rollers weighing not less than 240 pounds per inch width of tread.
4. Final compaction of the surface shall be accomplished by rollers weighing not less than 283 pounds per inch width of tread. Along curbs, structures and all places not accessible with a roller, the mixtures shall be thoroughly compacted with tampers. Such tampers shall not weigh less than 25 pounds and shall have a tamping face of not more than 50

square inches. The surface of the mixture after compaction shall be smooth and true to the established line and grade.

H. No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Engineer.

3.4 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 feet straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation from Indicated Elevation: Within 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Take samples and perform tests in accordance with New York Department of Transportation Standard Specifications.

B. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

C. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards compacted paving.

D. Asphalt Paving Density: ASTM D1188 or ASTM D2726; test one core sample from every 1000 square yards compacted paving.

E. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 1000 square yards compacted paving.

3.6 PROTECTION

A. Immediately after placement, protect paving from mechanical injury for 12 hours or until surface temperature is less than 140 degrees F.

B. Do not allow vehicular traffic or loads on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Engineer.

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SECTION 321623 – ASPHALT SIDEWALKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Asphalt sidewalks and pedestrian walkways

B. Preparation of subgrade and aggregate subbase associated with asphalt sidewalk construction

C. Related Requirements:

1. Section 312213 “Rough Grading” for preparation of Site for paving and base grade.
2. Section 312323 “Fill” for compacted subgrade for paving.
3. Section 321123 “Aggregate Base Courses” for base course.

1.3 QUALITY ASSURANCE

A. Asphalt sidewalk materials and construction shall conform to NYSDOT Standard Specifications Section 608 and applicable requirements of Sections 401 and 404.

B. Obtain materials from same source throughout.

C. Qualifications

1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
2. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection according to manufacturer instructions.

1.5 EXISTING CONDITIONS

A. Verify existing grades, elevations, utility structures, curb elevations, building entrances, and adjacent pavement before beginning Work.

B. Notify Engineer of conditions that would prevent construction to the lines, grades, slopes, or elevations indicated on the Drawings.

PART 2 - PRODUCTS

2.1 AGGREGATE SUBGRADE

A. As specified in Section 321123 “Aggregate Base Courses”.

2.2 MATERIALS

A. Asphalt Paving mixture: Provide asphalt mixture conforming to the applicable requirements of NYSDOT Standard Specifications Sections 401, 404, and 608.

1. Sidewalk Wearing Course: NYSDOT 9.5 Top Course asphalt mixture
2. Compacted thickness: 2 inches, unless otherwise indicated on the Drawings
3. Asphalt mixture shall be produced from an approved Job Mix Formula (JMF) in accordance with NYSDOT requirements.
4. Asphalt binder, aggregates, mineral filler, and additives shall conform to the requirements of NYSDOT Section 700 Materials Details.
5. Height: Equal to full depth of finished sidewalk.

B. Aggregate Base Course

1. Aggregate base shall conform to NYSDOT section 304, Type 2 Subbase Course.
2. Compacted Thickness:

    a. 6 inches minimum unless otherwise indicated on the Contract Drawings
    b. Aggregate shall be placed and compacted in accordance with NYSDOT Section 304

C. Tack Coat

1. Tack coat shall conform to NYSDOT Section 407
2. Apply tack coat to all existing asphalt and concrete surfaces that will be in contact with new asphalt pavement

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 “Execution”: Requirements for installation examination.

B. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

C. Verify that gradients and elevations of subgrade are as indicated on Drawings.

3.2 PREPARATION

A. Section 017300 “Execution”: Requirements for installation preparation.

B. Subgrade preparation shall conform to NYSDOT standards.

C. Aggregate base course shall conform to NYSDOT Section 304

D. Correct soft, yielding, or unstable areas prior to paving.

3.3 INSTALLATION

A. Subgrade:

1. As specified in Section 321123 “Aggregate Base Courses”.”

B. Weather Limitations:

1. Do not place asphalt when:

a. Air temperature is below 40 degrees Fahrenheit.
b. Surface is wet, frozen, or unstable
c. Weather conditions are unsuitable for proper compaction.

C. Tack Coat

1. Apply tack coat in accordance with NYSDOT Section 407 where new asphalt is placed against existing pavement, curbs, structures, or concrete surfaces

D. Asphalt Placement

1. Place asphalt pavement in accordance with NYSDOT section 401
2. Spread and compact asphalt mixture to the required section, thickness, grade, and cross slope.
3. Compact asphalt pavement using equipment capable of achieving the required density.
4. Finished sidewalk thickness shall be 2 inches minimum compacted thickness.

E. ADA Requirements

1. Sidewalk cross slope shall not exceed 2.0 percent
2. Running slope shall conform to the drawings and ADA requirements
3. Provide smooth transitions at driveways, curb ramps, and sidewalk connections.

3.4 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/4 inch in 10 feet.

B. Maximum Variation from True Position: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 017300 “Execution”: Requirements for testing, adjusting, and balancing.

B. Inspection and Testing:

1. Inspect temporary asphalt sidewalk prior to opening for access use and periodically during construction.
2. Verify asphalt mixture furnished is NYSDOT 9.5 Top Course and is obtained from an approved production source.
3. Verify the prepared subgrade and aggregate subbase are firm, stable, properly graded, and adequately compacted prior to asphalt placement.
4. Asphalt Thickness:
    a. Provide minimum 2-inch compacted thickness, unless otherwise indicated on the Drawings.
    b. Verify thickness during placement by depth checks or material yield.
    c. Asphalt cores are not required unless directed by the Engineer.
5. Aggregate Subbase:
    a. Provide minimum 6-inch compacted thickness of NYSDOT Type 1 Subbase Course, unless otherwise indicated on the Drawings.
    b. Compact to provide a firm and stable surface with no visible yielding, pumping, rutting, or displacement.
6. Compaction:
    a. Compact asphalt with suitable rolling equipment to provide a dense, smooth, stable surface.
    b. Continue compaction until roller marks, displacement, and other objectionable surface irregularities are eliminated.
    c. Field density testing is not required unless directed by the Engineer.
7. Surface Tolerance:
    a. Maximum variation in finished surface: 1/4 inch in 10 feet when measured with a straightedge.
    b. Correct surface irregularities that create tripping hazards, interfere with drainage, or adversely affect accessibility.

8. Drainage: Provide positive drainage.
9. Where the temporary sidewalk serves as an accessible pedestrian route, maintain applicable accessible width, running slope, cross slope, changes in level, and transition requirements throughout the duration of temporary use.
10. Inspection During Temporary Use:

    a. Inspect temporary sidewalk regularly and following construction activities that may damage or obstruct the pedestrian route.
    b. Repair settlement, rutting, cracking, loose material, abrupt changes in level, ponding, or other conditions that create a pedestrian hazard.
    c. Keep temporary sidewalk free of construction debris, equipment, stored materials, snow, ice, and other obstructions.

11. Do not open temporary asphalt sidewalk to pedestrian traffic until the asphalt has cooled and hardened sufficiently to prevent displacement, scuffing, or deformation.

3.6 ATTACHMENTS

A. Asphalt Sidewalk: NYSDOT 9.5 Top Course asphalt mixture over NYSDOT Subbase Course, Type 1; thicknesses as indicated on the Drawings.

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SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Turf renovation.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

C. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment:

1. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
2. Pesticide Applicator: State licensed, commercial.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in the Turfgrass Producers International’s (TPI) "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to

Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.6 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion:

1. Spring Planting: April 1.
2. Fall Planting: August 1.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED FOR GENERAL LAWN/RECREATION AREAS

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with Association of Official Seed Analysts (AOSA's) "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.
2. Sun and Partial Shade – Seed Mixture #1 – In accordance with the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book), Permanent Construction Area Planting, Table 4.4. Proportioned application rates, based on Pure Live Seed (PLS), shall be as follows:

   a. Creeping Red Fescue (Festuca rubra), Ensylva, Pennlawn, or Boreal variety, applied at a rate of 10 lbs/acre (0.25 lb/1,000 SF).
   b. Perennial Ryegrass (Lolium perenne), Pennfine or Linn variety, applied at a rate of 10 lbs/acre (0.25 lb/1,000 SF).
   c. Total seed mixture application rate shall be 20 lbs/acre (0.50 lb/1,000 SF), PLS.

3. Acceptable Suppliers:

a. Pinelands Nursery & Supply.
b. Ernest Seeds.
c. Or Approved Equal.

2.2 FERTILIZERS

A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Applied at a rate of 500 pounds per acre or 11 pounds per 1,000 square feet of 10-10-10 or equivalent with 50% water insoluble nitrogen.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 LIME

A. Description: Agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent.

B. Comply with ASTM C602.

C. Class: T.

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work:

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations:

1. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LIMING AND FERTILIZING

A. Apply lime at application rate recommended by soil analysis.

B. Work lime into top 4 inches of soil.

C. Apply fertilizer at application rate 500 pounds per acre or 11 pounds per 1,000 Square Feet.

D. Apply fertilizer after smooth raking of topsoil.

E. .Mix fertilizer thoroughly into upper 4 inches of topsoil.

F. Lightly water soil to aid dissipation of fertilizer.

3.4 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil: Place and mix planting soil in place over scarified and exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph:

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 2 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment:

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

G. Protect seeded areas from hot, dry weather or drying winds by applying straw mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.6 TURF RENOVATION

A. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles:

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

C. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

D. Mow, dethatch, core aerate, and rake existing turf.

E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

H. Apply initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

I. Apply seed and protect with straw mulch as required for new turf.

J. Water newly planted areas and keep moist until new turf is established.

3.7 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches:

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow to a height of 1-1/2 to 2 inches.

3.8 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.10 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: 120 days from date of planting completion:

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

B. Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Meadow Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than maintenance period below:

1. Maintenance Period: 120 days from date of planting completion.

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SECTION 330130.70 - SPRAY-IN-PLACE POLYMERIC PIPE LINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. “Spray-in-place polymeric” pipe lining.
2. Pre-inspection and post-inspection closed camera television inspection of piping to be rehabilitated.
3. Cleaning, rehabilitation, removal of obstructions and protruding service connections prior to complete pipe lining rehabilitation.

B. Provide materials, labor, equipment, and QA/QC to clean, prepare, and apply a 100%-solids epoxy SIPP liner to the interior of existing pressure pipe to achieve an AWWA Class III design with inherent ring stiffness (semi-structural/interactive). The work includes flow bypassing, access, cleaning, lining, testing, disinfection, and commissioning. Class III means the liner has its hoop strength and does not rely on adhesion for pressure containment, while still interacting with the host pipe.

1.3 ABBREVIATIONS AND DEFINITIONS

A. SIPP: Spray-in-place polymeric.

B. CCTV: Closed-circuit television.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Discuss following as a preliminary meeting agenda:

1. Preparatory activities before installing SIPP materials, including submittals, delegated design, notification to property owners, material storage, videos, and other specified actions.
2. Installation and testing procedures.
3. Post installation activities, including videos, cleanup, and repairs.

1.5 ACTION SUBMITTALS

A. Product Data: Identify construction materials including resins and other system components. Identify manufacturer and their location for coating material, including recommended repair and patching procedures, if applicable.

B. Manufacturers' shipping, storage and handling recommendations for SIPP system components.

C. Safety Plan: Provide a Safety Plan identifying persons, a description of a daily safety program for job site and emergency procedures to be implemented in the event of a safety incident. Conduct work in accordance with submitted Safety Plan.

D. Quality Control Plan: Provide a detailed quality control plan (QCP) that fully represents and conforms to following as a minimum:

1. A detailed discussion of proposed quality controls to be performed.
2. Defined responsibilities to specific personnel for assuring that quality requirements for this Contract are met.
3. Define proposed procedures for quality control including those pertaining to fit and finish, and product sampling and testing.
4. Proposed methods for product performance controls, including method of and frequency of product sampling and testing both in raw material form and cured product form.
5. A schedule for performance and product test result reviews between Contractor and Owner/Engineer at a regularly scheduled job meeting.
6. Prepare inspection forms and guidelines for quality control inspections in accordance with specified standards and submitted with QCP.

E. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Identify work scope locations, construction details, pipe diameters, traffic control measures, and related activities.
3. Design package sealed by a Professional Engineer experienced in pressure-pipe renewal:

a. Liner class confirmation (Class III) and minimum finished thickness (MFT) calculation.
b. Design internal pressure ▶50 psi; test pressure ▶75 psi; surge/transients.
c. Host pipe data (material, ID, ovality, pits/voids, joints), gap/hole spanning checks, and ring stiffness basis.
d. Termination details (ends, appurtenances, services) and any local reinforcement.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

1. Installer:

a. References: Names and telephone numbers of contacts to verify previous satisfactory performance.
b. Work Description: Full description of work performed.

c. SIPP Coating Manufacturer and Supplier: Names for each referenced project.
d. Supervisor or Foreman / Lead Personnel: Verifiable references.

2. Manufacturer:

a. Names and Product Information: SIPP coating materials to be utilized for this project and their suppliers.
b. Certified Statement from Manufacturer: Contractor is an approved installer as certified or licensed by the SIPP lining manufacturer.

3. Testing Laboratory:

a. Name and address of laboratory.
b. Certified statement from laboratory indicating that they are independent from and not associated with Contractor in any way, and A2lA certification for independent testing laboratory.

B. Material Certificates: For each type of spray-in-place pipe lining.

C. Material Test Reports: For each spray-in-place pipe lining, by a qualified testing agency.

D. Product Test Reports: For each cured-in-place pipe lining, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. QA/QC plan: cleaning verification, DFT/DFW (dry film thickness/wet film), cure, holiday, adhesion, and water quality testing.

F. Source quality control reports.

G. Disposal reports. Submit documentation of the work that is performed and the type of debris removed, as well as landfill permits and disposal documentation.

H. Field quality-control reports.

I. Sample Warranty: For manufacturer's warranty.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Successfully installed a minimum of 250,000 feet of proposed SIPP lining in pipe of a similar size, length, and configuration as specified and documented by verifiable references.

a. Experience in Installing SIPP Lining: 5 years.
b. Municipal Clients: Minimum five clients that SIPP Contractor has performed specified type of work for without defects or performance problems for a period of five years after installation:

2. On-Site Superintendent or Foreman: Full-time supervisor of SIPP lining installation, having successfully installed a minimum of 100,000 feet of proposed size range of SIPP lining for a minimum of five years.
3. Lead Personnel: Including superintendent, foreman, and lead crew personnel each having a minimum of three years of total experience with SIPP technology proposed and demonstrating competency and experience as documented by verifiable references.

B. Manufacturer Qualifications:

1. SIPP Coating Manufacturers: Successfully supplied a minimum of 500,000 feet of proposed lining and one million pounds of coatings as documented by verifiable references.

C. Material Certifications:

1. Independent Testing Laboratory Analysis of Lining Materials: Five reports from projects within past two years showing modulus of elasticity as determined by appropriate ASTM standard, and flexural stress as determined by ASTM D790 standard.

D. Preconstruction mockup to demonstrate surface prep, application, and QA tests.

E. Third-party inspection for critical holds: post-prep, after each pass, and final cure.

F. Owner or Engineer reserves the right to approve or disapprove Contractor and staff and Manufacturer based on submitted qualifications and follow-up interviews.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Maintain SIPP lining materials at a proper temperature in refrigerated facilities to prevent premature curing prior to installation. Protect SIPP lining materials from UV light. Reject SIPP lining materials showing evidence of premature curing and immediately removed from site.

B. Inspections of SIPP lining materials may also be made by Engineer or other representatives of Owner after delivery. SIPP lining materials are subject to rejection at any time on account of failure to meet any of specified requirements, even though sample SIPP lining may have been accepted as satisfactory at place of manufacture. Mark rejected materials after delivery for identification and remove from the job site.

1.9 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of sprayed-in-place pipe lining that fail in materials or workmanship within specified warranty period.

1. During this period, serious defects discovered in SIPP lining, as determined by Engineer and which may materially affect the integrity, strength, function or pipe operation, must be removed and replaced as recommended by manufacturer in a satisfactory manner.
2. Remove and repair defects in a manner that is satisfactory to Owner and Engineer. Defects include but not limited to the following:

a. Leakage through lining or between lining and pipe.

b. Reduction of lining thickness of more than ten percent of thickness design. Deliver final lining thickness based on installed product physical properties and as specified in Contract Documents.
c. Structural strength below the required limits.

B. At its own expense, Owner may conduct an independent CCTV inspection of SIPP lining work prior to completion of warranty period. Defects replaced at that time must be fully warranted by Contractor and manufacturer for a period of two years from date the defect was repaired.

1. Repair or replace wrinkles in flow stream, blisters that may affect the longevity of SIPP lining or other defects that may affect the integrity or strength of the SIPP or the flow capacity of the pipe.
2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

1. Warren Environmental, Inc.
2. Inlining by Layne Inlining, Inc.
3. Insituform by Insituform Technologies, Inc.
4. National Lining by National EnviroTech Group LLC.
5. SAK Lining by SAK Construction LLC.
6. Sancon SIPP by Sancon Engineering Inc.
7. Invert-a-Pipe by Inland Pipe Rehabiliatation.
8. Premier Pipe USA.

B. Source Limitations: Obtain all components and accessories for SIPP system from single manufacturer or products from a secondary manufacturer as approved by primary manufacturer.

2.2 SYSTEM REQUIREMENTS

A. SIPP Lining and Appurtenances:

1. Removal of obstructions to complete SIPP rehabilitation. Complete removal of pipeline obstructions and protruding service connections required for sewer rehabilitation using sprayed-in-place pipe lining prior to pre-rehabilitation CCTV inspection.
2. Verify neither SIPP system nor its installation causes adverse effects to any of Owner’s processes or facilities.

a. Product use shall not result in formation or production of detrimental compounds or by-products in the system or at wastewater treatment plant.
b. Notify Owner and identify any by-products produced as a result of installation operations, test and monitor levels, and comply with local waste discharge requirements.

c. Cleanup, restore existing surface conditions and structures, and repair SIPP system determined to be defective. Conduct installation operations and schedule cleanup in a manner to cause minimize inconvenience to traffic, pedestrians, businesses, and property Owners or tenants.

3. Do not change any material, design values, or procedural matters stated or approved, without informing Engineer and receiving written approval of the change. Such changes constitute a breach of contract and will result in rejection and removal of work performed with unapproved materials or processes. Replace with new materials and specified requirements.

2.3 MATERIALS

A. EPOXY LINING MATERIALS

1. All SIPP epoxy lining materials shall be 2 part components consisting of a base and activator, which shall be stored in separate tanks, with their temperatures regulated in accordance with the epoxy manufacturers' recommendations. Material shall be 301-14 High Performance Epoxy, rated for solids and grit laden wastewater, as manufactured by Warren Environmental or approved equal.
2. Two-component, 100%-solids epoxy formulated for centrifugal/spray robotic application inside pressure pipe; 100% solids, solvent free, zero VOC, structurally enhancing epoxy proven safe for aquatic life.. Examples exist on the market (owner to approve equals), but the spec is performance-based.
3. Viscosity, pot life, recoat, and cure are compatible with ambient conditions and access length.
4. The standard application thickness for each lining shall be at least 3MM.
5. Material shall be stored in accordance with manufacturers' guidelines, any previously opened material needs to be thoroughly inspected prior to use.
6. Material must be NSF-61 potable water certified.
7. Color: Light color preferred for inspection.
8. Compatibility with Ductile Iron Pipe. AWWA C620 epoxy.

B. SAFETY

1. All SIPP Installation processes shall adhere to all MSDS sheets, manufacturer's safety guidelines and be performed within strict conformance of all Federal, State and Local agencies having jurisdiction.
2. All Proper and recommended protective equipment and clothing shall be worn at all times to ensure the safety of all working on the project.
3. All related work shall be expedited by trained teams. All employees are to be confined space certified with a minimum 10 hour OSHA training certification. All OSHA standards must be strictly adhered to.

2.4 EQUIPMENT

A. SIPP PIPE LINING EQUIPMENT

1. Computer-controlled SIPP rig with rotational spray head and linear travel control, capable of consistent MFT over the specified pipe.
2. Surface prep tools: mechanical cleaning (abrasive blast or equivalent) to achieve the specified profile; debris capture and HEPA filtration.
3. SIPP Pipe Lining Rig shall be a computerized and fully automated capable of lining up to 600 feet in one lining application.
4. SIPP Pipe Lining spray head shall be able to spray material at 10,000 rpm and apply an epoxy coating evenly throughout the entire length of pipe that is in the contracted scope of work. Model to be proprietary and capable of lining varying pipe sizes during one lining pass applying an even thickness throughout each varying pipe dimension.
5. The Pipe Lining Equipment will be controlled with a computer operated system control that will monitor the flow characteristics of the lining material as it flows through the machine for constant quality control. The system will have automatic alarms in place to allow the machine to abort lining should any abnormalities occur during the process.

B. VIDEO INSPECTION EQUIPMENT

1. Real-time logging of travel speed, pump pressures, mix ratio, and WFT.
2. A CCTV Camera shall be able to enter the pipe of varying sizes larger than 1 1/4 inches, and travel throughout recording video, images and profiles to be used in programming of the lining rig for the lining application. The camera shall be in full color and have adjustable light to be able to see all areas of the interior of the pipe to be lined.

2.5 SOURCE QUALITY CONTROL

A. Provide SIPP lining materials from a single source.

B. Owner or an agent of Owner may inspect SIPP lining manufacturing. Give Owner or its agent an opportunity to witness manufacturing of project SIPP lining materials. Provide full access to witness process and provide information related to manufacturing as requested by Owner or Owner’s agent without delay and without claims of confidentiality or product privacy

C. Owner is responsible for costs associated with witnessing the manufacturing and plant inspection of SIPP linings.

PART 3 - EXECUTION

3.1 PREPARATION

A. The Contractor is responsible to procure water as necessary for this work. Obtain approval from Owner, Engineer, and Owner’s Contract Operator for use of existing facilities.

B. Clean each length of pipe to be lined and dispose of resulting residual material offsite in a manner acceptable to Owner and Engineer. Remove tuberculation and deposits; achieve

substrate cleanliness/profile suitable for epoxy per manufacturer (typically near-white metal for ferrous; sound, open-pore surface for concrete).

C. Conduct a pre-rehabilitation CCTV inspection of piping to be rehabilitated by SIPP lining methods. Perform inspection to identify pipe defects, to document location of valves, fittings, and to confirm point repair locations.

1. Ensure project manager or superintendent review of pre-rehabilitation inspection videos to confirm its quality, locations of valves and fittings, and locations of point repairs to be performed using compatible filler before lining (or account for gap spanning in design).

D. Submit video only after confirmation that quality is adequate for a clear review of pipeline. Engineer will review pre-rehabilitation inspection videos to confirm locations of point repairs to be performed. If an Inspector or Engineer is on site or immediately available, allow viewing of pre-installation video to verify the pipe is ready for SIPP installation which includes proper cleaning, trimming protruding taps, and mitigating significant infiltration.

E. Provide SIPP lining in full length of force main as shown on work orders.

3.2 PIPE CLEANING AND SURFACE PREP

A. An opening at both ends of the subject pipe for access is required to allow access and egress for cleaning equipment.

B. Surface preparation methods shall be based upon the conditions of the substrate and the requirements of the spray in place pipe lining system.

C. Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before the application of any coating material.

D. Protection of Surfaces Not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

E. Care shall be exercised not to damage adjacent WORK during blasting operations. Spraying shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blasting or coating operations.

F. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly coated surfaces.

G. Available methods include but are not limited to Hydro-jetting, pigging and brushing.

H. Upon completion of the cleaning process the pipe shall be showered with compressed air to remove any leftover debris

I. Properly dispose of all sanitary debris and material from cleaning, preparation, inspection, and SIPPL operations.

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3.3 INSTALLATION

A. Install SIPP lining via self-propelling lining device or via operator controlled application rig.

B. Closely follow requirements in submitted lining reports, including minimum inversion pressure, ideal head, maximum hot head, and maximum cold head for each installation.

C. Vent or exhaust noxious fumes or odors generated during and remaining after curing process is completed. Remain process in place until noxious odors have dissipated to an acceptable level in accordance with OSHA requirements for materials used. Maintain until there is no more air pollution or potential health hazard left to general public or construction workers.

D. All surfaces shall be inspected during and after preparation and before application of the monolithic surfacing system. Any evidence of remaining contamination or laitance shall be removed by high-pressurewater, abrasive blast, or other approved method before proceeding with applying the monolithic surfacing system.

E. The epoxy coatings shall be placed and cured in a single application.

F. Application procedures shall conform to the recommendations of the structural epoxy manufacturer, including material handling, mixing, and environmental controls during the application, safety, and equipment.

G. The equipment shall be specially designed to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.

H. The specified materials must be applied by manufacturer-approved workmen.

I. All specified surfaces will be coated with the structural epoxy system to provide a minimum total thickness of 250 mils for rehabilitated structures and 125 mils for new concrete structures. The epoxy liner shall be monolithic with proper sealing of connections to all unsurfaced areas and shall be placed and cured in one application.

3.4 LINING

A. The pipe matrix will be entered into the computer control system, mapping any abnormalities and/or imperfection into the pipe. This will allow the controls of the system to apply more or less epoxy material at the particular points noted.

B. The pipe is to be lined using the entrance and exit as needed along the matrix.

C. The SIPP Lining Rig shall have the umbilical pulled the length of the pipe to be lined where the spray head will be attached, capable of lining up to 600 feet in one pass.

D. The lining head will be implemented in an enclosure at the exit of the pipe matrix. The material flow and mix ratio will be checked for abnormalities as a final physical quality control measure prior to the lining head's entry.

E. The lining head is entered into the pipe matrix and is then left to automated controls of the SIPP Lining Machine. The computer control system is monitored by a pipe lining engineer during the

entire process. The system is monitored at the opening of the pipe as well as monitored from the pipe entrance.

F. During the lining process the Computer control system is required to print off a quality assurance report at a minimum of every 20 seconds. This report must include current mix ratio of material, pressure at which the material is applied, temperature of material, flow rate of material, distance currently in pipe and thickness of material currently being applied to the pipe.

3.5 FIELD TESTING AND ACCEPTANCE

A. Base field acceptance of SIPP lining on Owner's and Engineer's evaluation of installation, including a review of SIPP lining curing data, review of post-rehabilitation CCTV inspection data, and review of certified test data for installed SIPP lining. Complete SIPP sample testing and repairs to installed SIPP before final acceptance, meeting requirements of these specifications and documented in written form.

B. For every 1,000 linear feet of SIPP lining installed, perform sampling and testing to determine installed SIPP lining flexural properties and SIPP lining thickness.

1. Frequency of testing may be reduced as approved by Engineer after sufficient tests are performed to verify SIPP lining design, production, and installation procedures.
2. Thickness: Magnetic DFT measurements at all joints ad midway point of all pipe sections; acceptance ≥ MFT with no local <90% MFT.
3. Holiday testing: 100% of the lined surface using a calibrated high-voltage spark tester; voltage set per thickness; repair and re-test. (AWWA C620 includes inspection provisions; follow the manufacturer and standard.)
4. Adhesion tests to be performed on cast iron or ductile iron plate samples taken at the time of spray: pull-off tests (ASTM D4541) where required; report values; repairs as needed.
5. Hydrostatic/pressure test: Hold at test pressure 75 psi for 2 hr; no leakage/pressure loss beyond 1 psi.

C. Frequency of testing may be increased by Engineer when required tests show that installed SIPP lining does not meet specifications. Where tests fail, reevaluate lining thickness design to determine if installed physical properties meet minimum design requirements. Replace and reline with approval from Engineer without additional compensation.

D. Perform a post-rehabilitation CCTV inspection of force main rehabilitated using SIPP lining methods. Perform post-rehabilitation CCTV inspection following installation of SIPP lining. Review post-rehabilitation inspection videos to confirm the quality of videos and of installed SIPP. Only after confirmation that videos are of good quality, submitted to Engineer. If it is determined that repairs are needed at any segment, perform a new CCTV inspection of the entire segment after completing repairs.

END OF SECTION 330130.70

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SECTION 400506 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe penetrations.
2. Flexible connections.
3. Expansion joints.
4. Sleeve-type couplings.
5. Flange adapter.
6. Dismantling joint.
7. Cartridge filters

B. Related Requirements:

1. Section 055000 “Metal Fabrications”: Miscellaneous metalwork and fasteners as required by this Section
2. Section 078400 “Firestopping”: Penetrations through fire-rated materials
3. Section 079000 “Joint Protection”: Sleeve sealant for pipe penetrations
4. Section 099679 “Atmospheric Protection and Plant Service Areas Coatings”: For painting and coatings product and execution requirements.
5. Section 331300 “Disinfecting of Water Utility Distribution”: Disinfection of potable water piping
6. Section 400507 “Hangers and Supports for Process Piping”: Hangers, anchors, sleeves, and sealing of piping to adjacent structures
7. Section 400519 “Ductile Iron Process Pipe”: Ductile-iron piping materials and appurtenances
8. Section 400523 “Stainless Steel Process Pipe and Tubing”: Stainless steel piping materials and appurtenances
9. Section 400524 “Steel Process Pipe”: Steel piping materials and appurtenances
10. Section 400531 “Thermoplastic Process Pipe”: Plastic piping materials and appurtenances
11. Section 400551 “Common Requirements for Process Valves”: Common product requirements for valves for placement by this Section
12. Section 404213 “Process Piping Insulation”: Piping insulation as required by this Section.

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1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): The sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.

B. FM: Factory Mutual Insurance Company; FM Global is the communicative name of the company.

C. WH: Warnock Hersey; indicates compliance to relevant building codes, association criteria, and product safety and performance standards.

1.4 COORDINATION

A. Coordinate Work of this Section with installation of piping, valves and equipment connections specified in other Sections and indicated on Drawings.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Submit manufacturer catalog information for each specified product, including installation instructions.
2. Firestopping: Submit data on product characteristics, performance, and limitation criteria.
3. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
4. Expansion Joints: Indicate maximum temperature, pressure rating, and expansion compensation.

B. Shop Drawings:

1. Identification:

a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
b. Comply with ASME A13.1.

2. Indicate restrained joint details and materials.
3. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
4. Indicate layout of piping systems, including flexible connectors, expansion joints and compensators, loops, offsets, and swing joints.

C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings for maintenance of fire-resistance rating of adjacent assembly.

1.6 DELEGATED DESIGN SUBMITTALS

A. Submit signed and sealed Shop Drawings with design calculations and assumptions for:

1. Flexible connectors
2. Expansion joints
3. Pipe Restraints:

a. Determine restrained lengths and submit joint restraint details.
b. Use joint restraint devices specifically designed for applications as described in manufacturer data.

4. Firestopping Engineering Judgments: For conditions not covered by UL- or WH-listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction to accept as meeting fire-protection code requirements.

1.7 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

C. Manufacturer Instructions: Submit special procedures and setting dimensions.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.
3. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.
4. American Iron and Steel (AIS): Submit certification indicating compliance with requirements.

1.8 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.9 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.

B. Perform Work according to ASME B31.9 for installation of piping systems and according to AWS D1.1/D1.1M for welding materials and procedures.

C. Perform Work according to ASME B31.3 for installation of piping systems.

D. Through-Penetration Firestopping of Fire-Rated Assemblies:

1. Comply with UL 1479 or ASTM E814.
2. Minimum Positive Pressure Differential: 0.1-inch wgto achieve fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
3. Wall Penetrations: Fire F-ratings as indicated on Drawings, but not less than one hour.
4. Floor and Roof Penetrations:

    a. Fire F-ratings and Temperature T-ratings: As indicated on Drawings, but not less than one hour.
    b. Floor Penetrations within Wall Cavities: T-rating is not required.

E. Through-Penetration Firestopping of Non-fire-rated Floor and Roof Assemblies:

1. Materials to resist free passage of flame and products of combustion.
2. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
3. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

F. Fire-Resistive Joints in Fire-Rated Floor, Roof, and Wall Assemblies:

1. Comply with ASTM E1966 or UL 2079.
2. Rating: As indicated on Drawings for assembly in which joint is installed.

G. Fire-Resistive Joints between Floor Slabs and Exterior Walls:

1. Comply with ASTM E119.
2. Minimum Positive Pressure Differential: 0.1-inch wg to achieve fire-resistance rating as indicated on Drawings for floor assembly.

H. Surface-Burning Characteristics: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

C. Welders: AWS qualified within previous 12 months for employed weld types.

D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of New York.

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1.11 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.12 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

A. Furnish one-year manufacturer's warranty for products supplied under this Section.

PART 2 - PRODUCTS

2.1 PIPE PENETRATIONS

A. Performance and Design Criteria:

1. Firestopping Materials: As specified in Section 078400 “Firestopping”.
2. Firestop interruptions to fire-rated assemblies, materials, and components.
3. Firestopping: Provide certificate of compliance from authority having jurisdiction, indicating approval of materials used.

2.2 PIPE SLEEVES

A. All construction except new concrete walls:

1. Material: Schedule 40 galvanized steel conforming to ASTM A53.
2. 2-inch minimum circumference water stop welded on both sides to exterior sleeve at midpoint of wall
3. Ends cut and ground to be:

a. Flush with ground.

b. Flush with ceiling.
c. 2 inches above finished floors.
d. Sealed with caulking.
e. Sized as required.

B. New concrete walls with pipes up to 20 inches in diameter:

1. Material: non-metallic High-Density Polyethylene Sleeves (HDPE).
2. Integral hollow molded water stops.

a. 4 inches larger than the outside diameter of the sleeve.

3. End caps for forming and reinforcing ribs.
4. Century-Line as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

C. New concrete with pipes 20 to 60 inches in diameter:

1. Material: molded HDPE modular interlocking discs to make the width of the wall

a. Corrugated to prevent water migration between sleeve and concrete.
b. Cell-Cast as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

D. External wall penetrations:

1. 36 -in diameter and less may be made by means of a ductile iron sleeve capable of being bolted directly to the formwork:
2. Seal of the annular space between the carrier pipe and the sleeve made by means of a confined rubber gasket and be capable of withstanding 350 psi.:
3. Sleeve to have an integrally cast waterstop of 1/2-in minimum thickness, 2-1/2-in minimum height.
4. Manufacturers: Omni-Sleeve, Malden, MA or equal.

2.3 WALL CASTINGS

A. Ductile iron conforming to ANSI/AWWA A21.51/C151, thickness Class 53.

B. Diameter as required.

C. Flanges and/or mechanical joint bells drilled and tapped for studs where flush with the wall.

D. Castings provided with a 2-in minimum circumferential flange/waterstop integrally cast with or welded on both sides to the casting.

E. Located as follows:

1. For castings set flush with walls: located at the center of the overall length of the casting,
2. For castings which extend through wall: located within the middle third of the wall.

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2.4 SEALING MATERIALS

A. Mechanical seals:

1. Of rubber links shaped to continuously fill the annular space between the pipe and the wall opening or sleeve.
2. Link pressure plates molded of glass reinforced nylon:

    a. Colored throughout elastomer.
    b. Permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element.

3. Hardware:

    a. Mild steel with a 60,000 psi minimum tensile strength.
    b. 2-part Zinc Dichromate coating per ASTM B-633.
    c. Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test.
    d. Use Type 316 Stainless Steel hardware:

        1) In chemical areas.
        2) For submerged service.
        3) For penetrations in tanks containing sludge or wastewater.

4. Completed sealing system:

    a. Duty pressure rated for 20 psig differential pressure.
    b. EPDM for all services except fire rated assemblies

        1) Fire rated seals use silicone link material.

    c. Manufacturers:

        1) PSI-Thunderline/ Link-Seal as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or pre-approved equal.
        2) Advance Products & Systems, Inc.
        3) Fernco Inc.
        4) Flexicraft Industries.
        5) GPT; an EnPro Industries company.

B. Sealant:

1. A two-part foamed silicone elastomer manufactured by:

    a. Dow Corning Co., Product No. 3-6548 silicone R.T.V.
    b. 3M brand fire barrier products caulk C.P. 25 and 3M brand moldable putty MP+.
    c. Flame-Safe fire stop systems FS-900 by Rectorseal.

2. Sealant bead configuration, depth and width in accordance with manufacturer's recommendations.

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2.5 MISCELLANEOUS MATERIALS

A. Bonding Compound:

1. Sikadur Hi-Mod epoxy by Sika Corp.
2. Euco 452 by Euclid Chemical Corp.; Master Builders Company.
3. Or equal.

B. Non-shrink grout:

1. Masterflow 713 by Master Builders Co.
2. Euco NS by Euclid Chemical Co.
3. Five Star Grout by U.S. Grout Corp.
4. Or equal.

C. Escutcheon plates: Stainless steel as manufactured by Kohler, American Standard, or equal.

2.6 FLEXIBLE CONNECTIONS

A. Manufacturers:

1. For pressure pipe applications and applications with steel and copper piping:
2. Flexicraft Industries, Chicago, IL;
3. Hyspan Precision Products, Inc.;
4. Metraflex Company, Chicago, IL; Victaulic Company, Easton, PA or equal.
5. Flex-Weld, Inc.
6. For non-pressurized applications involving plastic, clay, asbestos cement, or cast iron applications: Fernco or equal.

B. Non-Pressurized Piping (Plastic, Clay, Asbestos Cement, Cast Iron utilized under 4.3 psig)

1. Flexible couplings: in accordance with ASTM D 5926, C1173 and CSA B602.
2. Couplings: rubberized PVC and be attached with the use of adjustable stainless steel clamps.

2.7 SERVICE CLAMPS

A. Manufacturers:

1. GE Oil & Gas (Dresser Industries)
2. Xylem (Smith-Blair)
3. Mueller. or equal.

B. Service clamps on ductile iron piping systems with outlets up to 2-inches as shown on the Drawings to have malleable or ductile iron bodies that extend at least 160 degrees around the circumference of the pipe and have EPDM gasket cemented to the saddle body. Bodies to be tapped for IPS. Clamps to have double straps.

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2.8 SLEEVE-TYPE COUPLINGS

A. Manufacturers:

1. GE Oil & Gas (Dresser).
2. Xylem (Smith-Blair).

B. Description: Provide products by one of the following or equal.

1. Description: To connect two plain end pipes.
2. Comply with AWWA C213, C219.
3. Working Pressure Rating: 200 psi.
4. Middle Ring: ASTM A-536, Grade 65-45-12, ductile iron.
5. Followers: ASTM A-536, Grade 65-45-12, ductile iron.
6. Gaskets:
    a. Material: Butyl rated for a maximum temperature of 250 deg F and compatible with service conditions.
    b. Comply with ASTM D2000.
7. Bolts: ASTM A307 galvanized steel.

C. Finishes:

1. Factory fusion bonded epoxy coated.

2.9 QUICK CONNECT COUPLINGS

A. Provide quick connect couplings on flushing connections or temporary water connections as shown on the Drawings. Quick connects to be of the cam and groove type consisting of male and female adapters conforming to A-A-59326 (MIL-C-27487) with hose shanks. Couplings to be constructed of aluminum, with EPDM seal material. Male adapter to connect to the pipe via. threaded connection and designed to receive a female coupler without threading, bolting and tools. Connection to remain tight and leakproof under pressure up to 100 psig.

2.10 CARTRIDGE FILTERS

A. Manufacturers:

1. Filter Housing Assembly:
    a. CT Series manufactured by CUNO 3M, Meriden, Connecticut.
    b. Or equal.
2. Filter Cartridges:
    a. Micro-Klean III manufactured by CUNO 3M, Meriden, Connecticut.
    b. Or equal.

B. Description

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1. Filter Housing Assembly:

    a. Cartridge filter housing, cover, internals and all wetted parts: Type 316 stainless steel.
    b. All interior and exterior surfaces chemically passivated after fabrication.
    c. Vessels: Screw-on head equipped with nitrile gasket seals.
    d. Inlet and outlet connections: NPT threaded adhering to ASME B1.20.1.
    e. With ¼-inch NPT Type 316 stainless steel vent plug for air removal. Vent plug equipped with fiber gaskets.
    f. Housings capable of operating up to 300 psig at 200 degrees F, at 5 gpm.

2. Filter Cartridge

    a. Rigid resin bonded construction consisting of acrylic fibers and phenolic resin.
    b. Rated at 150 microns with a specific pressure drop of 0.0031 psid/gpm-Cp or less.
    c. Cartridge length 9.75 inches in one element, not composed of stacked up elements of shorter length.
    d. Temperature rating: 180 degrees Fahrenheit.

2.11 INSULATION

A. As specified in Section 404213 “Process Piping Insulation”.

2.12 RESTRAINED FLANGE ADAPTER

A. Manufacturers:

1. GE Oil & Gas (Dresser), Style 128-W.
2. Xylem (Smith-Blair), Type 913.
3. Romac Industries 491.

B. Description:

1. To connect a plain end pipe to a pipe flange.
2. Max. Pressure Rating: 150 psi.
3. Complies with AWWA.
4. Body & Flange: Ductile iron.
5. Follower: Ductile iron coupling with AISI C1012 or ASME SA36.
6. Wedge Gasket: Buna N.
7. Bolts & Nuts: High strength, low alloy steel.
8. Harness Lugs: ASTM A36 Steel
9. Tie rods: Alloy steel or stainless steel per ASTM A193
10. Finish: Factory bonded epoxy coated.

2.13 DISMANTLING JOINT

A. Manufacturers:

1. GE Oil & Gas (Dresser), Style 131.

2. Xylem (Smith-Blair), Type. 975
3. Romac Industries, Model DJ400.

B. Description:

1. Double ended flanged adapter that allows for longitudinal adjustment between flanges and quick removal.
2. Max. Pressure Rating: 150 psi.
3. Complies with AWWA.
4. Body & Flange: Ductile iron A536 or A36 steel.
5. Follower: Ductile iron A536 or A36 steel coupling with AISI C1012.
6. Wedge Gasket: Buna N or S.
7. Bolts & Nuts: High strength, low alloy steel.
8. Tie-Rods: Required.
9. Finish: Factory bonded epoxy coated."

2.14 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assemblies.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolthole configurations or design and verify that new pipe and flanges mate properly.

C. Verify that openings are ready to receive sleeves and firestopping.

D. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches from pipe ends.

E. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

A. Cleaning: Thoroughly clean end connections before installation.

B. Close pipe and equipment openings with caps or plugs during installation.

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C. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. Coating: Finish piping appurtenances as specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coatings” for service conditions.

B. Pipe Penetrations:

1. Flashing:

a. Provide flexible flashing and metal counterflashing where piping penetrates weatherproofed or waterproofed walls, floors, and roofs.
b. Flash floor drains with topping over finished areas with lead, 10 inches clear on sides, with minimum 36-by-36-inch sheet size.
c. Fasten flashing to drain clamp device.

2. Sleeves:

a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
b. Set sleeves in position in forms and provide reinforcement around sleeves.
c. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
d. Extend sleeves through floors 1 inch above finished floor level and calk sleeves.
e. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent Work with stuffing or firestopping insulation and calk airtight.
f. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.
g. Install stainless-steel escutcheons at finished surfaces.

C. Firestopping:

1. Materials: As specified in Section 078400 “Firestopping”.

D. Restrained Joints: As shown on drawings.

E. Air Release and Vacuum Breakers: Provide vacuum breakers as indicated on Drawings.

F. Backflow Preventers:

1. Install with nameplate and test cock accessible.
2. Install according to local code requirements.
3. Do not install in vertical position.

G. Insulation: As specified in Section 404213 “Process Piping Insulation”.

H. Disinfection: Disinfect potable water piping as specified in Section 331300 “Disinfecting of Water Utility Distribution”.

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3.4 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences.

B. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

A. Keep equipment interior clean as installation progresses.

END OF SECTION 400506

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SECTION 400507 - HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section 013500 “Submittal Procedures”: Requirements for submittals.

B. Seismic Design and restraint requirements, in accordance with the Structural Design criteria.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's catalog data including load capacity.

B. Shop Drawings: Submit scaled piping layouts for each system. Indicate flow stream, pipe size(s) material(s), schedule(s), lining(s), critical dimensions between pipes, equipment and building features. Indicate by schedule pipe hanger/support type and locations. Provide detail of each type of hangers, supports, anchors, and guides in coordination with the submitted piping layouts and existing building conditions.

1.4 DELEGATED DESIGN SUBMITTALS

A. Delegated-Design Submittal: For hangers and supports for piping; Section 014000 “Quality Requirements” for additional delegated design requirements.

1. Supports shown in the Contract Drawings shall be considered diagrammatic and representative, and are shown for general coordination only. Not all required supports are indicated. The Contractor is responsible for a complete pipe support system per the delegated design requirements presented herein.
2. Engage the services of an independent registered professional engineer licensed in the State of New York ordinarily engaged in the business of pipe support systems analysis and design, to analyze system piping and service conditions, and to develop a detailed support system design, specific to the piping material, pipe joints, valves, and piping appurtenances proposed for use.

    a. Support system engineering groups include the following:
        1) SAC Incorporated https://www.sacincorporated.com/contact-us/
        2) Fenny Engineering http://www.fennyengineering.com/contact/
        3) Piping Solutions and Energy Associates https://www.pseassoc.com/request-for-service/
        4) Newman Associates https://newmanassoc.com/

3. The support system design shall include:

    a. Criteria by piping system.
    b. Summary of Contractor-selected related components including joints, class, valves, appurtenances, etc., and commercial supports and especially including pipe materials.
    c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to Bentley Systems AutoPIPE or SST Systems CAEPIPE.

        1) Present each system in an isometric graphic and show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints, and expansion/flexible joints.

    d. Submit support system design to the Engineer for review. The submittal needs to be stamped by a professional engineer registered in New York.

4. Coordinate support arrangements to eliminate interference with similar systems to be installed under HVAC, Plumbing, and Electrical, to account for structural expansion joints and to maintain access for both personnel and for the removal of equipment.

B. Manufacturers' Instructions: Submit special procedures and assembly of components.

C. Qualifications Statement: Submit qualifications for licensed professional.

1.5 DELIVERY, STORAGE AND HANDLING

A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.

B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.

C. Finished metal surfaces not galvanized, that are not of stainless-steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.

B. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

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PART 2 - PRODUCTS

2.1 MATERIALS

A. Metallic Pipe Support:

1. Submerged, buried, or within outdoor structures (vaults, etc.): Type 316 stainless steel (SS).
2. Within chemical areas: Vinyl ester fiberglass reinforced plastic (FRP) for pipe size up to 2 inch, epoxy coated steel for 2-1/2 inches size and larger.
3. Other locations: steel with galvanizing where noted, or if not otherwise noted, coating as required in Division 09 Finished Painting.
4. Additional requirements (including dielectric insulation) in ACCESSORIES Article.

B. Non-Metallic Pipe Support:

1. Submerged, buried, or within vaults: Type 316 stainless steel or FRP.
2. Within chemical areas: vinyl ester FRP.
3. Other locations: steel with galvanizing where noted, or if not otherwise noted, coating as required in Division 09 Finished Painting; all with local stress protection shields.
4. Additional requirements (including stress protection shields) in ACCESSORIES Article.

C. Wherever stainless steel is noted, it shall be Type 316 unless noted otherwise.

2.2 INSULATION

A. See ACCESSORIES Article and Drawings.

B. Section 404213 “Process Piping Insulation” for process piping insulation requirements.

2.3 SUPPORT AND RESTRAINT SYSTEMS

A. Steel or Ductile Iron Piping:

1. Cast iron and ductile iron, steel, and stainless-steel piping shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints, unless the Contract Drawings dictate larger spacings in coordination with existing conditions and the pipe stress analysis node locations.
2. Support spacing for ductile iron, steel, and stainless-steel piping 2-inch and smaller diameter shall not exceed 5 feet.

B. Copper Piping:

1. Supports for copper pipe shall be copper plated or shall have a 1/16 inch plastic coating.
2. Support spacing for copper piping and tubing 2 inch and smaller diameter shall not exceed 5 feet and greater than 2 inch diameter shall not exceed 8 feet.
3. Where pipe supports come in contact with copper piping, provide protection from galvanic corrosion by: wrapping pipe with 1/16 inch thick neoprene sheet material and

galvanized protection shield; isolators similar to Cooper B-Line B3195CT; or copper-plated or PVC-coated hangers and supports.

C. Non-Metallic Piping:

1. All uninsulated non-metallic piping such as PVC, CPVC, HDPE, PVDF, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by non-metallic protection shields or other method as approved by the Engineer.

    a. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference. All U-bolts or clamps for non-metallic pipes shall be plastic coated.
    b. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2 inch wide.

2. Individually supported PVC pipes shall be supported as recommended by the pipe manufacturer except that support-spacing shall be manufacturers recommendation minus 2-ft. down to 5 ft spacing recommendation, then spacing shall be 3 feet.
3. Supports for horizontal multiple PVC plastic piping:

    a. Shall be continuous wherever possible.
    b. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as: Husky Ladder Flange Out by MPHusky; or equal.
    c. Rung spacing shall be 12 inches. Tray width shall be approximately 6 inch for single runs and 12 inches for double runs.
    d. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to: Globe, Series 600; Unistrut Pipe/Conduit Clamps and Hangers; or equal.
    e. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

D. Framing Support System:

1. See Part 2 MATERIALS for materials of construction.
2. Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.
3. Column Members: Size in accordance with manufacturer's recommended method.
4. Support Loads: Calculate using weight of pipes filled with water.
5. Maximum Spans:

    a. Steel and ductile iron pipe 3 inch diameter and larger: 10 feet centers, unless the Contract Drawings dictate larger spacings in coordination with existing conditions and the pipe stress analysis node locations.

b. Other pipelines and special situations: Same as noted in previous paragraphs. Supplementary hangers and supports may be required.

E. All vertical pipes shall be supported at each floor or at intervals of not more than 12 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

2.4 ANCHOR BOLTS/SYSTEMS

A. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear, and pullout loads imposed by loading and spacing on each particular support. DO NOT USE ADHESIVE ANCHOR BOLTS ON ANY PIPE SUPPORT HUNG FROM A ROOF OR CEILING, unless specifically noted otherwise.

B. All post-installed anchors in concrete shall have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete.

C. The latest edition of the following specification and recommended practices shall become part of this specification as if written herein. Wherever requirements conflict, the more stringent shall govern.

1. ACI 318, Appendix D.
2. ACI 355.2, Mechanical Anchors “Qualification of Post-Installed Mechanical Anchors in Concrete”
3. Anchor manufacturer’s published installation requirements.

D. Expansion Anchors:

1. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1 inch behind the steel reinforcement.
2. Manufacturers:

a. Power-Stud+ SD4 and Power-Stud+ SD6 by Powers Fasteners, Brewster, NY.
b. Kwik Bolt as manufactured by Hilti USA, Tulsa, Oklahoma.
c. Wej-it by Wej-it Expansion Products, Inc., Broomfield, Colorado.

E. Unless otherwise noted: use Type 304 stainless steel anchoring parts/bolts and hardware for non-submerged supports, Type 316 stainless steel for submerged anchors.

F. Size of anchor bolts as designed by manufacturer, 1/2 inch minimum diameter, or as shown on the Drawings.

G. Anchors to concrete in chemical areas shall be epoxy secured vinyl ester FRP all thread, insertion depth and size as required by the manufacturer for the design loads. Nuts, bolts and hardware shall all be vinyl ester FRP construction.

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2.5 HANGER RODS

A. Where use of steel is allowed, hanger rods shall be hot-rolled steel, machine-threaded, and, except for stainless steel, galvanized after fabrication. The strength of the rod shall be based on its root diameter.

1. Hanger rods shall be attached to concrete structures using single or continuous concrete inserts by the named support manufacturers above. Where use of steel is allowed, inserts shall be malleable iron or steel with galvanized finish.
2. Beam-clamps, C-clamps, or welded-beam attachments shall be used for attaching hanger rods to structural steel members.

B. Minimum rod size for metallic rod hangers: (* For pipe diameters less than 14 inch, if using pipe roller, use 2 hanger rods with minimum diameter noted below for pipe's diameter).

	Nominal Pipe / Tube Diameter	Minimum Hanger Rod Diameter
1	Less than 2-1/2 inch	1/4 inch*
2	3 to 8 inches	1/2 inch
3	10 to 14 inches	3/4 inch*
4	16 to 20 inches	2 at 1 inch
5	24 inches	2 at 1-1/4 inch
6	30 inches	2 at 1-1/2 inch

2.6 SINGLE PIPE HANGERS

A. Unless otherwise indicated, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-41, 58, or 69 and shall be of the following type:

1. Anvil International.
2. Equal models by: Carpenter & Patterson, Inc., Wobum, MA.
3. Cooper B-Line.
4. Gulf State Manufacturing.
5. Unistrut Northeast, Cambridge, Massachusetts.
6. CADDY; nVent.
7. Carpenter & Paterson, Inc.
8. Empire Industries, Inc.
9. Globe Pipe Hanger Products Incorporated.
10. Haydon Corporation.
11. Hilti, Inc.
12. NIBCO INC.
13. PHD Manufacturing, Inc.
14. PHS Industries, Inc.
15. Unitron Product, Inc. / US-Strut.

B. Single pipes shall be supported by hangers suspended by hanger rods from structural steel members, concrete ceilings, bottom of trapeze hangers, and wall-mounted steel angle brackets.

C. Where pipes are near walls, beams, columns, etc., and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson, Figure Nos. 68, 79, 84, or 139 shall be used for hanging pipe. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.7 MULTIPLE PIPE HANGERS

A. Suspended multiple pipes, running parallel in the same horizontal plane that are adjacent to each other, shall be suspended by trapeze type hangers or wall brackets. Where use of steel is allowed, trapeze hangers shall consist of galvanized structural steel channel supported from galvanized threaded rod or attached to concrete walls, columns, or structural steel support members. See previous paragraphs about multiple PVC pipe supports.

B. Except as otherwise specified herein, pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs similar to:

1. Anvil Fig. 175.
2. Cooper B-Line B3147A or B3147B.
3. Where use of steel is allowed, material of construction shall be galvanized steel. Chair U bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.8 SINGLE PIPE SUPPORTS FROM BELOW

A. Single pipes located in a horizontal plane close to the floor shall be Pedestal type: Schedule 40 pipe stanchion, saddle, and anchoring flange.

1. Nonadjustable Saddle: MSS SP 58, Type 37 with U-Bolt.

   a. Anvil, Figure 259.
   b. Cooper B-Line, Figure B3090.

2. Adjustable Saddle: MSS SP 58, Type 38 without clamp.

   a. Anvil, Figure 264.
   b. Cooper B-Line, Figure B3093.

B. Pipes less than 3 inch in diameter:

1. Hold in position by supports fabricated from steel C channel, welded post base similar to Unistrut, Figure P2072A, where use of steel is allowed; and pipe clamps similar to Unistrut, Figures P1109 through 26.

2. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected by horizontal member of sufficient load capacity to support pipe.
3. Fasten supports to nearby walls or other structural member to provide horizontal rigidity.
4. More than one pipe may be supported from a common fabricated support.

C. Pipes 3 inch in diameter and larger:

1. Support by adjustable stanchions.
2. Provide at least 4 inch adjustment.
3. Flange mount to floor.

D. Use yoked saddles for piping whose centerline elevation is 18 inch or greater above the floor and for all exterior installations.

E. Pipe roller type supports shall be used where required to accommodate thermal movement in conjunction with axial supports.

2.9 WALL SUPPORTED SINGLE AND MULTIPLE PIPES

A. Single or multiple pipes located adjacent to walls, columns, or other structural members shall be supported using welded steel wall brackets, where use of steel is allowed, as manufactured by Carpenter and Patterson, Figure No. 69, 84, or 139.

B. Where noted, multiple pipes may be supported on C-channel with steel brackets similar to Unistrut pipe clamps; with pipe anchor chairs; or equal.

C. Individual pipes, up to 8-in diameter, where noted, may use MSS Type 8 pipe clamps as noted on the Drawings.

D. Securely fasten all members to wall, column, etc., using double-expansion shields or other method as approved by the Engineer. Provide additional wall bearing plates as required.

2.10 BASE ANCHOR SUPPORT

A. Bend Support: Where pipes change direction from horizontal to vertical via a bend, install a welded or cast base bend support to carry the load. Fasten to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.

B. Concrete Supports: Where indicated, securely fasten pipe bends to concrete supports with suitable metal bands as required and approved by the Engineer. Isolate piping from poured concrete with a neoprene insert.

2.11 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut type system as specified, they shall be supported in one of the following methods.

1. For pipes 1/4 to 2 inch in diameter:

a. Provide extension hanger ring with an extension rod and hanger flange.
b. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported.
c. Where use of steel is allowed, the hanger ring shall be steel- or PVC-clad depending on the supported pipe material of construction. The hanger ring shall be equal to Carpenter & Patterson, Figure Nos. 81.
d. Where use of steel is allowed, the anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson, Figure No. 85.

2. For pipes equal to or greater than 2 inches in diameter:

a. Extended pipe clamps similar to Carpenter & Patterson, Figure No. 267 may be used.
b. Attach hanger to concrete structures using double expansion shields,
c. Attach hanger to metal support members using welding lugs similar to Carpenter & Patterson, Figure No. 114.

B. Pipe supports shall be provided for closely spaced vertical piping systems required to provide a rigid installation. The interval of vertical support spacing shall be as specified, but in no case shall vertical interval exceed 12 feet. The support system shall consist of a framework suitably anchored to floors, ceilings, or roofs.

C. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12 feet shall be supported by base elbows/tees, clamps, brackets, wall rests, and pipe collars, all located as required to ensure a rigid installation.

D. Pipe riser clamps, per MSS SP58, shall be used to support all vertical pipes extending through floor slabs. Where use of steel is allowed, riser clamps shall be galvanized steel manufactured by:

1. Carpenter & Patterson, Figure No. 128.
2. Anvil, Figure 261.
3. Cooper B-Line, Figure B3373.
4. Or equal.

E. Copper-clad or PVC-coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.

2.12 SPECIAL SUPPORTS

A. Frame Work Supports:

1. Vertical and horizontal supporting members shall be U-shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps. See pipe clamp and strap requirements.
2. For piping 3 inch and smaller, framework shall be as manufactured by:

a. Unistrut Corporation.
b. Power-Strut (or Ackinstrut where fiberglass systems are specified).

c. Multi-Strut by Carpenter-Paterson.
d. Or equal.

3. For piping larger than 3 inch, the support frame shall be fabricated from structural stainless steel or steel shapes, depending upon the support location, and secured through the use of drop in, adhesive or expansion anchors.
4. The assemblies shall be furnished complete with all nuts, bolts, and fittings required for a complete assembly including end caps for all Unistrut members.
5. Electrical Conduit Support: Under Division 26.
6. The design of each individual framing system shall be the responsibility of the Contractor. Submit shop drawings, and show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached. See also Article SUPPORT AND RESTRAINT.

B. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural stainless steel or steel shapes in accordance with applicable provisions of Section 055000 “Metal Fabrications,” or Unistrut-type frame; have anchor hardware similar to items previously specified herein; shall meet the minimum requirements listed below; and be subject to the approval of the Engineer.

C. Additional Pipe Support Situations:

1. Supporting Multiple Chemical and Related Piping:

a. Location: indicated on Drawings or otherwise required, especially adjacent to chemical pumps.
b. Use: framework support.
c. Materials: FRP, with proper local stress protection.

2.13 SHOP FACTORY FINISHING

A. Prepare and prime metallic (except stainless steel) supports in accordance with Division 09.

2.14 ACCESSORIES

A. Insulation Shield: Install on insulated non-steel piping. Oversize the rollers and supports, as required. Manufacturers:

1. Anvil, Figure 167.
2. Cooper B-Line, Series B3151.

B. Welding Insulation Saddle: Install on insulated metal pipe. Oversize the rollers and supports, as required. Manufacturers:

1. Anvil, Figure 160.
2. Cooper B-Line, Series B3160.

C. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.

1. Isolation pads to be neoprene, waffle type.
2. Manufacturers:

a. Mason Industries, Type W.
b. Korfund.

D. Dielectric Barrier:

1. Install between carbon steel members and copper or stainless-steel pipe.
2. Install between stainless steel supports and non-stainless steel ferrous metal piping.
3. All stainless-steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields.

E. Electrical Isolation: Install 1/4 by 3 inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field dimensions as indicated on Shop Drawings.

3.2 INSTALLATION

A. Obtain permission from Engineer before using powder-actuated anchors.

B. Obtain permission from Engineer before drilling or cutting structural members.

C. Inserts:

1. Install inserts for placement in concrete forms. Before setting inserts, all drawings and figures shall be checked that have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. ENGINEER shall be consulted prior to any approval for through bolt systems.
6. Existing slab reinforcing shall be field verified by GPR scan or similar prior to any drilling for through bolts. Under no circumstance shall existing reinforcing be drilled through. Hole locations shall be coordinated accordingly with the overall pipe support layout and design.

D. Pipe Hangers and Supports:

1. Install according to: ASME B31.3 and MSS SP 58.
2. Support horizontal piping as indicated on Shop Drawings, depending upon pipe size.
3. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.
4. Place hangers within 12 in of each horizontal elbow.
5. Use hangers with 1-1/2 in minimum vertical adjustment.
6. Support horizontal cast iron pipe adjacent to each hub, with 5 ft maximum spacing between hangers.
7. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Provide copper-plated hangers and supports for copper piping.
11. Design hangers for pipe movement without disengagement of supported pipe.
12. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
13. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
14. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
15. Use beam clamps where piping is to be suspended from building steel.
16. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
17. Use offset clamps where pipes are indicated as offset from wall surfaces.
18. Proceed with installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.
19. The installation of pipe support systems shall not interfere with the operation of any overhead bridge cranes, monorails, access hatches, etc. No piping shall be supported from stairs, other pipes, ladders, and walkways unless authorized by the Engineer.
20. Repair mounting surfaces to original condition after attachments are made.
21. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
22. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.

E. Insulation:

1. Provide clearance in hangers and from structure and other equipment for installation of insulation.
2. Conform to Section 404213 “Process Piping Insulation”.

F. Equipment Bases and Supports:

1. Provide housekeeping pads as detailed on Drawings.
2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
3. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
4. Provide rigid anchors for pipes after vibration isolation components are installed. Comply with Section 400513 - Common Work Results for Process Piping.

G. Prime Coat:

1. Prime coat exposed steel hangers and supports.
2. 099679 **"**Atmospheric Protection and Plant Sevice Areas Coatings"**.**
3. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 FIELD QUALITY CONTROL

A. All pipe support systems shall be tested after installation in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired, augmented or replaced to the satisfaction of the Engineer.

B. After the work is installed, but before it is filled for start-up and testing, the Support System Design Engineer shall inspect the work and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.

C. Submit a report, including all field modifications and including all certificates.

1. Insert state where project is located.
2. The report shall bear the stamp of a professional engineer registered in State where work installed and shall be subject to the review of the Engineer.

3.4 ATTACHMENT SCHEDULE

A. Pipe Hanger Spacing:

1. Pipe Material: ABS.

    a. Maximum Hanger Spacing: 4 feet
    b. Hanger Rod Diameter: 3/8 inch

2. Pipe Material: Aluminum.

    a. Maximum Hanger Spacing: 10 feet
    b. Hanger Rod Diameter: 1/2 inch

3. Pipe Material: Cast iron.

    a. Maximum Hanger Spacing: 5 feet
    b. Hanger Rod Diameter: 5/8 inch

4. Pipe Material: Cast Iron, with 10-foot length of pipe.

    a. Maximum Hanger Spacing: 10 feet
    b. Hanger Rod Diameter: 5/8 inch

5. Pipe Material: CPVC.

    a. Size: 1 inch and smaller.
    b. Maximum Hanger Spacing: 3 feet
    c. Hanger Rod Diameter: 1/2 inch

6. Pipe Material: CPVC.

    a. Size: 1-1/4 inches and larger.
    b. Maximum Hanger Spacing: 4 feet
    c. Hanger Rod Diameter: 1/2 inch

7. Pipe Material: Copper tube.

    a. Size: 1-1/4 inches and smaller.
    b. Maximum Hanger Spacing: 6 feet
    c. Hanger Rod Diameter: 1/2 inch

8. Pipe Material: Copper tube.

    a. Size: 1-1/2 inches and larger.
    b. Maximum Hanger Spacing: 10 feet
    c. Hanger Rod Diameter: 1/2 inch

9. Pipe Material: Fiberglass:

    a. Maximum Hanger Spacing: 4 feet
    b. Hanger Rod Diameter: 1/2 inch

10. Pipe Material: Glass.

    a. Maximum Hanger Spacing: 8 feet
    b. Hanger Rod Diameter: 1/2 inch

11. Pipe Material: Polybutylene.

    a. Maximum Hanger Spacing: 2.7 feet
    b. Hanger Rod Diameter: 3/8 inch

12. Pipe Material: Polypropylene.

    a. Maximum Hanger Spacing: 4 feet
    b. Hanger Rod Diameter: 3/8 inch

13. Pipe Material: PVC.

    a. Maximum Hanger Spacing: 4 feet
    b. Hanger Rod Diameter: 3/8 inch

14. Pipe Material: Steel.

    a. Size: 3 inches and smaller.
    b. Maximum Hanger Spacing: 12 feet
    c. Hanger Rod Diameter: 1/2 inch

15. Pipe Material: Steel.

    a. Size: 4 inches and larger.

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b. Maximum Hanger Spacing: 12 feet
c. Hanger Rod Diameter: 5/8 inch

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SECTION 400517 - COPPER PROCESS PIPE AND TUBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper pipe and fittings.
2. Copper tube and fittings.
3. Accessories.

B. Related Requirements:

1. Section 400506 “Couplings, Adapters, and Specials for Process Piping” for piping appurtenances.
2. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
3. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.

1.3 DEFINITIONS

A. Pipe: Hollow, cylindrical metal product that is normally used to transport gases or fluids, includes iron pipe size (I.P.S.) and schedule number in its classification, and is measured by the nominal outside diameter (NPS) and wall thickness; regardless of the wall thickness, the nominal OD of same size pipe does not change.

B. Piping: A system of pipes and fittings.

C. Tube: Hollow, cylindrical metal product that is normally used for structural purposes having an outside diameter that is not standardized for threading and is dimensionally measured on the exact outside diameter and wall thickness, often specified as a gauge.

D. Tubing: A system of tubes and fittings.

E. Soldering: Joining of metals through the use of heat and capillary flow of a filler metal having a melting temperature below 840 degrees F, and which creates a weaker bond than a brazed joint.

F. Brazing: Joining of metals through the use of heat and capillary flow of a filler metal having a melting temperature above 840 degrees F, but below the melting point of the metals being joined.

G. Flux: Material used in soldering and brazing to clean the metal surfaces and to make it easier for solder to flow over the pieces being joined.

H. DHP, Deoxidized High-residual Phosphorus Copper: Copper deoxidized with phosphorus residual in amounts 0.015 to 0.040%. The copper is not susceptible to hydrogen embrittlement. The copper is relatively low-electrical conductivity due to the amount of phosphorus present.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding pipe, tube, and fittings.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials list.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Source Quality-Control Submittals: Indicate results of shop and factory tests and inspections.

B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1. Except as provided under NFPA 99, brazing procedures and brazer performance to be qualified per Section IX, Welding and Brazing Qualifications of the ASME Boiler and Pressure Vessel Code, or AWS B2.2 both as modified below.
2. Brazers: Qualified by visual examination of test coupon followed by:

    a. Sectioning (per ASME Section IX)
    b. Macroetching (per AWS B2.2)

3. Brazing Procedure Specification: Use by Contractor during installation work to address cleaning, joint clearance, overlap, internal purge gas, purge gas flow rate, and filler material.

C. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

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1.7 QUALITY ASSURANCE

A. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

C. Perform Work according to State of New York Department of Transportation standards.

D. Maintain a copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Photograph and provide written documentation of damaged material.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Pipe: Seamless copper, ASTM B306, DWV, Type K - heavy wall.

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2.2 TUBE MATERIALS

A. Tube: Seamless copper, ASTM B88, Type K, heavy wall.

2.3 FITTING MATERIALS

A. Cast bronze, threaded adaptors, 150 lb, screwed, ASTM B62, ANSI/ASME B16.15.

B. Brass tube solder type, ASTM B62, ASME B16.18.

C. Wrought copper, solder type, ASTM B75, ASME B16.22.

D. Cast brass or bronze recessed drainage pattern, ASME B16.23.

E. Soldered cast brass or wrought copper drainage pattern, ASME B16.29.

F. Bronze unions with ground joint seats, 125 lb, ASTM B62.

G. Brazed type, MSS SP-73.

2.4 CONNECTION MATERIALS

A. Solder: ASTM B32, alloy TC (95 percent Tin, 4.85 percent Copper 0.15 percent Selenium), lead free, certified to comply with ANSI/NSF 61.

B. Brazing: AWS A5.8/A5.8M, brazing filler metal classified as BCu4 or BCu5, with minimum melting point of 1300 degrees F. Use wrought fittings for brazing.

C. Do not use connection materials containing lead of any percentage.

2.5 ACCESSORIES

A. Bolting: Comply with ASTM B98/B98M.

B. Solder: Comply with ASTM B32.

C. Piping Supports:

1. Material: Copper.
2. As specified in Section 400507 “Hangers and Supports for Process Piping.”
3. Comply with MSS SP-58.

2.6 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Owner Inspection:

1. Make completed piping and tubing components available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean pipe and fittings before installation.

3.3 INSTALLATION

A. Comply with ASME B31.3.

B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.

C. Fittings:

1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
2. Install fittings according to manufacturer instructions.
3. Bolts:

a. Tighten progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
b. Use torque wrench to tighten bolts to manufacturer instructions.

D. Provide required upstream and downstream clearances from devices as indicated on Shop Drawings.

E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping”.

G. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

H. Dielectric Fittings: Provide between dissimilar metals.

I. Field Cuts: According to pipe manufacturer instructions.

3.4 TOLERANCES

A. Laying Tolerance: 5/8 inch.

3.5 FIELD QUALITY CONTROL

A. Inspection: Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.

1. Repair damaged piping or provide new, undamaged pipe.
2. After installation, inspect for proper supports and interferences.

B. Pressure Testing:

1. Test Pressure: Not less than 150 psig or 50 psi in excess of maximum static pressure, whichever is greater.
2. Conduct hydrostatic test for minimum two hours.
3. Filling:

    a. Fill section to be tested with water slowly and expel air from piping at high points.
    b. Install corporation cocks at high points.
    c. Close air vents and corporation cocks after air is expelled.
    d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
6. Leakage:

    a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine if any leakage is present.
    b. Maintain pressure within plus or minus 5 psi of test pressure.
    c. If test of pipe indicates leakage, locate source of leakage, make corrections, and retest until leakage is eliminated.

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3.6 CLEANING

A. Keep pipe interior clean as installation progresses.

B. After installation, clean pipe interior of soil, grit, and other debris.

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SECTION 400519 - DUCTILE IRON PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ductile-iron pipe.
2. Ductile-iron, malleable-iron, and cast-iron fittings.
3. Accessories.
4. Delegated design.

B. Related Requirements:

1. Section 400506 “Couplings, Adapters, and Specials for Process Piping” for piping appurtenances.
2. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
3. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.
4. Section 404642 “Cathodic Process Corrosion Protection” for passive cathodic protection for buried ferrous piping.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding pipe and fittings.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.
2. Include plans, elevations, sections, and attachment details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail fabrication and assembly of.
5. Include diagrams for power, signal, and control wiring.

C. Product Schedule: Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Influent Pump Station: Pumps, Valves, and Flowmeters.
2. Influent Pump Station; Buried and Exposed Pipe, and Connections to Existing Pipe.
3. Influent Pump Station connection to the wet well.

B. Manufacturer's Certificate: Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe fittings, gaskets, linings and exterior coating for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

C. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

E. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

F. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

G. Welding certificates.

H. Certified Affidavit of Compliance: Prior to shipment of pipe. State that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance AWWA and ASTM standards and requirements specified herein.

I. Product Test Reports: As required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

J. Source quality-control reports.

K. Field quality-control reports.

L. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE

A. Materials (including linings) in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

B. Hydrostatically test each length of ductile iron pipe at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Furnish certified test results in duplicate to the Engineer prior to time of shipment.

C. Inspect and test by Manufacturer the ductile-iron pipe and fittings at the foundry as required by the AWWA C600, Hydrostatic Testing. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

D. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner, at the Owner's expense.

E. Engineer will inspect the pipe and fittings after delivery. Products are subject to rejection at any time on account of failure to meet any of the specified requirements, even though accepted as satisfactory at the place of manufacture. Immediately mark pipe rejected after delivery and remove from the job site.

F. Permanently mark pipe and fittings with the following information:

1. Manufacturer name and trademark
2. Manufacturing date.
3. Size, type, class, or wall thickness.
4. Production Standard (AWWA, ASTM, etc.).

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

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1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Photograph and provide written documentation of damaged materials.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Cover all openings to prevent entrance of dirt, water, and debris.
3. Protect piping and appurtenances by storing off ground
4. Limit stacking height to manufacturers specified maximum
5. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Piping:

1. Comply with AWWA C115, C150, and C151.
2. Thickness Class**:** As indicated on piping schedule.
3. Ductile Iron pipe as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; all divisions of the McWane Company or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA).

B. Fittings:

1. Material: AWWA C110, ductile iron.
2. Class: Same as that of connected piping.
3. Mechanical Joints:

a. Comply with AWWA C110 and AWWA C111.
b. Glands: Ductile iron with asphaltic coating.
c. Push-on Joints: Comply with AWWA C111.

4. Restrained Joints: Comply with AWWA C111.
5. Flanged Fittings: Comply with AWWA C110.

a. Assembly bolts: square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Threads conform to ANSI B1.1. Bolt length: 1/8” to 5/8” protrusion from nut after torquing.
b. Steel flanges in conformance with AWWA C207, Class D, may be mated to iron valves, fittings, or other parts having either integral Class 125 iron flanges or screwed Class 125 companion flanges. When such construction is used, the raised face on mating flanges shall be removed.

6. Sleeve type couplings: Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Co or approved equal.
7. Flanged coupling adaptors: Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD or approved equal.

C. Cement-Mortar Lining:

1. Comply with AWWA C104.
2. Thickness: Double.
3. Wastewater Applications:

a. Lining material as defined on the Drawings.
b. ASTM C150 Type II cement mortar lining and asphaltic seal coat in accordance with AWWA C104.

D. Special Linings

1. Epoxy Lining:

a. Line ductile iron pipe and fittings with a ceramic-filled amine-cured epoxy, Protecto 401 by Induron.
b. Lining thickness of 40 mils minimum. Applicator approved by the coating manufacturer and applied in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant.
c. Submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.

E. Exterior Coating:

1. Exposed Service: As specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coatings”.
2. If required, coatings "hold-backs" to be provided at pipe and fitting ends for satisfactory installation for joint connections in the field.
3. Provide all necessary coating materials to perform field coating applications at joints compatible with or equal to the shop applied material.
4. Field repair of pipe with damaged coating receives prior approval of the Engineer. If, in the opinion of the Engineer coating damage is beyond repair, pipe to be replaced at the expense of the Contractor.
5. All flange bearing surfaces are uncoated.
6. Mechanically clean or brush blast all surfaces to have exterior coating applied to ductile iron surfaces. Chemical cleaning or wiping with solvent is not acceptable.

2.2 ACCESSORIES

A. Thermal Insulation:

1. As indicated on the pipe schedule**.**

B. Gaskets:

1. Full face type or ring type per AWWA C111 to provide positive sealing for the flanged ductile iron joints.
2. Thickness: 1/8-inch.
3. NSF61 certified for potable water applications.

2.3 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Owner Inspection:

1. Make completed piping components available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean pipe and fittings before installation.

B. Surface Preparation: As specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coatings”.

3.3 INSTALLATION

A. Buried Service Piping: As specified in Section 331116 - Site Water Utility Distribution Piping.

B. Exposed Service Piping:

1. According to ASME B31.3.
2. In compliance with manufacturer’s instructions.
3. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.
4. Clean each length prior to installation.
5. Support per Section 400507.
6. Do not use equipment flanges for support; support pipe separately.

C. Fittings:

1. According to manufacturer instructions.
2. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.
4. Flanged joints to be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts to conform to the same ANSI Standard as the flanges.
5. Provide required upstream and downstream clearances from devices as indicated on Drawings.

D. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.

E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 - Hangers and Supports for Process Piping.

G. Provide expansion joints as specified in Section 400506 - Couplings, Adapters, and Specials for Process Piping, and pipe guides as specified in Section 400507 - Hangers and Supports for Process Piping, to compensate for pipe expansion due to temperature differences.

H. Disinfection: Disinfect potable water piping as specified in Section 331300 - Disinfecting of Water Utility Distribution.

I. Dielectric Fittings: Provide between dissimilar metals.

J. Insulated flanged joints:

1. Provide between dissimilar metals.

2. Flange insulation kits to include flange insulating gasket, flange bolt insulating sleeves, and bolt insulating washers.

K. Field Cuts: According to pipe manufacturer instructions. Cutting by abrasive saw only, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining repaired to the satisfaction of the Engineer. Seal Field cut ends approved epoxy coating in accordance with manufacturer's instructions.

L. Finish primed surfaces according to Section 099679 “Atmospheric Protection and Plant Service Areas Coatings.”

3.4 TOLERANCES

A. Deflection at joints not to exceed that recommended by the pipe manufacturer.

B. Supply and install fittings, in addition to those shown on Drawings, in areas where conflict exists with existing facilities.

3.5 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.
2. Repair damaged piping or provide new, undamaged pipe at no additional cost to the project.
3. After installation, inspect for proper supports and interferences.

B. Pressure Testing:

1. Test Pressure:

   a. As indicated on piping schedule.
   b. If not indicated on piping schedule, then not less than 200 psig, 50 psi in excess of maximum static pressure, or 150 percent of maximum operating design pressure, whichever is greater.

2. Conduct hydrostatic test for minimum two hours.
3. Filling:

   a. Fill section to be tested with water slowly and expel air from piping at high points.
   b. Install corporation cocks at high points.
   c. Close air vents and corporation cocks after air is expelled.
   d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
6. Leakage:

a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
b. Maintain pressure within plus or minus 5 psi of test pressure.
c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
d. Compute maximum allowable leakage by following formula:

1) L = SD x sqrt(P)/C.
2) L = testing allowance in gph.
3) S = length of pipe tested in feet.
4) D = nominal diameter of pipe in inches.
5) P = average test pressure during hydrostatic test in psig.
6) C = 148,000.
7) If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
f. Correct visible leaks regardless of quantity of leakage.

3.6 CLEANING

A. Keep pipe interior clean as installation progresses.

B. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400519
(*references follow*)

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ATTACHMENT A
Use as a reference:

LININGS AVAILABLE FOR DUCTILE PIPE

Description:	Maximum Service Temp. (Degree F): [1]	Common Use:	Thickness:
CEMENT MORTAR	With Sealcoat - 150 Degrees Without Sealcoat - 212 Degrees	Drinking Water Salt Water Non-Septic Gravity Sewers Sanitary Sewer Force Mains	
PROTECTO 401 (ceramic-filled amine-cured epoxy)	120 to 150 Degrees [2]	Septic Sewer Acids [3] Alkali Waste Pickling Brine	40 Mil (nominal)

[1] Maximum service temperatures listed are intended as general guidelines. For higher service temperatures, consult manufacturer for specific recommendations.

[2] Maximum service temperature for epoxies depends on service conditions and specific formulation. Consult manufacturer for recommendations for elevated temperature service.

[3] Consult manufacturer for specific acid service use.

[4] Maximum service temperature for polyethylene for acids and alkali waste depends on the specific acid or alkali waste and service condition(s). Consult manufacturer for recommendations for elevated temperature service.

END OF ATTACHMENT A

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SECTION 400523 - STAINLESS STEEL PROCESS PIPE AND TUBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Stainless steel pipe and fittings.
2. Stainless steel tube and fittings.
3. Accessories.

B. Related Requirements:

1. Sections of Division 40 “Instrumentation and Controls”, other than those specified herein, are specified under their respective Sections.
2. Section 400506 "Couplings, Adaptors, and Specials for Process Piping" for pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
3. Section 400551 "Common Requirements for Process Valves" for common product requirements for valves for placement by this Section.
4. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves and sealing of piping to adjacent structures.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections as specified in other Sections.

1.4 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information on pipe materials, tube materials, and fittings.

B. Shop Drawings:

1. Indicate piping layouts and schedules, with dimensions, fittings, expansion joints, locations of valves and appurtenances, joint details, wall penetration details, methods, types and locations of hangers and supports, and pertinent technical specifications for piping to be furnished.
2. Include data and information required for complete piping systems. Base dimensions on actual equipment to be furnished. Show types and locations of pipe hangers and/or supports on layouts for each pipe submittal. Since not all dimensions will be checked by Engineer, nor will every detail be reviewed by Engineer, Contractor will be responsible for accurate dimensioning of piping systems.

C. Cleaning Methods:

1. Include pre-cleaning, descaling, chemicals to be used, or mechanical descaling method, post-weld cleaning to restore corrosion resistance and final cleaning/passivation/pickling.
2. Include method and schedule for drying pipe so that it is ready for service as part of proposed cleaning method.
3. Include name and qualifications of firm that will be doing cleaning.
4. Include name and qualifications of independent firm that will be doing inspection of cleaned pipe.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Welder Certificates: Submit welders' certification of compliance with AWS D1.1/D1.1M, verifying qualification within previous 12 months.

1.6 DELEGATED DESIGN SUBMITTALS

A. Delegated Design Submittals: Where pipe sizing has been delegated as shown on plans, submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizing methods and calculations used.

1.7 INFORMATIONAL SUBMITTALS

A. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

C. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.8 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, fittings, and appurtenances, connections, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

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1.9 QUALITY ASSURANCE

A. Furnish stainless steel pipe and fittings by a single manufacturer who is fully experienced, reputable, qualified and regularly engaged for the last 5 years in manufacture of materials to be furnished.

B. Permanently mark each length of pipe with manufacturer's name or trademark, and compliance with standards.

C. Materials in Contact with Potable Water: Certified according to NSF/ANSI 61 and NSF/ANSI 372.

D. Fabricator Qualifications: Factories, including mills, foundries, factories and machine shops, which hold a current ISO 9001 Certificate of Quality System Registration. Furnish documentation necessary to verify Supplier’s certification and registration.

E. Furnish work in new and unused condition. Include products and services from Suppliers having a successful record of manufacturing and servicing Work specified herein for a minimum of 10 years prior to Effective Date of Agreement.

F. Perform and document quality control (QC) and quality assurance (QA) procedures performed during manufacturing at factory; during loading of Work for transport at factory; during transport to Site; during unloading and storage of Work at Site; and during installation and startup at Site, all part of Work specified herein.

G. Owner and Engineer will perform independent testing of Work, herein referred to as “QA verification”, at any time during manufacturing at factory; during loading for transport at factory; during transport to Site; during unloading and storage at Site; and during installation and startup at Site. Owner will provide an industry specialist and Engineer to perform QA verification procedures. Allow unhindered access to Owner and Engineer, including access for still and video photography of Work.

H. Owner will provide an industry specialist and Engineer to perform QA verification procedures. QA Verification will include chemical analysis, examination, and testing as specified, following QA and QC procedures performed by Supplier and Contractor. Allow unhindered access to Engineer, including access for progress photographs and video documentation of work. Remove and replace, at no increase in Contract Price or Contract Time, defective Work, verified in non-compliance with acceptance criteria specified herein.

I. Where Defective Work is identified and rejected, based on QA verification, provide additional QA verification analyses, inspections and testing performed by Owner or Engineer on corrected Work.

J. In addition, reimbursement for subsequent QA verification inspections includes repeat QA verification analyses, testing and/or inspection related costs, including costs associated with personnel travel expenses described above; laboratory analysis; and repeat testing or inspection report review and analysis by Owner or Engineer.

K. Design, manufacture, deliver and install products in accordance with requirements of specified herein. Provide new and unused products specified herein from Suppliers having a successful record of manufacturing and servicing products specified herein for a minimum of 10 years.

L. Submit to Engineer, four copies of certified mill test reports (MTRs) for chemical analysis, mechanical properties including tensile, impact, and bend test results for materials used in manufacture of products specified herein. Verify MTRs identify products, for which material will be used, and information necessary to verify compliance with requirements specified herein.

M. If there are difficulties in operation of systems included under this Contract due to defective Work, correct defective Work and meet acceptance testing requirements.

N. Inspection by Owner or Engineer or failure to inspect does not relieve Contractor of his responsibility to provide materials and perform Work in accordance with Contract Documents.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.

C. Welders: AWS qualified within previous 12 months for employed weld types.

D. Licensed Professional: experienced in design of specified Work and licensed at Project location.

E. Welding Qualifications: Qualify procedures according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."

F. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

1.12 AMBIENT CONDITIONS

A. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F.

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1.13 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.14 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL TUBE AND FITTINGS

A. Tube:

1. Type: Seamless.
2. Comply with ASTM A269/A269M.
3. Grade: Type 304/304L.

B. Seamless Stainless Steel Alloy Tube:

1. Install seamless stainless steel alloy tube, ¼-inch to 2½-inch diameter in designated size and wall thickness as scheduled and indicated on Drawings.
2. Provide seamless tube manufactured from the following alloys in accordance with designated ASTM standard:

a. ASTM A269, Grade S30403, (304L) austenitic stainless steel (ASME P-8), ID and OD; mechanically polished to a No. 2B finish, as a minimum.
b. Provide seamless annealed stainless steel alloy tube manufactured and/or distributed by:

1) Tioga Pipe Supply Company, Philadelphia, Pennsylvania.
2) Outokumpu Piping Products, Wildwood, Florida.
3) Rath Gibson, Janesville, Wisconsin.
4) Swagelok, Solon, Ohio.
5) Plymouth Tube, Warrenville, Illinois.
6) Bristol Metals (Brismet), Bristol, Tennessee.
7) Alaskan Copper Works, Seattle, Washington.

C. Fittings:

1. Threaded:

a. Comply with ASTM A182 and ASME B16.11.

b. Grade: Type 304/304L
c. Threads: Comply with ASME B1.20.1.

2. Butt-Welding Fittings:

a. Comply with ASTM A403/.
b. Grade: Type Type 304/304L

3. Socket-Welding Fittings:

a. Comply with ASTM A403.
b. Grade: Type Type 304/304L

4. Welded Stainless Steel Tube Fittings

a. Only use welded stainless steel tube fittings, 3 inch to 12 inch diameter with ASTM A778 light-wall extra-low-carbon stainless steel pipe,; designed and manufactured in accordance with ASTM A774; fitting dimensions in accordance with MSS SP-43.
b. Provide welded stainless steel tube fittings manufactured from the following alloys in accordance with designated ASTM standard:

1) ASTM A774, Grade TP304L (extra low carbon (<0.03%) alloy for welded fabrication) austenitic for tube manufactured from ASTM A778 Type 304L extra-low carbon light-wall austenitic stainless steel.
2) ASTM A774, Grade TP316L (extra low carbon (<0.03%) alloy for welded fabrication) for pipes manufactured from ASTM A778 Type 316L extra-low carbon light-wall austenitic stainless steel.

c. Provide low-pressure light-wall fittings for stainless steel pipe manufactured and/or distributed by one of the following:

1) Felker Brothers, Marshfield, Wisconsin.
2) Douglass Brothers, Portland, Maine.
3) Swepco Tube, Clifton, New Jersey.

5. Compression Tube Fittings and Adapters

a. Use compression fittings and adapters constructed of same material as connecting tube, ¼-inch to 2½-inch diameter, on stainless steel tube where specified and indicated on drawings.
b. Provide all threaded joints for medium pressure oil hydraulic tube fittings of SAE straight-thread O-ring end-seal type.
c. Provide compression type couplings between tubes, bends and adapters for oil hydraulics.
d. Provide one of the following compression fittings for stainless steel tube:

1) Tube fittings and adapters manufactured by Swagelok, Solon, Ohio.
2) Gyrolok fittings manufactured by Hoke, Spartanburg, South Carolina.
3) Tube fittings manufacture by Tube Fittings Division, Parker Hannifin Corporation, Columbus, Ohio.

4) Tube fittings manufactured by Brennan Industries, Solon, Ohio.

6. Flared 37 Degree Tube Fittings and Adapters

a. Use flared 37 degree fittings and adapters ¼-inch to 2-inch diameter on tube fittings where indicated on Drawings. Do not used on oil hydraulic systems. Provide dimensions in accordance with SAE J514 and threads in accordance with ASME B1.20.1.
b. Meet the following material standards:

1) ASTM A182, Grade F304/F304L (ASME P-8) (L – low alloy for welded fabrication) Austenitic for tubes manufactured from ASTM A269, Type 304/304L.

c. Provide flared fittings manufactured by one of the following::

1) Parker Hannifin Corporation, Columbus, Ohio.
2) Brennan Industries, Solon, Ohio.
3) Swagelok, Solon, Ohio.

7. Flared 45 Degree Tube Fittings and Adapters

a. Use f fittings and adapters ¼-inch to 2-inch diameter where specified and indicated on Drawings. Provide dimensions in accordance with SAE J513 or SAE J512 with threads in accordance with ASME B1.20.1 and bodies forged to ASTM A182.
b. Meet the following material standards:

1) ASTM A182, Grade F304/F304L (ASME P-8) (L – low alloy for welded fabrication) Austenitic for tubes manufactured from ASTM A269, Type 304/304L.

c. Provide flared 45 degree fittings from one of the following manufacturers:

1) Parker Hannifin Corporation, Columbus, Ohio.
2) Brennan Industries, Solon, Ohio.
3) Mueller Industries, Covington, Tennessee.

2.2 ACCESSORIES

A. Pipe-Thread Tape:

1. Material: PTFE.
2. Comply with ASTM D3308.

B. O-Ring Seals: EPDM.

C. Anti-seize Bolting Lubricants:

1. Install flange bolts using a nickel anti-seize lubricant capable of achieving required bolt torque and sealing stress and permitting future disassembly with minimal manual input.

2. Remove excess anti-seize compound by degreasing solvent prior to finish painting piping.
3. Anti-Seize Compound:

    a. Never-Seez Pure Nickel Special Lubricant manufactured by Bostik, Wauwatosa, Wisconsin.
    b. Loctite Heavy Duty Anti-Seize Lubricant Manufactured by Henkel Technologies, Rocky Hill, Connecticut.
    c. Chesterton 772 Premium Nickel Anti-Seize Compound manufactured by Chesterton Technical Products, Stoneham, Massachusetts.

4. Flange Bolts: Adequately degreased of all corrosion inhibiting slush oil and excess anti-seize lubricant prior to field application of prime and finish coatings.

2.3 SOURCE QUALITY CONTROL

A. Section 14000 “Quality Requirements”: Requirements for testing, inspection and analysis.

B. Provide shop inspection and testing of completed assembly.

C. Owner Inspection:

1. Make completed tubingcomponents available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

D. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.
3. Coordinate QC and QA testing of Work to be witnessed by Owner or Engineer in factory, such that they may be conducted on consecutive days and completed during a single trip. Notify the Engineer of scheduled factory QC and QA testing and inspections three (3) weeks, as a minimum, prior to first scheduled testing date.

E. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design, and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Ream tube ends and remove burrs.

B. Thoroughly clean pipe and fittings before installation.

3.3 INSTALLATION

A. Comply with ASME B31.3. Install pipe, fittings and specials true to alignment and rigidly supported. Do not exceed deflection at pipe joints recommended by *Supplier*. Support all pipe and appurtenances connected to equipment to prevent any strain on equipment and valves nozzles, and adjoining pipe flanges

B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.

C. Fittings:

1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
2. Install according to manufacturer instructions.
3. Bolting:

    a. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
    b. Use torque wrench to tighten bolts to manufacturer instructions.

D. Concrete encase pipe under concrete slabs. Wrap stainless steel pipe in a protective material, such as a petrolatum tape or coat pie as needed, prior to encasement.

E. Provide required upstream and downstream clearances from devices as indicated on Shop Drawings.

F. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

G. Provide expansion joints as specified in Section 400506 - Couplings, Adaptors, and Specials for Process Piping to compensate for pipe expansion due to temperature differences.

H. Dielectric Fittings: Provide between dissimilar metals.

I. Field Cuts: According to pipe manufacturer instructions.

J. Field welding of stainless steel is not permitted.

K. Joining preparation and finished welds: Under no circumstances may permanent backer-rings or other consumable inserts be used for field or shop welding of steel pipe. Non-consumable refractory inserts are allowed with Engineer’s approval.

L. Assemble joints between straight lengths of carbon steel pipe with full-penetration groove welds. Make full-penetration butt-welded field joints for pipe larger than 8 inch diameter using line-up clamps. Submit alternative methods to line-up clamps proposed with welding submittals for Engineer's approval.

M. Join socket-welded fittings, used with seamless mill grade stainless steel piping, by fillet welding as indicated on Drawings. Use socket welded fittings only on oil fluid power system piping.

N. Prepare pipe joints by a machining process without damage to pipe exterior. Cut ends smooth and at a right angle to axis of pipe and beveled where required in accordance with approved welding procedure specifications. Deburr pipe and tube as part of preparation of all joint configurations.

O. Rust spots and corrosion pits on new stainless steel pipe and fittings are not allowed. Verify pipe, tube and fittings are inspected by the Engineer and Contractor upon delivery and stored in a location that will prevent entry of contaminants prior to installation.

P. Protect pipe, tube, fittings and valves, and adhere to the following mandatory requirements, and others specified in paragraphs below:

1. Protect stainless steel materials from contact with carbon steel including but not limited to hoisting and rigging equipment, steel tables, storage racks and hand tools.
2. Do not bundle pipe and fittings using ferrous metal banding at factory or Supplier's facility.
3. Do not allow contact between wear surfaces of tools used for carbon steel fabrication and surfaces of stainless steel pipe, tubes and fittings. These tools include abrasive grinding and cutting wheels, wheel cutters and rollers, threading taps and dies, tube bending equipment and all other bearing edge tools.
4. Use manual or powered wire brush tools for surface repair and joint preparation manufactured from stainless steel. Brushes with carbon steel wire cannot be used for fabrication of stainless steel.
5. Shield stainless steel pipe, tube and fittings from all on-site carbon steel pipe and structural steel cutting and blasting operations.
6. Remove all exterior surface scratches; surface contamination by ferrous metal grinding kerf; contamination by paint markers and crayons etc.; and labels after installation.

Q. Verify engineer examines exterior surfaces of pipe, tube and fittings at Site for free iron contamination by ferroxyl test or other method. Clean all contaminated surfaces at Site by pickling using a lean spray-applied pickling cleaner suitable for large surfaces system. Follow pickling with passivation of entire treated surface by a neutralizing rinse. Provide one of the following spray-applied pickling solutions:

1. Avesta Classic Cleaner 401®, manufactured by Avesta Finishing Chemicals, Orchard Park, New York.
2. Antox® 75E Pickling Cleaner, manufactured by Chemetall US, New Providence, New Jersey.
3. Kytex® Brightener 123, manufactured/distributed by Harvard Chemical Research, Atlanta, Georgia.

R. Perform field cutting of stainless steel pipe by mechanical wheel cutter or abrasive saw, leaving a smooth cut at right angles to axis of pipe. Use new abrasive cutting wheels for stainless steel pipe and tube designed to prevent iron, sulfur or chlorine contamination to surface under preparation or repair, and surfaces of adjacent piping. Deburr pipe and tube as part of preparation for all joint configurations. Abrasive cutting wheels acceptable for use on stainless steel pipe and tube as follows:

1. Charger® cutting wheels manufactured by Norton/Saint-Gobain Abrasives, Worcester, Massachusetts.
2. Saitech Z-Tech® cutting wheels manufactured by United Abrasives/SAIT, Windham, Connecticut.
3. pecialist® cutting wheels manufactured by Flexovite, Angola, New York.

S. Perform field grinding of stainless steel pipe and tube, including root pass and enter-pass weld grinding using new grinding wheels. Use grinding wheels designed to prevent iron, sulfur or chlorine contamination to surface under repair or surfaces of adjacent piping. Abrasive grinding wheels acceptable for use on stainless steel pipe and tube as follows:

1. Norzon Plus® grinding wheels manufactured by Norton/Saint-Gobain Abrasives, Worcester, Massachusetts.
2. Saitech Pipeline® grinding wheels manufactured by United Abrasives/SAIT, Windham, Connecticut.
3. Flexon® ZA24S grinding wheels manufactured by Flexovite, Angola, New York.

T. Use wire wheels, to remove defects on pipe surface after installation, constructed of same material as pipe wall or Type 316 stainless steel for super austenitic and duplex stainless steel piping. Verify surface finish on pipe meets specified mill-applied surface finish or better.

U. Installation of Grooved Joint Couplings and Fittings:

1. Assemble steel grooved-joint couplings on piping systems in accordance with latest version of Manual I-100 “Field Installation Handbook” published by Victaulic Company, Easton, Pennsylvania.
2. Install coupling gaskets using Supplier’s standard lubricant compatible with elastomer gaskets. Complete lubrication of gasket exterior, gasket sealing lips, housings, and pipe ends prior to joining to prevent gasket pinching.
3. Tighten coupling nuts evenly by alternating sides until metal-to-metal contact occurs at bolt pads. For angle-bolt-pad couplings, even offsets must be present at bolt pads to obtain pipe-joint rigidity.

V. Bolting Procedure for Flanged Joints:

1. Assemble flanged pipe joints in accordance with gasket Supplier’s instructions and as specified herein. Utilize calibrated bolting equipment capable of applying a measured torque to flange bolts during assembly. Submit bolting patterns, procedures and bolting equipment data to Engineer prior to pipe fitting and bolting.
2. Use hydraulic cassette wrenches for assembly of flanged pipe joints requiring greater than 900 ft-lbs of assembly torque. Document each flanged joint assembly included in Work using “Flange Bolting Worksheet” at end of this Section. Do not use torque multipliers. Engineer reserves right to require documentation of any flange joint requiring less than 900 ft-lbs of bolt torque.

3. Calculate clamping forces and target assembly torque for assembly of all flanged pipe joints included in Work. Verify calculations take into consideration pipe diameter, gasket Supplier's recommended assembly stress; bolt material tensile and yield stress; gasket Supplier's recommended bolt stress; pipe service, design and test pressures. Verify calculations are stamped by a professional engineer.
4. Visually inspect and clean flange bolts, stud-bolts, nuts and washers prior to bolting. Lubricate bolts and nuts; if hardened washers are not used, lubricate flange surface around bolt holes. Remove excess lubricant on surfaces to receive protective coatings by cleaning and degreasing solvent prior to applying a coating system.
5. Hand-tighten all nuts and bolts, then tighten them to 10 to 20% of target torque. Do not exceed 20% of target torque, for initial torque. Tightened bolts according to pattern recommended by gasket Supplier. Do not reuse nuts removed during disassembly of existing or newly assembled joints. Dispose of used nuts in presence of Engineer.
6. Perform three rounds of bolt tightening on flanges having 4 to 8 bolts following hand tightening, first to 30 percent; then 60 percent; and finally, 100 percent of target torque calculated by Contractor.
7. Perform four rounds of bolt tightening for flanges having 12 bolts or more, following hand tightening, first to 20 percent; then 40 percent; then 80 percent, and then 100 percent of target torque calculated by Contractor.
8. Measure gap between flanges following application of 100 percent of target at every other bolt to confirm uniformity. Perform a final re-tightening to 100% of target torque 24-hours after 100 percent tightening at end of initial bolting sequence. Verify every bolt and stud-bolt has a minimum of three full threads exposed beyond nut following final tightening.
9. Fill out "Flange Bolting Worksheet", located at end of this Section, for all flanged joints on project. Identify joints in accordance with designation included in approved laying schedule. Submit form to Engineer at end of each workday, after 24-hour re-tightening sequence, for filing in project records.

W. Installation of Stainless Steel Tube:

1. Install tubing using compression fittings and adapters or by welding.

    a. Tubing to be Used with Compression Fittings: Bright annealed and electro-polished as specified above and protected from scratches and deformation during shipping, storage on site and assembly.

2. Minimize use of fittings by tube bending. Perform tube bending using manual or mechanized dies designed for use with annealed stainless steel tube.
3. Cut stainless steel tube to length using cutter-wheel type tube cutters. Debur cut tube ends prior to swaging or welding. For all edge tool components used for installation of stainless steel tube use only new or dedicated for use with stainless steel equipment.

X. Installation of Compression Tube Fittings

1. Install compression fittings for annealed stainless steel tubing in accordance with manufacturer's instructions. Remove all markings applied to tube and fittings during assembly by solvent cleaning after installation. General installation requirements below are based upon use of Swagelok tubing and serve as minimum requirement. Adhere to manufacturer's instructions during installation. Do not mix nuts and ferrules from different tube fitting manufacturers.

2. Swage compression fittings 1-inch diameter and smaller manually. Hand-tighten nut, and then turn another 1 and ¼ turns by a manual wrench to engage ferrule to tube wall. Compression ferrules for fittings larger than 1 inch diameter hydraulically swaged to tube by a hydraulic swaging tool in accordance with manufacturer's instructions. Apply manufacturer's standard lubricant to body threads and back of ferrule prior to swaging. Verify Engineer inspects fittings after initial assembly for proper pull-up with gap inspection gauges.
3. Install adapter fittings in accordance with requirements below for type of connecting joint, including SAE straight thread O-ring joints, standard tapered threaded joints, SAE hydraulic flanges and welded joints.
4. Do not use thread sealant with SAE straight O-ring threaded joints.
5. Do not use standard tapered threaded joints adapters or liquid thread sealants used for oil operated hydraulic fluid lines. In addition, do not use NPTF Dryseal threads for any adapters for use with any service.
6. Disassemble welded adapters prior to tack welding and re-lubricate prior to hydraulic swaging after welding. Remove all adjacent O-rings and other heat sensitive materials prior to welding and/or protected with heat sinks during welding.
7. Avoid disassembly of compression fittings after initial assembly as much as possible. If a compression joint must be disassembled, mark nut and fitting nut flats to use as a guide for proper pull-up after reassembly.

3.4 FIELD QUALITY CONTROL

A. Section 017300 "Execution": Requirements for testing, adjusting, and balancing.

B. Cleaning: After installation, clean completed lines with Oakite deoxidizer or similar deoxidizer as recommended by manufacturer to remove all foreign matter, construction stains or shop markings. Rinse cleaned lines with steam or hot water. Verify all cleaning chemicals are NSF/ANSI 60 approved.

C. Inspection:

1. Inspect for damage to piping or tubing that may be detrimental as determined by Architect/Engineer.
2. Repair damaged piping, or provide new, undamaged pipe.
3. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, tube, or fittings.

D. Pressure Testing:

1. Test Pressure: Not less than 200 psig or 50 psi in excess of maximum static pressure, whichever is greater.
2. Conduct hydrostatic test for minimum two hours.
3. Filling:

    a. Fill section to be tested with water slowly and expel air from piping at high points.
    b. Install corporation cocks at high points.
    c. Close air vents and corporation cocks after air is expelled.
    d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
6. Leakage:

    a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
    b. Maintain pressure within plus or minus 5 psi of test pressure.
    c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
    d. Compute maximum allowable leakage by following formula:

        1) L = SD x sqrt(P)/C.
        2) L = testing allowance, in gallons per hour.
        3) S = length of pipe tested, in feet.
        4) D = nominal diameter of pipe, in inches.
        5) P = average test pressure during hydrostatic test, in psig.
        6) C = 148,000.
        7) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

    e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
    f. Correct visible leaks regardless of quantity of leakage.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 CLEANING

A. Keep pipe interior clean as installation progresses.

B. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400523

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SECTION 400524 - STEEL PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-lined steel pipe.
2. Fittings.
3. Accessories.

B. Related Requirements:

1. Section 099679 “Atmospheric Protection and Plant Service Areas Coating” “”: Finishes as required by this Section.
2. Section 400506 “Couplings, Adapters, and Specials for Process Piping”: Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
3. Section 400507 “Hangers and Supports for Process Piping”: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.
4. Section 400551 “Common Requirements for Process Valves”: Common product requirements for valves for placement by this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding pipe and fittings.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and material lists, locations of all expansion joints, supports, anchors, harnessing, valves, etc.

C. Complete schedule of all components included in the pipeline drawings, indicating the materials and schedule number of thickness of all pipe, the materials and class of all fittings and valves.

D. Details of pipe coating, wrapping, lining, and painting.

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1.5 DELEGATED DESIGN SUBMITTALS

A. Submit signed and sealed Shop Drawings with piping layout and with design calculations and assumptions for pipe sizing methods.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Welder Certificates: Submit welders' certification of compliance with AWS D1.1/D1.1M, verifying qualification within previous 12 months.

C. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications including certified materials test reports indicating physical and mechanical properties and heat treatment for all piping components.

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

E. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

A. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

C. Perform Work according to Project standards.

D. Maintain one of each standard affecting Work of this Section on Site.

E. Roll or permanently inscribe the manufacturer's name or trademark, the year of manufacture and the ASTM or API specification number on the pipe surface at the manufacturer's plant. Alternately, stencil the manufacturer's name or trademark, year of manufacture and ASTM or API specification number on the pipe surface. Pipe 1-1/2 inches and less in nominal diameter shall be bundled and tagged.

F. Utilize only certified welders, having current certificates conforming to the requirements of the ASME code to perform all welding on steel pipes. Welders to be qualified under the requirements of Section IX Welding Qualifications, of the ASME Boiler and Pressure Vessel Code.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

C. Welders: ASME qualified within previous 12 months for employed weld types.

D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in the State of New York.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS

A. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F.

1.12 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

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PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Sodium Hypochlorite Service Piping:

1. Comply with ASTM A106/A106M; Grade B.
2. Dimensions: Comply with ASME B36.10M.

B. Joints:

1. Description: Flanged.

C. Fittings:

1. Type:

a. Flanged.

2. Dimensions: Comply with ASME B36.10M.
3. Flanged Connections: All locations.
4. Flanged Fittings:

a. Van Stone flanges shall not be used with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.
b. Forged Steel: Comply with ASTM A105/A105M.
c. Steel flanged fittings:

1) Forged steel slip-on flanges.
2) Class 125 and Class 250 fittings, ASME B16.5, 150 pound or 300 pound, except flanges that are flat faced.

d. Class 125 fittings, AWWA C207, Class B.
e. Cast steel flanged fittings to be assembled with forged steel flanges of the same pressure rating, conforming to ASME B16.5.
f. Facing and Drilling:

1) Comply with ASME B16.5.

g. Backing Flanges:

1) Material: Cast steel.
2) Comply with ASTM A216/A216M
3) Class: 150.
4) Type: Van stone.
5) Drilling: Comply with ASME B16.5.

h. Fasteners:

1) Bolts: Comply with ASTM A193/A193M hex head.

2) Nuts: Comply with ASTM A194/A194M; hex head.
3) Washers: Constructed of same material as bolts.

2.2 PLASTIC-LINED STEEL PIPE AND FITTINGS

A. PTFE-Lined Steel Pipe and Fittings:

1. As indicated on Drawings.
2. Maximum Design Pressure: 150 psig at 80 degrees F.
3. Maximum Operating Temperature: 100 degrees F.
4. Minimum Liner Thickness: 150 mils.
5. Lock liner to shell.
6. Gaskets: FKM.

2.3 FINISHES

A. Coat machined faces of flanges with temporary rust-inhibitive coating.

B. Prepare piping for field finishes as specified in Section 099679.

2.4 ACCESSORIES

A. Pipe-Thread Tape:

1. Material: PTFE.
2. Comply with ASTM D3308.

2.5 SOURCE QUALITY CONTROL

A. Testing:

1. Provide shop inspection and testing of completed pipe sections.
2. Conduct 15,000-V minimum electrostatic spark test on each plastic-lined pipe to ensure integrity of plastic liner.
3. Test thermal shock resistance of glass-lined pipe according to ASTM C600.

B. Owner Inspection:

1. Make completed pipe sections available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

E. Engineer reserves the right to perform shop inspections of the manufacture of the pipe. Provide at least 30 days' notice to the Engineer prior to the beginning of any work so that inspection may be arranged. Furnish all facilities required for the inspection of materials and workmanship in the shop.

1. Inspection may include, welding inspection, review of certified material test reports, traceability check, and witness of assembly and fit-up. Prior to manufacture, the pipe fabricator shall supply the following information on suppliers of plate, piping, and other components: Items(s) furnished, company name and address, contact name, telephone and fax number. The Engineer reserves the right to visit any or all of the suppliers and conduct inspections at their facilities.
2. The inspector has the authority to reject any material or work that does not meet the requirements of the Contract Documents.
3. Inspection at the shop is intended as a means of facilitating the work and avoiding errors. Shop inspection does not relieve the responsibility for furnishing proper materials or workmanship.
4. Engage inspectors to inspect welded connections and to perform tests and prepare test reports. Perform non-destructive testing as required by the specification under which the pipe is manufactured.
5. Correct or reweld and retest deficient welds to the specified requirements as determined by the Engineer and/or an independent testing lab.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Drawings.

B. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new pipe and flange mate properly.

3.2 INSTALLATION

A. According to ASME B31.3.

B. Run piping straight along alignment as indicated on Drawings, with minimum number of joints.

C. Fittings:

1. Clean gasket seats thoroughly and wipe gaskets clean prior to installation.
2. Install fittings according to manufacturer instructions.
3. Bolts:

a. Determine torque per AWWA M11.
b. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
c. Use torque wrench to tighten bolts to manufacturer instructions.
d. Project 1/4-inch beyond the nut when joint with gasket is assembled.

D. Provide required upstream and downstream clearances from devices as indicated on Drawings.

E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping.” Where temporary supports are used during construction, provide sufficient strength and rigidity to prevent shifting or distortion of the pipe.

G. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and provide pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

H. Dielectric Fittings: Provide between dissimilar metals.

I. When required, cut pipe by machine in a neat workmanlike manner without damage to the pipe. Cut ends to be smooth and at right angle to the axis of the pipe. Clean all steel pipe thoroughly before installation including smoothing and cleaning interior and exterior cut ends. All uncoated pipes to be placed on end and hammered to remove scale and loose particles. Repair lining damage to the satisfaction of the Engineer before the pipe is installed.

J. Welding of steel butt-welding fittings, steel fabricated fitting and steel pipe to be in strict conformity with the Code for Pressure Piping, ASME B31.1, Section 6 and its Supplements. Submit Certificates of qualifications of current issue, conforming to the requirements of the Code to the Engineer before proceeding with any pipe welding. Use backing rings of carbon steel with spacer nubs that strike-off or melt with the weld for all pipe welding butt joints unless otherwise specified.

K. Perform field welding of cement mortar lined steel pipe only where approved and in accordance with AWWA C206. Use flanged or other approved joints not approved for field welding.

1. Machine cut the ends of the lined pipe for pipe-to-pipe joints to provide an approximate bevel of 27-1/2 degrees. Ends may be chipped provided there is no damage to the cement lining, cleaned of scale, rust, oil and other foreign matter. Where fittings already having a bevel of 37-1/2 degrees are to be welded to pipe, pipe ends to be beveled to a 17-1/2 degree angle, making a total angle of bevel between joints of approximately 55 degrees. A 1/8-inch land to be provided where possible.
2. Pipe ends to be joined will be approximately 1/32 inch apart before tacking. Backing rings will not be used at welded joints in cement mortar lined pipe. Small tack welds to be made using a 1/8-inch electrode. The first bead or layer of welding laid by bridging across from bevel to bevel at the bottom of the groove just at the top of the land. A suitable crown reinforcement layer to be made on the top of the joint to finish off.
3. Direct current (DC) will be used for welding, with the base material on the negative side.
4. The first pass will be a stringer bead using a 1/8-inch electrode with a current of 80 to 90 amperes at 50 to 55 Volts. The second and succeeding passes to be woven beads using a 1/8-inch electrode and a current of 90 to 100 amperes at 55 to 58 Volts. All passes to be

made slowly and with care not to burn through the land or the shoulder into the lining of the pipe. The joint will not be hotter than 100 deg. F. For large size pipe, a 5/32-inch electrode may be used, provided the temperature of the joint is held within 100 deg. F.

5. No stress relieving of welded joints is necessary unless the pipe wall thickness warrants it. After the weld is completed, the joints in the lining will be filled with a special compound of a wet slurry mix of the same cement used for the lining. Where accessible from the end of the pipe, the welded joint is to be swabbed with cement using a paint brush thoroughly wetted with the cement slurry.
6. Defects causing leaks in welded joints will be repaired by welding without damaging the cement lining using procedures similar to that specified hereinbefore.

L. Finished welds to be examined as required by AWWA C206.

3.3 TOLERANCES

A. Circumferential deflection of all pipe in-place: not to exceed 2.0 percent of the pipe diameter.

B. Install pipe within tolerance of 5/8 inch.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.
2. Repair damaged piping or provide new, undamaged pipe.
3. After installation, inspect for proper supports and interferences.

B. Pressure Testing:

1. As indicated in piping schedule.

C. Pressure Testing: According to ASME B31.3 and pipe schedule.

3.5 CLEANING

A. Keep pipe interior clean as installation progresses.

B. After installation, clean pipe interior of soil, grit, loose mortar, and other debris.

END OF SECTION 400524

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SECTION 400531 - THERMOPLASTIC PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. PVC pipe.
2. Polyethylene (PE) pipe and tube.
3. Fittings.
4. Accessories for plastic piping.

B. Related Requirements:

1. Section 400506 “Couplings, Adapters, and Specials for Process Piping”: Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
2. Section 400507 “Hangers and Supports for Process Piping”: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information regarding pipe and fittings.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, materials lists, location of all fittings, valves, and in-line accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer’s recommended butt fusion welding procedures identifying all quality control checks during the fusion procedure including the minimum and maximum allowable bead formation during the heat soak process and the final weld roll back process for the various size pipes.

E. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

1.6 QUALITY ASSURANCE

A. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

B. Manufacturer: Company listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture each of the respective thermoplastic pipe systems.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection:

1. Accept materials on Site in manufacturer's original packaging and inspect for damage.
2. Manufacturer's Packaging: Comply with ASTM D3892.

B. Storage: Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from puncture, abrasion, moisture, dust, and UV by storing in clean, dry location remote from construction operations areas.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

1.9 AMBIENT CONDITIONS

A. Minimum and Maximum Temperatures: Do not install pipe when temperature is below 40 degrees F or above 90 degrees F if pipe is exposed to direct sunlight.

B. UV Protection: Provide pipe installed above ground or outside with UV protection.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PVC PIPE, TUBE, AND FITTINGS

A. PVC Pipe and Fittings:

1. Pipe and Fittings:

a. Comply with ASTM D1785, Class 12454.
b. Schedule: 80.
c. Fittings: ASTM D2467, Schedule 80, socket.

2. Fittings: ASTM D2467, Schedule 80, socket.

2.2 HDPE PIPE AND FITTINGS

A. HDPE Pipe and Fittings:

1. Pipe: ASTM D3035 / AWWA C901 for sizes up to 3” ASTM F714 / AWWA C906 for sizes 4” and greater
2. SDR: SDR 17.0, rated for a maximum 125 psig working pressure
3. Fittings:

a. Comply with AWWA C901 or C906 for size 4 inches or greater.
b. Type: Molded to comply with ASTM D3261.
c. Minimum pressure rating equal to or greater than the pipe to which they are joined.

4. Joints: Butt fusion or Flanged.
5. Materials:

a. PE 4710 high density polyethylene resin.
b. Comply with ASTM D3350.
c. Minimum Cell Classification: 445574-C-C.

6. Contractor is responsible for the design, fabrication, and support of the temporary bypass piping. Fitting types and connections by Contractors approved means and methods.

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2.3 ACCESSORIES

A. PVC Piping:

1. Flange Bolting:

a. Hex-Head Bolts: Stainless steel; ASTM F593 Grade 316.
b. Hex-Head Nuts: Stainless steel; ASTM F594 Grade 316.

2. Flange Gaskets:

a. Type: Full faced.
b. Material: EPDM.
c. Comply with ASME B16.21.

3. Push-On Joint Seals:

a. Material: EPDM.
b. Comply with ASTM F477.

4. Solvent Cement:

a. Comply with ASTM D2564.
b. Formulated for use with sodium hypochlorite and other caustic solutions.
c. Primers: Comply with ASTM F656, manufactured by the solvent weld cement manufacturer.

2.4 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed pipe sections.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

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3.2 PREPARATION

A. Thoroughly clean pipe and fittings before installation.

B. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. Comply with ASME B31.3 and B31.9.

B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.

C. Fittings:

1. According to manufacturer instructions.
2. Gaskets:

a. Clean seats thoroughly.
b. Wipe gaskets clean prior to installation.

3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.

D. Provide required upstream and downstream clearances from devices as indicated.

E. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping”.

G. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and provide pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

H. Field Cuts: According to pipe manufacturer instructions.

I. Joining:

1. Heat Joining: Comply with ASTM D2657.

a. Butt-fusion joints to be done by a factory-qualified joining technician as designated by the pipe manufacturer.
b. Field Samples: join two sample welds on each size of pipe to be installed using the same fusion welding equipment that will be used for completion of the entire work. These sample welds will be compared to the manufacturer’s sample previously submitted in accordance with Part 1.
c. Pipe joints with beads in excess of 3/16-in will not be approved by the Engineer.

2. Electrofusion: Comply with ASTM F1290.

3. Primers and Cleaners: Comply with ASTM F402.
4. PVC Solvent-Cemented Joints: Comply with ASTM D2855.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for piping defects that may be detrimental as determined by the Engineer.
2. Repair damaged piping, or provide new, undamaged pipe.
3. After installation, inspect for proper supports and interferences.

B. Pressure Testing:

1. Test Pressure: Not less than 150 psig or 1.5 times the system's working pressure, whichever is greater.
2. Conduct hydrostatic test for minimum two hours.
3. Filling:

    a. Fill section to be tested with water slowly and expel air from piping at high points.
    b. Install corporation cocks at high points.
    c. Close air vents and corporation cocks after air is expelled.
    d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.

3.5 CLEANING

A. Keep pipe interior clean as installation progresses.

B. Clean pipe interior of soil, grit, shavings, and other debris after pipe installation.

END OF SECTION 400531

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SECTION 400532 – DOUBLE WALL CHEMICAL PIPE SYSTEM

PART 1 - GENERAL

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Double walled PVC pipe and fittings
2. Fittings and accessories for double-walled pipe system.

B. Related Requirements:

1. Section 331300 “Disinfecting of Water Utility Distribution”: Disinfection requirements for potable-water systems.
2. Section 400506 “Couplings, Adapters, and Specials for Process Piping”: Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
3. Section 400507 “Hangers and Supports for Process Piping”: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.
4. Section 400531 “Thermoplastic Process Pipe”: piping materials, fittings, and appurtenances for single-walled pipe connections.
5. Section 400551 “Common Requirements for Process Valves”: Common product requirements for valves for placement by this Section.
6. Division 03 – Concrete.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and as indicated on Drawings.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's catalog information regarding pipe, fittings, gaskets, piping appurtenances and leak detection system.
2. Chemical compatibility chart demonstrating proposed products, including delivery pipe, carrier pipe, fittings, gaskets and associated materials which could be exposed to the process chemical, are compatible with the listed process chemicals for the specified operating conditions including concentration, pressure, and temperature.
3. Manufacturer's catalog information regarding pipe hangers and supports, demonstrating compatibility with the proposed piping system.

B. Shop Drawings:

1. Indicate layout of piping systems, including equipment, critical dimensions, sizes, materials lists, location of all fittings, valves, in-line accessories, and wall-penetrations.
2. Identify slope, elevations of all floor and wall penetrations, location of high and low points, location of expansion loops or joints, drain ports, and flushing connections.
3. Identify location of all low point leak detection switches, visual inspection ports, leak detection wiring, conduit and cable.
4. Provide wiring diagram and example HMI screens for all automated electronic leak detection system panels.

1.5 DESIGNATED DESIGN SUBMITTALS

A. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizes and sizing methods.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificates: Certify that products meet or exceed specified requirements.

1. NSF-61, NSF-51, food grade certification

B. Manufacturer’s recommended butt fusion welding procedures identifying all quality control checks during the fusion procedure including the minimum and maximum allowable bead formation during the heat soak process and the final weld roll back process for the various size pipes.

C. Manufacturer to provide a sample joint for each size pipe to be supplied that is 12-inches long and has two heat fusion welds that identifies the manufacturer’s minimum and maximum allowable bead thicknesses. Provide documentation that the sample was pressure tested to 150 psi or the specified pressure.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and invert and centerline elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

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1.8 QUALITY ASSURANCE

A. All plastic pipe and fittings of each type shall be furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished; however, it shall not be a requirement that the pipe and fittings be manufactured by the same manufacturer, provided that the pipe and fittings are compatible in both compounding and size.

B. Design, fabricate and install double containment piping to meet ASME/ANSI B31.3 where applicable manufacturer shall provide thermal stress analysis demonstrating the ability of the double-containment piping system to handle the stated piping conditions with a restrained or a flexible design, as follows:

1. Flexible Design: System shall be a flexible design with provisions to allow inner and outer pipe ability to move independent of one another. Anchors will be selectively used to direct thermal expansion into expansion loops, and/or offsets, etc. Manufacturer or Design Engineer should be consulted for the proper location of anchors and expansion compensation design.

C. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and certified or otherwise approved in writing by manufacturer.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection:

1. Accept materials on Site in manufacturer's original packaging and inspect for damage.
2. Manufacturer's Packaging: Comply with ASTM D3892.

B. Storage: Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from puncture, abrasion, moisture, dust, and UV by storing in clean, dry location remote from construction operations areas.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

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1.11 AMBIENT CONDITIONS

A. Comply with requirements for ambient condition control facilities for product storage and installation.

B. Minimum and Maximum Temperatures: Do not install pipe when temperature is below 40 degrees F or above 90 degrees F if pipe is exposed to direct sunlight.

C. UV Protection: Provide pipe installed above ground or outside with UV protection.

1.12 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

A. Applicability:

1. Requirements: Sodium Hypochlorite Chemical Piping System: Contractor to begin double wall chemical pipe system as specified herein on the outside of the existing secondary chemical containment area, as shown on Drawings.

a. For requirements regarding single-walled plastic pipe within the secondary containment area, refer to Section 400531 “Thermoplastic Process Pipe.”

B. Unit Responsibility:

1. Single Source: Provide materials manufactured by a single “DC Piping System Supplier”. DC Piping System Supplier shall have the sole responsibility for the proper manufacturing, shipping, delivery, assembly, testing, and shall assume proper functioning of all pipe, fittings, accessories, controls, and appurtenances.

C. System Description

1. The equipment and materials specified herein are intended to be standard types of plastic pipe and fittings for use in transporting wastewater, water, air, and chemicals.
2. Design components of the plastic piping systems shall be designed for the following conditions:

a. System: Sodium Hypochlorite (SH) and Sodium Bisulfite (SB)

1) Fluids:

a) 10 - 15 percent Sodium Hypochlorite

b) 35 – 40 percent Sodium Bisulfite

2) Carrier Pipe Diameter: 0.5 inch and 1-inch, as Shown on Drawings.
3) Containment Pipe Diameter: 2 inch and 3 inch, as Shown on Drawings.
4) Material: Double-Contained PVC
5) Pressure: Atmosphere to 150 psig
6) Temperature: 40 to 100 degrees F.
7) Special Conditions: Pulsation from hose pumps.

2.2 DOUBLE WALL PVC PIPE AND FITTINGS

A. General:

1. For all underground applications. Transition from single-walled CPVC as indicated on the Drawings.
2. Manufacturer:

   a. Asahi America; Pro-Lock.
   b. GF+; Double-See.
   c. Ipex; Guardian.
   d. Spears Manufacturing.

3. Materials:

   a. Delivery Pipe: sch 80 PVC.
   b. Containment Pipe: sch 80 PVC.

B. Description:

1. Pipe:

   a. Comply with ASTM D1785, Class 12454.
   b. Schedule: 80.

2. Fittings:

   a. Flanges: Comply with ASME B16.5; rated for a maximum 150 psig working pressure.
   b. Socket Type: Comply with ASTM D2467, Schedule 80.

3. Joints: Socket welded.
4. Materials:

   a. Comply with ASTM D1785.
   b. Minimum Cell Classification: 12454

2.3 ACCESSORIES

A. PVC and CPVC Piping:

1. General:

    a. Use of clear (fully transparent) sch 80 PVC piping on the double-containment piping system is allowed only at the low point drip legs and drain connection fittings.
    b. For all aboveground applications of single-walled CPVC or other plastic pipe, refer to Section 400531.

2. Flange Bolting:

    a. Hex-Head Bolts: Stainless steel; ASTM Grade 316.
    b. Hex-Head Nuts: Stainless steel; ASTM Grade 316.

3. Flange Gaskets:

    a. Type: Full faced.
    b. Material: EPDM.
    c. Comply with ASME B16.21.

4. Push-On Joint Seals:

    a. Material: EPDM
    b. Comply with ASTM F477.

5. Solvent Cement:

    a. Comply with ASTM D2564.
    b. Formulated for use with sodium hypochlorite and other caustic solutions.
    c. Pipe and fittings 12-inch diameter and smaller: IPS 711 Weld-on Cement or Approved Equal.
    d. Heavy bodied, medium setting.
    e. ASTM 2564, 100 percent solvent and PVC resin. No fillers permitted.
    f. Universal plastic pipe solvent is not acceptable.
    g. Must be formulated and compatible for use with 12.5 percent strength sodium hypochlorite.

6. Primer:

    a. Staining solvent conforming to standard ASTM F656.
    b. Manufactured by solvent weld cement manufacturer.

7. Fittings:

    a. Provide force-transfer type fittings at all locations where it is necessary to lock the inner and outer pipes of the DC piping system or where the DC piping connects to single-walled pipe.

        1) Provide solid Dogbone™, or Design-Builder-approved Equal at all terminations of the outer containment pipe and at all other connections to single-walled pipe.

2) Provide Dogbone™ seals or Design-Builder-approved Equal, type fittings on either side of in-line valves located on double-walled pipe.
3) Provide annular Dogbone™, or Design-Builder-approved Equal, type fittings to lock inner and outer pipes together on buried portions.
4) Provide restraint Dogbone™, or Design-Builder-approved Equal, type fittings at pipe hanger locations to withstand the thermal end-load.

b. Provide expansion loops every 100 LF or as recommended by manufacturer, whichever is greater.
c. Provide outer wall adapter fittings at all low points for leak detection and drainage of the exterior containment pipe. See detail on Drawings.
d. All fitting materials shall be sch 80 PVC, manufactured and supplied by the DC pipe system manufacturer.

8. Carrier Pipe Supports at Fittings:

a. Match Carrier Pipe materials for Secondary Containment Supports at Fittings.
b. Designed for field assembly of carrier pipe fittings in secondary containment fittings using self-centering, locking support clips.
c. Carrier pipe fittings and secondary containment pipe fittings anchored together using support clips.
d. Support clips consist of male by female, solvent weld, socket fittings with centering legs.
e. Support clips must permit uninterrupted drainage along the invert of the secondary containment pipe.

9. Carrier Pipe Support Clips:

a. Carrier pipe supports to support and center the carrier pipe inside the secondary containment pipe.
b. Carrier pipe supports must permit uninterrupted drainage along the invert of the secondary containment pipe.
c. Provide carrier pipe supports at intervals recommended by the double containment system manufacturer.

10. Wear pads:

a. Provide wear pads made of EPDM rubber (non-metallic, UV resistant material) for installation between plastic pipe and metal pipe supports to avoid direct contact between metal and plastic pipe..
b. Example products: Walraven Bismat 5000; Unistrut “Cush-a-Clamp”; Unistrut P2600; or Equal.

11. Pipe Supports:

a. Type 316 stainless steel compliant with ASTM A240.
b. Comply with other requirements as per Section 400507.

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2.4 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed pipe sections.

B. Owner Inspection:

1. Make completed pipe sections available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Ream pipe and tube ends, remove burrs, and bevel plain-end pipe.

B. Thoroughly clean pipe and fittings before installation.

C. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. Comply with ASME B31.3 and B31.9.

B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.

C. Fittings:

1. According to manufacturer instructions.
2. Gaskets:

a. Clean seats thoroughly.
b. Wipe gaskets clean prior to installation.

3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.

D. Provide required upstream and downstream clearances from devices as indicated.

E. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping.”

1. Double-walled pipe shall not be in direct contact with metal brackets.
2. Provide rubber or EPDM wear pad between metal pipe supports and pipe.

G. Install buried piping with bedding and backfill as specified in Section 312333. Blocking under pipe is not permitted.

H. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and provide pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

I. Disinfection: Disinfect potable-water piping as specified in Section 331300 ‘Disinfecting of Water Utility Distribution.”

J. Field Cuts: According to pipe manufacturer instructions.

K. Joining:

1. Heat Joining: Comply with ASTM D2657.

a. Butt-fusion joints to be done by a factory-qualified joining technician as designated by the pipe manufacturer.
b. Field Samples: join two sample welds on each size of pipe to be installed using the same fusion welding equipment that will be used for completion of the entire work. These sample welds will be compared to the manufacturer’s sample previously submitted in accordance with Part 1.
c. Pipe joints with beads in excess of 3/16-in will not be approved by the Design-Builder.

2. Electrofusion: Comply with ASTM F1290.
3. Connect to different pipe materials by means of flanges, specified adapters, or transition fittings.

4. Solvent Cement Welded PVC and CPVC Pipe:

    a. Join by means of socket fittings and solvent cement welding in conformance with ASTM D2855 and ASTM F402.
    b. Make solvent-cement welded joints in strict compliance with the manufacturer's/supplier's instructions and recommended procedures.

5. Primers and Cleaners: Comply with ASTM F402.
6. PVC Solvent-Cemented Joints: Comply with ASTM D2855.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for piping defects that may be detrimental as determined by the Design-Builder.
2. Inspect pipe supports to confirm wear pads are properly located.
3. Repair damaged piping, or provide new, undamaged pipe.
4. After installation, inspect for proper supports and interferences.

B. Clean Water Pressure Testing:

1. Sequence:

    a. Conduct preliminary pressure tests of piping segments with clean potable water prior to burying pipe (outdoor segments) or making final connections. Test segment length not to exceed 200LF.
    b. Conduct system pressure tests for fully installed system – including pump suction piping to discharge point and associated single-walled pipe - with clean potable water prior to testing with applicable process chemical.

2. Test Pressure: Not less than 150 psig or 1.5 times the system’s working pressure, whichever is greater.
3. Conduct hydrostatic test for minimum two hours with clean potable water.
4. Filling:

    a. Fill section to be tested with water slowly and expel air from piping at high points.
    b. Install corporation cocks at high points.
    c. Close air vents and corporation cocks after air is expelled.
    d. Raise pressure to specified test pressure.

5. Observe joints, fittings, and valves under test.
6. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
7. Leakage:

    a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
    b. Maintain pressure within plus or minus 5 psiof test pressure.
    c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.

d. Correct visible leaks and repeat test to verify no leaks at the required test pressures.

8. Repeat clear water hydrostatic test for fully-installed piping system – including both single-walled and double-walled piping located from the pump discharge to injection point.
9. Conduct a field check of the operating pressures measured during clean water testing:

    a. Adjust system valving to normal positions for standard operation and adjust PRVs and PCVs to pressure setpoints set forth in these Contract Documents.
    b. Run chemical feed pumps one at a time on clean water and measure operating pressures for each fully-installed chemical delivery pipe (includes single-walled pipe on either end of the double-walled pipe). Compare to setpoints.
    c. Report results to Design-Builder via submittal. Confirm operating pressure setpoints for PRVs and PCVs with Design-Builder prior to start-up testing.

C. Secondary Containment Pneumatic Testing:

1. Medium: Instrument Grade Air or Nitrogen.
2. Test Pressure: 5 psig maximum.
3. Duration: 2 hours.
4. Maximum Allowable Pressure Drop: 0.1 psig over 2 hours.
5. Maintain 10 psig, minimum, in primary containment pipe during testing of secondary containment pipe.
6. Test Safety: As specified in Section 40 05 01 for Pneumatic Pressure Testing.
7. Conform to double containment pipe system manufacturer's compressed gas testing procedures.

D. Process Chemical Start-up Testing:

1. Sequence: After demonstrating no leakage of process piping, and measured operating pressures during the clean water pressure test, proceed to test the fully installed chemical delivery piping system with the applicable process chemical to confirm no leakage.
2. Flush piping with clean potable water and expel air from high points. Close air vents and corporation cocks after air is expelled prior to initiating pumping of process chemicals.
3. Confirm all drain valves and flushing connections are fully closed.
4. Test pressure shall be 80 psi as measured at the pump discharge or 100 psig the system's measured working pressure (from the clean water test), whichever is greater. Adjust PRV setpoints at injection points to achieve target test pressure.
5. Conduct test for minimum two hours with applicable process chemical.
6. Filling:

    a. Chemical delivery pipelines should be full of potable water at the start of this test.
    b. Initiate pumping of appropriate process chemical. Confirm process chemical is being discharged at injection point prior to starting test duration.

7. Observe joints, fittings, and valves under test.
8. If leakage is noted, stop test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
9. Unless testing results indicate otherwise, restore PRV and PCV pressure setpoints to those specified in Contract Documents upon the conclusion of field testing.

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10. The Owner will furnish up to 800 gallons of each chemical to Contractor for the purpose of field testing. Contractor is responsible to reimburse Owner for additional quantities.

3.5 CLEANING

A. Keep pipe interior clean as installation progresses.

B. Clean pipe interior of soil, grit, shavings, and other debris after pipe installation.

END OF SECTION 400532

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SECTION 400551 - COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Common requirements for valves.
2. Common requirements for valve actuators.
3. Valve tags.
4. Valve Schedule.

B. Related Requirements:

1. Section 055000 “Metal Fabrications” for miscellaneous metalwork and fasteners specified by this Section.
2. Section 220523 “General-Duty Valves for Plumbing Piping” for miscellaneous plumbing valves as required by Project.
3. Section 330110.58 “Disinfection of Water Utility Piping Systems.”
4. Section 400507 “Hangers and Supports for Process Piping” for product and execution requirements for valve supports specified by this Section.
5. Section 400548 “Vibration and Seismic Controls for Process Piping” for product and execution requirements for vibration and seismic control specified by this Section.
6. Section 400557 “Actuators for Process Valves and Gates.”

1.3 COORDINATION

A. Coordinate Work of this Section with individual process valve specifications.

1.4 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.5 ACTION SUBMITTALS

A. Valve Schedule:

1. Submit valve schedule populated with all Division 40 process valves specified for this project. Include all information shown on the Sample Valve Schedule included in this project.
2. Approval of valve schedule submittal to precede all individual valve submittals. All subsequent individual valve submittals to include the approved valve tag number or group on the submittal cover sheet.

B. Valve Tags:

1. Materials, dimensions and thickness of tags, materials and gauge of cable and splicing hardware.
2. The color palette for Owner selection.
3. Full scale drawing of sample with lettering dimensions and scribe depth.
4. Valve tag lettering provided with Valve Schedule above.

C. Power Actuator Data:

1. Sizing calculations

   a. Provide fluid pressure and velocity sizing basis.
   b. Provide maximum valve torque based on disc shape and flow direction.
   c. Clearly indicate safety factors and mechanical ratios of any intermediate gearing.

2. Maximum output torque of actuator and intermediate gearing.
3. Details of actuator mounting, including orientation of actuator and intermediate gearing.
4. Dimensional drawing of actuator assembled on valve.
5. Pneumatic/Hydraulic pressure requirements, electrical power supply, plumbing connection sizes and locations.
6. Wiring diagram, control wiring and protocol.
7. Valve cavitation limits for positioning, modulating and control valves mated to power actuator.

D. Shop Drawings: Valve and actuator model number and size, valve parts list, materials of each part including material standard designation (ASTM or other), position indicators, limit switches, actuator mounting.

E. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.

1.6 DELEGATED DESIGN SUBMITTALS

A. Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.

1.7 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit installation and operation instructions for each component including valve, actuator, gearbox, and any included instrumentation.

B. Source Quality-Control Submittals: Indicate results of integrators facility tests and manufacturers factory tests and inspections.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Manufacturer Certification of Installation: Certify that equipment has been installed according to manufacturer instructions.

E. Qualifications Statement:

1. Submit qualifications for manufacturer and licensed professional.

1.8 QUALITY ASSURANCE

A. Maintain clearances as indicated on Drawings.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Mate valves to actuators at manufacturer's or integrator's facility. Fully test assembled product and certify ready for installation prior to shipment to the job site.

1. Only in special cases for extremely large assemblies where installation requires disassembly, may actuators be mounted to the valves in the field.

D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

E. Furnish affidavit of compliance with testing and manufacturing standards referred in this specification and the individual valve specifications.

F. Provide the services of a qualified and factory-trained service representative of the manufacturer to provide installation inspection and check out, and operational and maintenance instruction, for each type of the following equipment for the following durations:

Equipment	Valve Sizes	Installation Inspection	O and M Instruction
480 volt electric actuators	N/A	1 day	1 day
230 volt electro-hydraulic actuators	N/A	1 day	1 day
Pressure regulating valves	10-in and up	1 day	1 day
Gate valves	12-in and up	1 day	1 day
Knife gate valves	12-in and up	1 day	1 day
Surge relief valves	10-in and up	1 day	1 day
Cone valves	12-in and up	1 day	1 day
Combination Air Valves	4-in and up	1 day	1 day
Vacuum Breaker/Air Release Valves	2-in and up	1 day	1 day

G. Obtain Manufacturer's Certification of Proper Installation for Specified valves and valve assemblies.

H. Perform Work according to State of New York standards.

I. Maintain 1 copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum ten years' documented experience.

B. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in the State of New York.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Deliver factory mated power actuated valves on rigid wooden skids, fully braced and strapped to prevent damage to valve, actuator or coupling system.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to materials ordering or any fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Furnish one-year manufacturer's warranty for valves and actuators.

PART 2 - PRODUCTS

2.1 VALVES

A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.

B. Provide all valves of the same type by same manufacturer

C. Valve Ends: Compatible with adjacent piping system and as indicated on valve schedule.

D. Operation:

1. Close by turning clockwise.
2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

E. Valve Marking and Labeling:

1. Marking: Comply with MSS SP-25.
2. As indicated in valve schedule.
3. Labeling (valve tags):

a. Fiberglass reinforced plastic, ASTM D709, 70 mil thick, 2 1/2-inch diameter or 2 1/2-inch by 1 ¼-inch.
b. Lettering 1/16-inch thick of silk screening or other permanent embedment of subsurface printed graphics, permanently sealed.
c. Colors of lettering and backing as selected by Owner.
d. Two, 1/4-inch clear opening 316 stainless steel grommets at each end, center of hole 3/8-inch from tag edge.
e. 3/32-inch 316 SS cable and splice hardware.

F. Valve Construction: As Specified in Valve Sections.

G. Do not use Van Stone flanges with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

2.2 VALVE ACTUATORS

A. Provide actuators in accordance with the valve schedule included on the Drawings.

B. Provide mechanical position indicators for power actuated and gearbox actuated valves.

C. Comply with AWWA C541 (Pneumatic and Hydraulic actuators) and C542 (Electric Motor Actuators) as applicable.

D. Provide chain actuators for shutoff valves mounted greater than 7 feetabove operating floor level.

E. Gear and Power actuators as specified in Section 400557.00 “Actuators for Process Valves and Gates”.

2.3 INSULATION

A. As indicated in pipe schedule.

2.4 FINISHES

A. Valve Coating: Comply with AWWA C550.

B. Factory finishes are included in individual valve sections.

C. Stainless Body Valves: Do not coat.

D. Do not coat flange faces of valves unless otherwise specified.

2.5 SOURCE QUALITY CONTROL

A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

B. Owner Inspection:

1. Make completed valve manufacture available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping system is ready for valve installation.

B. Fully examine valves for debris, damage and interior finish blemishes prior to installation. Do not install valves with soiled interior or any visible damage to seats, discs or interior finish.

C. Identify any piping, plant or equipment clearance issues prior to installation, bring to Engineer’s attention via job meetings, submittal process or request for information process.

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3.2 INSTALLATION

A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.

B. Inspect valve interiors before line closure for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. Clean connecting pipes prior to installation, testing, disinfection and final acceptance.

C. Disinfect valves installed in potable water lines with approved pipeline disinfection process.

D. Rigidly support valves to avoid stresses on piping.

E. Coat studs, bolts and nuts with anti-seizing lubricant.

F. Dielectric Fittings: Provide between dissimilar metals.

G. Clean field welds of slag and splatter to provide a smooth surface.

H. Mate, adjust and fully test gearboxes, electric, hydraulic and pneumatic actuators to valves at manufacturer's or integrator's facility.

1. Only in special cases for extremely large assemblies where installation requires disassembly may actuators be mounted to the valves in the field. These circumstances require preinstallation meetings.

I. Do not install stems vertically downward.

J. Unless otherwise indicated on the Drawings:

1. Install Gate, Globe, Ball valves with stem vertical in the 12 o'clock position.
2. Install Plug valves with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
3. Install Butterfly valves 12 inch and smaller with stem horizontal or vertical in the 12 o'clock position,
4. Install Butterfly valves 14 inch and larger with the stem horizontal unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
5. Install Control valves in horizontal pipelines with top works vertically upward.

K. Install all brackets, extension rods, guides, the various types of operators and appurtenances as indicated. Before properly setting these items, check all drawings and figures which have a direct bearing on their location.

L. Inspect all materials for defects in construction and materials. Clean debris and foreign material out of openings, etc. Verify valve flange covers remain in place until connected piping is in place. Verify operability of all operating mechanisms for proper functioning. Check all nuts and bolts for tightness. Repaired or replace valves and other equipment which do not operate easily or are otherwise defective.

M. Where installation is covered by a referenced standard, install and certify in accordance with that standard, except as herein modified. Also note additional requirements in other parts of this Section.

N. Unless otherwise noted, provide joints for valves and appurtenances utilizing the same procedures as specified under the applicable type connecting pipe joint. Install valves and other items as recommended by the manufacturer. Verify manufacturers' torqueing requirements for all valves.

O. Coordinate direction of flow through offset type and shaped butterfly valve discs with the mated actuator torque capacity.

P. Rotate valve operators and indicators to display toward normal operation locations. Consult with Engineer prior to installing valves with handwheels to confirm final position of handwheel.

Q. Vertically center floor boxes, valve boxes, extension stems, and low floor stands over the operating nut, with couplings as required.

1. Adjust elevation of the box top to conform to the elevation of the finished floor surface or grade at the completion of the Contract.
2. Support boxes and stem guides during concrete placement to maintain vertical alignment.

R. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.

S. Install 1-inch gate valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.

T. Install valves with clearance for installation of insulation and to allow access.

U. Provide access where valves and fittings are not accessible.

V. Pipe Hangers and Supports: As specified in Section 400507 “Hangers and Supports for Process Piping”.

W. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.

X. Install insulation as indicated in pipe schedule.

3.3 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.
2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
3. Engineer will witness field testing.
4. Functional Test:

a. Prior to system startup, inspect valves and actuators for proper alignment, quiet operation, proper connection and satisfactory performance.
b. After installation, open and close all manual valves in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage.
c. Cycle valves equipped with electric, pneumatic or hydraulic actuators 5 times from full open to full closed in the presence of the Engineer to exhibit operation without vibration, jamming, leakage, or overheating.
d. Operate pressure control and pressure relief valves in the presence of the Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.

5. Field test pipe lines in which the valves and appurtenances are to be installed. During these tests, adjust, remove or replace defective valve or appurtenance, or otherwise make acceptable to the Engineer. Test regulating valves, strainers, or other appurtenances to demonstrate conformance with the specified operational capabilities. Correct deficiencies, replace device or otherwise made acceptable to the Engineer.

END OF SECTION 400551

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SECTION 400553 - IDENTIFICATION FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods for valves.

1.3 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's catalog literature for each specified product.

B. Shop Drawings:

1. Indicate list of wording, symbols, letter size, spacing of labels, and color-coding for mechanical identification and valve chart and schedule.
2. Indicate valve tag number, location, function, and valve manufacturer's name and model number.

C. Samples: Submit two tags for each size to be used on Project.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 SUSTAINABLE DESIGN SUBMITTALS

A. Manufacturer's Certificate:

1. Certify that products meet or exceed specified sustainable design requirements.
2. Materials Resources Certificates:

a. Certify source and origin for salvaged and reused products.
b. Certify recycled material content for recycled content products.
c. Certify source for regional materials and distance from Project Site.

B. Product Cost Data:

1. Submit cost of products to verify compliance with Project sustainable design requirements.
2. Exclude cost of labor and equipment to install products.
3. Provide cost data for following products:

a. Salvaged, refurbished, and reused products.
b. Products with recycled material content.
c. Regional products.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials: Furnish two containers of spray-on adhesive.

B. Tools: Furnish special crimpers and other devices required for Owner to reinstall tags.

1.8 QUALITY ASSURANCE

A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.

B. Perform Work according to State of New York standards.

C. Comply with recommended water treatment plant color coding from the latest version of Ten State Standards unless otherwise requested by Owner.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark Pipe Markers.
2. Kolbi Pipe Marker Co.
3. Pipemarker.com (Brimar Industries, inc.),
4. Seton Identification Products.

B. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. R&R Identification Co.
f. Seton Identification Products.

2. Description:

a. Laminated three-layer plastic with engraved black letters on light, contrasting background color.
b. Minimum Tag Size and Configuration: 2 inches; diameter.
c. Provide with brass hooks suitable for attaching the tag to the valve operator.
d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

B. Metal Tags:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. Pipemarker.com (Brimar Industries, Inc.).
f. R&R Identification Co.
g. Seton Identification Products.

2. Description:

a. Stainless-steel construction; stamped letters.
b. Minimum Tag Size and Configuration: 2 inches; diameter with finished edges.
c. Provide with brass hooks suitable for attaching the tag to the valve operator.
d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

C. Information Tags:

1. Manufacturers:

a. Brady ID.
b. Seton Identification Products.

2. Description:

a. Clear plastic with printed text DANGER and message consisting of material information.
b. Minimum Tag Size: 3-1/4 by 5-5/8 inches.
c. Furnish grommet and self-locking nylon ties.

3. Tag Chart: Typewritten, letter-size list of applied tags and location, plastic laminated.

2.3 STENCILS

A. Manufacturers:

1. Kolbi Pipe Marker Co.
2. Marking Services, Inc.
3. Pipemarker.com (Brimar Industries, Inc.),

4. R&R Identification Co.
5. Seton Identification Products.

B. Description:

1. Quality: Clean-cut symbols.
2. Letters:

OUTSIDE DIAMETER OF PIPE	SIZE OF LETTERS
3/4-in to 1-1/4-inch	1/2-inch
1-1/2-in to 2-inch	3/4-inch
2-1/2-in to 6-inch	1-1/2-inch
8-in to 10-inch	2-1/2-inch
Over 10-inch	3-inch

C. Stencil Paint:

1. Description: Manufacturer's standard.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Marking Services, Inc.
d. R&R Identification Co.
e. Seton Identification Products.

2. Description:

a. Factory-fabricated, flexible, and semi-rigid plastic.
b. Preformed to fit around pipe or pipe covering.
c. Larger sizes may be of maximum sheet size, with spring fastener.
d. Letter sizes per Paragraph 2.3B.
e. Color shall be white or black depending on background color.

B. Plastic Tape Pipe Markers:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. Pipemarker.com (Brimar Industries, Inc.).

f. Seton Identification Products.

2. Description:

a. Flexible, 3.5 mil vinyl film tape with pressure-sensitive adhesive backing and printed markings.
b. Letter sizes per Paragraph 2.3B.
c. Color shall be white or black depending on background color.

C. Plastic Underground Pipe Markers:

1. Manufacturers:

a. Kolbi Pipe Marker Co.
b. Marking Services, Inc.
c. Pipemarker.com (Brimar Industries, Inc.).
d. Rhino Marking and Protection System.
e. Seton Identification Products.

2. Description:

a. Brightly colored, continuously printed plastic ribbon tape.
b. Minimum Size: 6 inches wide by 4 mils thick.
c. Manufactured for direct burial service.
d. Letter sizes per Paragraph 2.3B.

2.5 CEILING TACKS

A. Manufacturers:

1. Marking Services, Inc.
2. R&R Identification Co.
3. Seton Identification Products.

B. Description:

1. Material: Steel.
2. Head:

a. Color-coded.
b. Diameter: 3/4 inch.

2.6 LABELS

A. Manufacturers:

1. Brady ID.
2. Seton Identification Products.

B. Description:

1. Material: Aluminum.
2. Minimum Size: 1.9 by 0.75 inches.
3. Adhesive backed, with printed identification and bar code.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

a. Brady ID.
b. Master Lock Company, LLC.

2. Description:

a. Material: Anodized aluminum.
b. Furnish hasp with erasable label surface.
c. Minimum Size: 7-1/4 by 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

a. Brady ID.
b. Master Lock Company, LLC.

2. Description:

a. Material: Plastic.
b. Furnish device to restrict access to valve operator and to accept lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Stencil Painting: Prepare surfaces as specified in Section Manufacturer’s standard.

3.2 INSTALLATION

A. According to manufacturer instructions.

B. Apply stencil painting as specified in Section Manufacturer’s standard.

C. Install identifying devices after completion of coverings and painting.

D. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.

E. Labels:

1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
2. For unfinished covering, apply paint primer before applying labels.
3. Titles:

   a. Locate a maximum 26 feet apart.
   b. Locate directly adjacent to pipeline breaches on each side wall.
   c. Locate adjacent to each side of the valve regulator, flow meter, strainer, cleanout and all pieces of equipment.
   d. Identify the contents by complete name at least once in each room or space and thereafter may be labeled by generally recognized abbreviations.

F. Tags:

1. Identify valves in main and branch piping with tags.
2. Install tags using corrosion-resistant chain.
3. Number tags consecutively by location.

G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

H. Piping:

1. Identify piping, concealed or exposed, with plastic pipe markers.
2. Identify service, flow direction, and pressure.
3. Install in clear view and align with axis of piping.
4. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Ceiling Tacks:

1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.
2. Locate in corner of ceiling panel closest to equipment.

END OF SECTION 400553

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SECTION 400557 - ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Following types of actuators for linear, multi-turn, and quarter turn valves and gates:

1. Manual actuators.
2. Electric motor actuators.

B. Related Requirements:

1. Section 055000 “Metal Fabrications” for miscellaneous metalwork and fasteners as required.
2. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
3. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.

1.3 DEFINITION

A. Where the term “valve” alone is used in this Section, it applies to both valves and gates as the corresponding text context dictates.

1.4 COORDINATION

A. Section 400551 “Common Requirements for Process Valves” for valve schedule requirements.

B. Coordinate Work of this Section with installation of valves, gates, and accessories.

1.5 PREINSTALLATION MEETINGS

A. Convene minimum one week at site prior to commencing Work of this Section.

1.6 SUBMITTALS

A. Product Data: Manufacturer information for actuator with model number and size indicated.

B. Shop Drawings:

1. Parts list, materials, sizes, position indicators, limit switches, actuator mounting, wiring diagrams, control system schematics with external interfaces on assembly drawings.
2. Actuator Shop Drawings with respective valve and gate submittal.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

D. Manufacturer Instructions: Special procedures and placement requirements.

E. Source Quality-Control Submittals: Results of factory tests and inspections and provide required certifications.

F. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

G. Qualifications Statements:

1. Qualifications for manufacturer and installer.
2. Manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Documentation of actual locations and types of actuators.

1.8 QUALITY ASSURANCE

A. Valve Actuators in NEC Locations: Comply with NFPA 70.

B. Minimum NEMA Enclosure Classification:

1. Non-submergence Installations: NEMA 4X.
2. Submergence Installations: NEMA 6P/IP68.

C. Perform Work according to State of New York Department of Transportation standards.

D. Maintain a copy of each standard affecting Work of this Section on Site.

E. Single Source Requirements:

1. Furnish electric motor actuators in the scope of the project by the same manufacturer. Coordinate this requirement with actuated valves and gates included in scope of vender furnished equipment.
2. Furnish actuators, floor stands, stem guides, stems, extensions, and accessories for slide gate assemblies by slide gate manufacturer.

F. Mate actuators to equipment at equipment manufacturers or integrators facility.

1. Test assembled product. Certify ready for installation prior to shipment to job site.
2. For extremely large assemblies requiring disassembly for installation, the actuator may be disassembled for shipment and remounted in the field.

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1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Manufacturer’s Special Warranty: Submit standard written warranty against manufacturing defects for manual and electric-motor actuators.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to valve and gate schedule for actuator type, accessories, and sizing information.

B. Provide clockwise closed actuation unless otherwise noted on the valve and gate schedule.

C. Supply chain actuators for manual valves located 7 feet or higher above finished floor.

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2.2 ACCESSORIES

A. Floor Stands:

1. Materials:

a. Stand: Cast iron or fabricated steel**.**
b. Stem Bushing: Sintered bronze.
c. Position Indicator: Bronze.

2. Height to input shaft or handwheel: 32 inch.
3. Base Mounting Requirements:

a. Concrete Floor Mounting: Type 316 stainless-steel anchor bolts.
b. Face of Basin or Offset Mounting: Heavily reinforced, adjustable wall bracket with required anchor hardware using Type 316 stainless steel.

4. Actuator Mounting Requirements:

a. Manual Actuator: Cast iron handwheel on top of floor stand with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut (for rising stem). Where manual effort is greater than 40 lb rim pull with 2 feet diameter wheel, provide geared actuator with a handwheel or crank.

1) Handwheel casting to include the word “OPEN” and an arrow indicating the direction of operation.

b. Gearbox or Direct Powered Actuator: Through bolt holes matched to actuator or gearbox bolting pattern.

5. Non-rising stem position indicator: Mechanical indicator connected to and driven by stem extension and cast position marks on floor stand with the word “OPEN” cast at the top of the travel, and a field mounted aluminum “CLOSED” tag supplied with drive rivets, installed based on number of valve turns.
6. Rising Stem Position Indicator: Permanent markings on transparent stem covers.

B. Stem Covers: Fracture-resistant clear polycarbonate stem covers for rising stems. Closed top with position indicator markings.

C. Extension Stems and Stem Guides:

1. Extension stems and couplings to actuate recessed, buried, below slab valves and gates via operating nut or floor stand mounted actuator.
2. Stem Extensions and Stem Couplings: Alloy steel, hardware of Type 316 stainless steel unless specified otherwise in the respective slide gate specification.
3. Stem and Stem Couplings: Rated for five times the maximum input torque capacity of the actuator.
4. Adjustable, Cast Iron Wall Bracket Type Stem Guides: Include bronze bushing.
5. Spacing: 10 feet spacing or at spacing calculated by manufacturer to prevent buckling with a safety factor of 2 based on design thrust, shaft material and shaft size.

D. Torque Tubes:

1. Supply where shown on the Drawings or Valve and Gate Schedule.
2. Supported by/mated to valve bonnet/yoke.
3. Sized by supplier for the required actuator torque.
4. Drilled specifically for valve and actuator bolt pattern.
5. Internal extension keyed or shaped specifically to mate to valve shaft and fabricated of Type 316 stainless steel.
6. Internal extension designed for axial adjustment for mating purposes.

2.3 MANUAL ACTUATORS

A. Operating Nuts:

1. 2 inch cast iron AWWA design.

   a. Painted Carbon Steel Tee Handle Operator: 2 inch AWWA nut socket end extension length for nut actuated valves where nuts are recessed in valve boxes.
   b. Tee Extension Length: Determine based on nut height as shown on Drawings with handle height approximately 3 feet above operating surface.

2. Operating Nuts Recessed on Concrete: Cast iron floor box with cover and tee handle operator with 2 inch AWWA nut socket end.
3. Nut Operated Non-Rising Stem Buried Valves: Cast iron bonnet skirts, extension pipes valve box and cover. Stem extensions with AWWA nut end to elevation shown on the Drawings or scheduled.
4. Lever type handle on manually operated 4-in and 6-in diameter ductile iron body ball valves and 4-in eccentric plug valves and smaller.

B. Manual Handwheel Actuators:

1. Comply with AWWA C504.
2. Provide manual handwheels actuators for 16-in diameter resilient gate valves and smaller.
3. Provide manual handwheel actuators for knife gate valves 16-in and smaller.
4. Maximum Handwheel Pull: 40 lbs.
5. Handwheel Material: Cast of ductile iron.
6. Handwheel Diameter for Gate Valves Sizes:

   a. For 6-in Valve: 12”
   b. For 8-in Valve: 14”
   c. For 10-in Valve: 16”
   d. For 12-in Valve: 18”
   e. For 14-in Valve: 20”
   f. For 16-in Valve: 22”

7. Handwheel Diameter for Knife Gate Valves:

   a. For 6-in thru 10-in Valves: 16”
   b. For 12-in thru 16-in Valves: 20”

C. Gear-Assisted Manual Valve Actuators:

1. Comply with AWWA C504.
2. Provide gear assisted manual valve actuators for plug valves 6-in and larger.
3. Provide gear assisted manual valve actuators for knife gate valves 18-in and larger.
4. Maximum Handwheel Pull: 40 lbs.
5. Handwheel Material: Cast or ductile iron.
6. Handwheel Diameter for Knife Gate Valves:

    a. For 18-in thru 24-in Valves: 12”

7. Housings: Cast or ductile iron.
8. Worm or helical gear type.
9. Gears: Hardened steel, machine cut and mated.
10. Bearings: Permanently lubricated bronze.
11. Input and Output Shafts: Sealed with greased, waterproof machine shaft seals.
12. Filled with waterproof grease and designed for submerged service where scheduled.

D. Chain Wheels:

1. Supply for manual valves 3 inch diameter or larger mounted 7 feet and greater above operating floor level.
2. Type: Sprocket rim with chain and floating chain guide.
3. Chain Wheel and Guides Materials: Cast iron with hot-dip galvanized chain.
4. Chain Length: Extend to5-1/2 feet above operating floor level.
5. Chain Storage: Include where chains may interfere with personnel egress, made with high-strength thermoplastic polymer in safety orange color.

    a. Basis-of-Design: Trumbull, Model ‘Chain Up’ as manufactured by Trumbull Manufacturing. Inc., or equal.

6. Chain Wall Hooks: Include where feasible to prevent chain from impeding personnel egress.

E. Direct Manual Slide Gate Actuators:

1. Small Gates not Requiring Gear Reduction to Achieve Rim Pull Requirements: Yoke or floor stand mounted handwheel with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut.

F. Gear-Assisted Manual Slide Gate Actuators:

1. Provide manually actuated slide gates where direct mount actuators cannot meet rim pull requirements and design safety factors.
2. Include power actuators where torque requirements dictate.
3. Comply with AWWA C504.
4. Yoke mount for self-contained gates and floor stand mount for non-self-contained gates.
5. Accessories specified hereinabove where pertinent to the application.
6. Handwheel or crank style operator with maximum rim or crank pull of 40 lbs

    a. Crank operators of cast iron construction with revolving brass grip.

b. Handwheel casting to include the word “OPEN” and an arrow indicating the direction of operation.

7. Gear Boxes:

a. Bevel or parallel shaft as required by installation geometry.
b. Fully enclosed cast or ductile iron housings.
c. Suitable for pedestal or yoke (bench) mounting.
d. Mechanical seals on input shafting.
e. Shafting fully supported with anti-friction ball or roller bearings throughout.
f. Precision machined high strength bronze lift nuts.
g. Precision cut steel gears.
h. Input Shafts: Type 316 stainless steel.
i. AWWA drive nut for removable crank, wheel or portable power operator to be 2 inches
j. Single or compound reduction as required to achieve rim pull requirements.
k. No damage to gearbox components with 100 lbs rim pull.
l. Coordinate with gate stem design such that catastrophic failure occurs at stem nut prior to stem buckling.

8. Tandem gear drives where indicated on Gate Schedule. Tandem drives include parallel gear boxes, Type 316 stainless-steel interconnecting shafting, and flexible couplings furnished by the manufacturer.

2.4 ELECTRIC MOTOR ACTUATORS

A. General:

1. Where specified on the Valve and Gate Schedule.
2. Comply with AWWA C542.
3. Actuators for Valves 3 inches and Smaller: 120 Volt, 1 Phase, 60 Hertz power supply.

a. Actuators for Valves Larger than 3 inches and for slide gates and weir gates: 480 Volt, 3 Phase, 60 Hz power supply.

B. 120 Volt Power Actuators:

1. Actuators to have reversing motor, reduction gearing, local position indicator, position limit switches, provision for manual override, 100 to 1000 in-lbs torque range and motor thermal and electronic control protection.
2. Enclosure:

a. Cast aluminum or steel alloy.
b. Powder coated or fusion bonded epoxy finish.
c. NEMA 4X.

3. Power Train:

a. Self-locking planetary epicyclical gear design.
b. Hardened steel gears with bronze bearings.

c. Housing Penetrations: Seal with mechanical seals.
d. Housing: Equip with space heaters.
e. Mounting System: ISO 5211.

4. Actuator for Open/Close/Jog Reversing Service: Proportional/modulating service where required in the equipment specifications or Instrumentation Drawings.
5. Motors:

a. Design for valve actuation service.
b. Insulation: Class F.
c. Split phase capacitor protection.
d. Duty Cycle: 40 percent at 100 degrees F for open/close duty, and 100 percent for modulating duty.
e. 90-Degree Travel Time: 10 to 20 seconds depending on actuator size.
f. Actuator Switches: Have two SPDT 15 Amp rated switches for remote open/close valve position indication.

6. Products: Subject to compliance with requirements, provide one of the following or equal:

a. Series 92 as manufactured by Asahi/America.
b. EPM-6 by Hayward.
c. P Series as manufactured by Promation Engineering, Inc.
d. Or equal.

C. 480 Volt Power Actuators:

1. General: 3 phase 60 hz supply rated, self-contained, totally enclosed with motor, integral reversing starters, local controls, reduction gearing, limit switch gearing, limit switches, control power transformer, torque switches, bored and keyed drive sleeve for non-rising stems, declutch lever, auxiliary handwheel, and local position indication.
2. Separately seal motor and control compartments with space heaters in limit switch, motor, and control compartments.
3. Suitable for indoor and outdoor use, fully functional in ambient temperature range from 40 to 140 degrees F at 100 percent relative humidity.
4. Size to guarantee full travel, seating and unseating torque or thrust as specified by the valve or gate manufacturer.
5. Size to provide torque required to operate valve or gate at 90 percent of nominal voltage.
6. Design Travel Rate:

a. As indicated on valve and gate schedule, and if not so indicated:

1) Gate Valves and Slide Gates: 12 inches per minute.
a) Motors shall be limited to 7.5 HP regardless of travel speed.
2) Globe Valves: 4 inches per minute.
3) Quarter Turn Valves: 30 seconds per 1 foot of throat diameter.

7. Enclosure:

a. Cast iron construction.
b. NEMA 4X for watertightness from pressure hose.

c. NEMA 6 for submergence up to 6 feet for 30 minutes.
d. NEMA 6P for submergence up to 15 feet for 72 hours.
e. IP 68-8 for submergence up to 26 feet for 96 hours per EN 60529.
f. NEMA 7 for Class 1, Division 1 & 2, Groups C & D hazardous environment.
g. Operate successfully a minimum of 10 full cycles under submersion.
h. External Fasteners: Type 316 stainless steel.
i. Include anti-condensation heater, suitable for continuous operation with alarm output to indicate heater failure.

8. Motors:

a. High-starting torque; low stall torque, low inertia, designed and built by actuator manufacturer.
b. Embed thermistor in each motor winding for thermal protection.
c. Insulation: Class F, with a duty rating of at least 15 minutes at 40 degrees F ambient temperature.
d. Electrical disconnection by means of plug and socket. Allow motor removal without loss of lubricant.
e. Hardware to ensure motor runs with correct rotation for required direction of valve travel regardless of power supply connection sequence.

9. Motor Protection:

a. De-energize without damage in the event of a stall condition when attempting to move a jammed valve.
b. De-energize in the event of an over-torque condition.
c. Imbed a minimum of three thermal devices in motor windings to de-energize the motor in case of overheating.
d. Lost phase protection algorithm.

10. Gear Train:

a. Grease filled, O-ring sealed in cast or ductile iron gear case.
b. Suitable for operation in any orientation.
c. Hardened, machine cut steel gears, and precision machined alloy bronze worm gear.
d. Reduction gearboxes as specified in Paragraph “Gear-Assisted Manual Valve Actuators.”

11. Manual Operation:

a. Handwheel which does not rotate during motor operation.
b. Output contact with declutch mechanism to indicate manual operation.
c. Utilize actuator worm shaft/worm wheel to maintain self-locking gearing and to facilitate changeover from motor to manual operation when the actuator is under load. Do not use designs that bypass actuator worm gear or break valve load at worm gear.
d. Automatic return from manual to motor operation upon starting motor.
e. Manual operation capable with seized motor.

12. Position and Torque Calibration:

    a. Sensing by absolute encoder using hall effect sensors. Incremental encoders requiring batteries to retain settings upon loss of power are not acceptable. Settings stored in permanent non-volatile memory.
    b. Torque and travel adjustment parameters:

        1) Position Setting Range: 10 to 5,000 turns, with resolution of 2.81 degrees and accuracy to 5.0 degrees of actuator output.
        2) Torque Setting: 40 to 100 percent of rated torque.

    c. Torque switch bypass for the torque sensing system to inhibit torque switch trip during unseating or during starting in mid-travel against high inertia loads.

13. Wiring and Terminals:

    a. Tropical grade insulated stranded cable of appropriate size for the control and 3-phase power.
    b. Include a removable plug and socket head for termination of all external wiring. Include actuators without plug and socket terminal connections having power and control disconnect switches for ease of maintenance and safety.

14. Controls:

    a. Microprocessor: Based with mechanically and electronically interlocked reversing contactors for Open/Close duty and solid-state contactors for modulating duty.
    b. Local/Off /Remote Selector Switch and Open/Stop/Close Pushbuttons: Mount on actuator face with red and green indication lights for open/close and amber for fault.
    c. Remote On/Off Service: Actuator to accept one remote signal to open and a second remote signal to close.
    d. Modulating Service: When in remote mode, actuator to accept a 4 to 20 mA DC position control signal and position valve 0 to 100 percent of travel in proportion to control signal.
    e. Monitoring Relays: Remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops, and Local-Off-Remote selector switch position.
    f. Gear Actuated Position Transmitter: On modulating duty actuator that is a two-wire device, produce 4 to 20 mA DC signal proportional to 0 to 100 percent travel.
    g. Transmitter: Have easily accessible zero and span adjustment potentiometers.
    h. DC Power Supply: Integral with operator and powered from 110-volt AC internal transformer. Positioner board to provide repeatable accuracy to 0.25 percent of span and have separate trim pots for zero, span, and dead band adjustment.

15. Position Indication: Continuous mechanical dial indication of valve and gate position in step with the actuator at all times in both the hand wheel and motor operation. For modulating applications, graduations on mechanical dial position indicator to be 0 to 100 percent scale.
16. Limit Switches:

    a. Adjustable type to trip at any point between fully opened and fully closed.

b. Mid-travel Switches: Provide as noted in valve and gate schedule.
c. Do not allow set position to be lost if over travel occurs in either manual or electric modes of operation.
d. Two independent and fully adjustable rotary type position limit switches each with 15 Amp DPDT contacts for remote open/close position indication.

17. Torque Switches: Actuator with adjustable torque switches and be responsive to load encountered in either direction of travel.
18. Terminal Compartment:

a. Separate from the inner electrical components of actuator with a watertight seal.
b. Three threaded cable entries.
c. Stud-type Terminals: Embed in a terminal block of high tracking-resistance compound.
d. Three-phase Power Terminals: Shroud from control terminals by means of an insulating cover.

19. Remote Control Stations:

a. For actuators located below the operating floor, located more than 7 feet above the operating floor, or where indicated on the drawings, provide a UL Listed remote control station at the operating floor level with the same enclosure rating as the actuator.
b. Include a Local/Off/Remote selector switch, Open/Stop/Close pushbuttons and Open/Close indicating lights.

1) Local/Off/Remote selector to include padlock mount for the Off position.

c. Include auxiliary contacts for remote indication of switch position.

20. Manufacturers: Provide products by one of the following or equal.

a. IQ/IQM as manufactured by Rotork, Plc.
b. Limitorque QX/MX as manufactured by Flowserve Corporation.
c. EIM TEC2000 as manufactured by Allied Valve, Inc.
d. AUMA SA/SAR as manufactured by AUMA Riester GmbH & Co. KG.

2.5 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Shop inspect and test completed assemblies.
2. Factory performance test each actuator and supply individual test certificates. Submit test certificates prior to shipment of valve actuators. Test equipment to simulate a typical valve and gate load, and record the following parameters:

a. No load current.
b. Current at maximum torque setting.
c. Stall current.
d. Torque at maximum torque setting.

e. Stall torque.
f. Test voltage and frequency.
g. Flash test voltage.
h. Actuator output speed.

B. Owner Inspection:

1. Make completed actuator assembly available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field dimensions are as indicated on Shop Drawings.

3.2 INSTALLATION

A. Install products plumb, square, and true according to manufacturer’s published installation instructions.

B. Securely mount actuators using brackets or hardware specifically designed for attachment to valves/gates.

C. Extend chain actuators to 5-1/2 feet above operating floor level.

3.3 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences according to manufacturer’s requirements and Section 400551 “Common Requirements for Process Valves”.

B. Repair damaged coatings with material equal to original coating.

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3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Perform adjustments during normal occupancy hours.

3.5 DEMONSTRATIONS

A. Train Owner's maintenance personnel to adjust, operate, and maintain actuators.

1. Time Duration: Allow four hours during a single day.

END OF SECTION 400557

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SECTION 400559.23 - STAINLESS STEEL SLIDE GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Stainless steel slide gates.

B. Related Requirements:

1. Section 400523 “Common Work Results for Process Valves” for powered lifting devices.
2. Section 400557 “Actuators for Process Valves and Gates.”

1.3 DEFINITIONS

A. Operating Head: Distance from centerline of gate to maximum water level of channel.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's product information for system materials and component equipment.

B. Shop Drawings:

1. System materials and component equipment.
2. Description of materials cross-referenced to a sectional drawing listing material by trade name and ASTM reference number.
3. Certified shop and installation drawings showing details of construction, dimensions and anchor bolt locations.
4. Installation and anchoring requirements, fasteners, and other details.
5. Descriptive literature, bulletins and/or catalogs of the equipment.
6. The weight of each component.
7. Description of surface preparation and shop prime painting of gates and accessories.
8. Gate identification number, location, service, type, size, design pressure, operator details, stem details, and loads.
9. Listing of forces transmitted to floor stands if applicable.

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1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Manufacturer's Instructions: Detailed instructions on installation requirements, including storage and handling procedures.

C. Source Quality-Control Submittals: Results of shop and factory tests and inspections.

D. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

E. Manufacturer Reports:

1. Certify that equipment has been installed according to manufacturer's instructions.
2. Document activities on Site, adverse findings, and recommendations.

F. Qualifications Statements:

1. Submit qualifications for manufacturer and licensed professional.

1.6 DELEGATED DESIGN SUBMITTALS

A. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for seating pressure.

B. Copy of PE License of Engineer of Record.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of installed slide gates and components.

B. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of manufacturer's recommended spare parts.

B. Tools: Furnish special wrenches and other devices required for Owner to maintain equipment. Provide special tools and spare parts required for normal operation and maintenance of the equipment.

C. O&M Manual: two copies of manufacturer's operation and maintenance manuals.

1. Include required cuts, drawings, equipment lists, descriptions, etc. to instruct operating and maintenance personnel unfamiliar with such equipment.
2. Include trouble shooting data and full preventive maintenance schedules.

D. Factory Representative: Provide one day to instruct representatives of the Owner on proper operation and maintenance of the equipment.

1.9 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF Standard 61 and NSF Standard 372.

B. Perform Work according to standards set by authorities having jurisdiction.

C. Maintain a copy of each standard affecting Work of this Section on Site.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer's instructions.

C. Protect materials from physical damage, moisture and dust by storing in clean, dry location remote from areas involved in construction operations.

1. Provide additional protection according to manufacturer's instructions.

1.12 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Document field measurements on Shop Drawings.

1.13 WARRANTY

A. Furnish three-year manufacturer's warranty for slide gates.

B. Furnish five-year manufacturer's warranty that clear plastic stem covers will not crack, discolor, or become opaque.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Seating pressure:

1. Three feet of water.
2. Measurement: From maximum water surface to centerline of gate.

B. Minimum Vertical Loading: 50 percent of force on the gate from operating head acting on horizontal centerline of gate, multiplied by effective gate area, plus weight of slide and stem.

C. Gate Reinforcement: As required for deflection not greater than 1/360 of span.

D. Operating Head:

1. Safety Factor: Design gate to operate under specified operating head with safety factory of five.

2.2 STAINLESS STEEL SLIDE GATES

A. Manufacturers:

1. Golden Harvest, Inc.
2. Whipps
3. Waterman Industries.

B. Description:

1. Comply with AWWA C561.
2. Self-contained stainless steel slide gate, with extended frame, yoke, lifting stem attached to yoke, lift and lift support, stem, stem guide, and stem block.
3. Size: As indicated on Drawings.
4. Operating Head: fourteen feet.
5. Closure: Conventional.
6. Opening: Upward.

C. Gates: Type 304 stainless steel, self-contained type with disc arranged to lower or raise to open and with guides designed to mount on the face of or embedded in concrete.

1. Disc or Sliding Member: Type 304 and the stainless steel plate reinforced with "U" or angle-shaped stainless steel members welded to the plate not more than 16 inch apart.

a. Deflection: 1/360 of span of the gate under the design head.
b. Reinforcing Ribs: Extend into guides so they overlap seating surface of the guide.
c. A Specially Molded Resilient Seal:

1) Mounted on bottom of embedded unit discs or on the edge of the disc to provide flush bottom closure.
2) Seal Shape: Produce a seating surface with minimum width of 3/4 inch and extend into secondary slot of the guide.
3) Vertical Seal Face: In contact with seating surface of guide providing a proper seal at the corners.

d. Reinforcements, Retainer and Bolts: Same material as disc.

e. The invert of embedded unit frames to have an angle welded to the lower ends of the guides forming a seating surface for a resilient seal mounted on the disc. Angle to be the same material as the guides.

2. Minimum Thickness: 1/4 inch.
3. Configuration: Removable.

D. Guides: Type 304 stainless steel construction, designed for maximum rigidity, weighing a minimum of 3 lbs per foot.

1. Holes for anchor bolts every 18 inches for face mounted units or embedding keyways for embedded units.
2. Guides to extend beneath opening a sufficient amount to support the disc in fully down or open position for downward opening gates.
3. Weld angle to guides across the invert of the opening on face-mounted gates and up both sides of all gates.
4. Provide a rigid sealing system comprising of low friction high abrasion resistant self-adjusting seals of UHMWPE fitted on frame with compression resilient cord seals to ensure forced contact between seal and face of slide.
5. Arrange seal so it deflects 1/16 inch minimum. Angle, strips and bolts to be the same material as the guides.
6. Where guides extend above operating floor, they must be sufficiently strong, so no further reinforcing is required.
7. Where required, the yoke supporting the operating bench stand will be formed by two angles welded at top of the guides providing a one-piece rigid frame.

E. Yokes: Structural steel. Bolted to gate frame.

1. Arrangement: Disc and stem to be removable without disconnecting the yoke.

F. Seats: Impacted into dovetail slots and held in position without use of screws or other fasteners.

1. Maximum Clearance between Seating Faces: 0.004 inch when gate is fully closed.

G. Wedges: Machined brass blocks with angled faces and secured with a stud bolt to prevent slippage during operation.

1. Wedge Types: Side, top, and bottom.

H. Frames: One-piece configuration.

1. Mounting: Channel wall.
2. Material: Type 304 stainless steel.
3. Furnish continuous embed or mounting flange.
4. Thickness: 1/4 inch.
5. Seats: Ultra-high-molecular-weight polymer.
6. Bottom Flush Closure: Resilient seal securely attached to frame along invert.

I. Lifting Nut: Brass.

1. Grease fitting.

2. Polymer bearing pads above and below lifting nut.

J. Lifting Stem: Type 304 stainless steel for the entire length.

1. Tensile Strength: 60,000 psi.
2. Diameter: Of sufficient size at base of thread to lift the weight of the gate, offset the resistance of the gate to the maximum unbalanced head and fully allow for starting impact.
3. Transmit in compression at least two times the rated output of the crank operated floor stand with a 40 effort on the crank.
4. Stems More Than One Section: Joined by stainless steel couplings pinned and bolted to the stems.
5. Threaded and Keyed Couplings of Same Size: To be interchangeable.
6. Bronze Stop Collars: On the stem preventing over closing of the gate.
7. Minimum Diameter: 1-1/2 inch to withstand twice the rated output of the operator.
8. Slenderness Ratio (l/r): Less than 200.
9. Stem Guides: Provide as recommended by manufacturer. High nickel content cast iron, bronze brushed, mounted in a high nickel content cast iron bracket. Adjustable in two directions and spaced at sufficient intervals to adequately support the stem. Spacing not to exceed 10 feet.
10. Configuration: Rising. Removable.
11. Thread: Machine cut threads, Acme type, double lead. Cut threads are not acceptable.
12. Fully lubricated.
13. Maximum Number of Turns: 16 per foot of travel.
14. Stem Covers: Provide rising stem gates with clear fracture resistant polycarbonate covers.

    a. Will not discolor or become opaque for a minimum of 5 years after installation.
    b. Capped, vented, and of a length to allow full travel of gate.
    c. Bottom end mounted in a housing or adapter plate for easy field mounting.
    d. Indicator markings showing gate position.

2.3 FINISHES

A. Stainless-Steel Surfaces: Mill finish.

2.4 ACCESSORIES

A. Hardware: Type 304 stainless steel. Conform to ASTM A193/A194 and F593/F594 unless otherwise specified.

B. Attaching Bolts and Anchor Bolts: Type 304 stainless steel. Furnished by slide gate manufacturer.

C. Nameplates: Per Section 460553, “Identification for Water and Wastewater Equipment.”

2.5 SOURCE QUALITY CONTROL

A. Shop inspection and testing of completed assemblies.

B. Owner Inspection: Make completed clarifier equipment available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner seven days before inspection is allowed.

C. Owner Witnessing: Allow witnessing of factory inspections and test at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify facilities are ready to receive slide gates.

3.2 PREPARATION

A. Clean surfaces according to manufacturer's instructions.

3.3 INSTALLATION

A. Install slide gates according to manufacturer's instructions.

B. Ensure products are installed plumb, true, and free of warp or twist.

C. Locate operators to avoid interference with handrails and other Work.

D. Gate Installation: Under the supervision of the gate manufacturer’s factory representative.

1. Factory Representative: Furnish services for one day. Who has complete knowledge of proper installation, startup and operation of cast iron slide gates. Inspect the final installation and supervise a test of the equipment.

E. If there are difficulties in operation of the equipment due to the manufacturer's fabrication or Contractor's installation, additional service will be provided at no cost to the Owner.

F. Guides: Surface and Flange Mounted.

1. Install guides with expansion anchors.
2. Position guides at elevation as indicated on Drawings.

G. Guides: Recessed.

1. Cut slot in concrete to receive guides.

2. Position guides at elevation as indicated on Drawings.
3. Grout guides in place according to manufacturer's instructions.

H. Sealant:

1. Apply 1/8 inch thick layer of elastomeric sealant to back of frame.
2. Tighten nuts snug until sealant begins to flow beyond frame.
3. Remove excess sealant.
4. Cure sealant for minimum seven days.
5. Tighten nuts to their final positions.

I. Lubricants: Oil and grease as required for initial operation.

3.4 FIELD QUALITY CONTROL

A. Inspection: Verify gate and components alignment, smooth operation, with no binding or scraping.

B. Testing per AWWA C561:

1. Leakage Under 20 feet of Seating Head: 0.05 gpm/ft. of seating perimeter
2. Leakage Under 20 feet of Unseating Head: 0.2 gpm/ft. of seating perimeter
3. After installation, field test slide gates ensuring items of equipment are in compliance with Specifications, including leakage requirements.
4. Leakage tests shall be performed for a minimum 24 hour duration unless otherwise approved by the Engineer.
5. For units failing to meet specified requirements, make necessary change and retest units. If unit remains unable to meet test requirements to Engineer’s satisfaction, it will be replaced with a satisfactory unit at no additional cost to Owner.

C. Manufacturer Services: Manufacturer's representative experienced in installation of products furnished per this Section for a minimum of one day on Site for installation, inspection, field testing, and instructing and training Owner's personnel in maintenance of equipment.

D. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and re-inspect.

1. Make final adjustments to equipment under direction of manufacturer's representative.

E. Furnish physical checkout and installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

F. Submit the equipment manufacturer's Certificate of Field Testing.

G. Submit the equipment manufacturer's Certificate of Functional Testing.

3.5 ADJUSTING

A. Adjust slide gates to provide smooth operation.

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3.6 DEMONSTRATION

A. Demonstrate equipment operation, routine maintenance, and emergency repair procedures to Owner's personnel.

3.7 ATTACHMENTS

A. Slide Gate Schedule:

1. SG-1:

a. Description: Influent Channel, Gate SG-1.
b. Material: Stainless steel.
c. Size: 5 by 12 feet. – Field verify dimensions.
d. Operating Head: 14 feet.
e. Stem Configuration: Rising.
f. Closure: Bottom flush.
g. Opening: Upward.
h. Operator: Motor Actuated with manual handwheel.
i. Area Classification: Class 1, Div 1
j. Motor Power: 480v/3pH/60 Hz
k. Additional Requirements:

1) Gate and actuator construction must be coordinated so that the gate can be opened when subjected to a seating pressure of 1.5 feet above the gate centerline.
2) Gate must seat watertight with allowable leakage specified above when experiencing a seating pressure of 2 feet above the bottom of the gate.

END OF SECTION 400559.23

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SECTION 400561 - GATE VALVES (OWNER-SUPPLIED)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid wedge, resilient-seated gate valves.

B. Refer to the Valve Schedule for Gate Valves that are to be supplied by the Owner as part of a pre-purchase agreement under separate contract.

C. Related Requirements:

1. Section 220523 “General-Duty Valves for Plumbing Piping”: Miscellaneous plumbing valves as required by Project.
2. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.
3. Section 400557 “Actuators for Process Valves and Gates”.

1.3 DEFINITIONS

A. Outside screw and yoke (OS&Y) valve: A valve in which the operating screw is driven by a threaded nut that is built into the handle.

1.4 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this section.

1.5 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C500, C509, C515.

B. Provide Installation Inspection and Operator Training per Section 40 05 51 “Common Requirements for Process Valves”.

C. Provide testing and inspection certificates.

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PART 2 - PRODUCTS

2.1 SOLID WEDGE, RESILIENT-SEATED GATE VALVES

A. Manufacturers:

1. M&H Valve.
2. Mueller
3. J&S Valve.
4. American R/D Valve.

B. Description:

1. Wastewater service.

a. Valve shall have full port nominal port diameter unobstructed when in full open position.
b. Valve shall be rated for solids-laden wastewater service.

2. As specified in Section 40 05 51 “Common Requirements for Process Valves”.
3. Comply with AWWA C509 and C515.
4. Working Pressure: 250 psig at 248 deg. F.
5. End Connections: ASME B16.1, ASME B16.5, and ASME B16.42, flanged.
6. Body: No recesses in valve body.
7. Suitable for horizontal orientation as per process drawings equipped with scrapers. Rollers or sliders as required.

C. Operation:

1. As specified in Section 40 05 51 “Common Requirements for Process Valves”.
2. Stem: Non-Rising. Stem diameters and the prescribed number of turns to open shall be not less than the applicable requirements of Table 8 of ANSI/AWWA C515.
3. Refer to Valve Schedule for operation.

a. Motor Actuated.

1) Provide electric actuators for gate valves >24” according to project drawings and valve schedule.
2) Where shown in valve schedule and drawings, include extended stems and floor stands.
3) See Section 400557 “Actuators for Process Valves and Gates” for electric actuator requirements.
4) Electric actuators shall be provided as a matched assembly from the valve vendor to ensure correct torque and opening speeds are met.

b. Handwheel.

D. Materials:

1. Wedge: ASTM A126, cast iron or ASTM A536, ductile iron, fully encapsulated with synthetic rubber bonded and vulcanized in accordance with ASTM B429, Method B. Mechanically attached seats, exposed iron on the wetted wedge, double-disc construction, metal solid-wedge construction, and metal plow-style designs are not permitted.
2. Body and Disc: ASTM A126, cast iron or ASTM A536, ductile iron.
3. Stem, Stem Nuts, Glands, and Bushings: Type 316 stainless steel.
4. Connecting Hardware: Type 316 stainless steel.

E. Finishes:

1. As specified in Section 40 05 51 “Common Requirements for Process Valves”.
2. Body, Internal and External, Including Bonnet: AWWA C550, Epoxy, 12-mil minimum thickness.
3. Gate: ASTM D2000 EPDM encapsulated or ASTM D429 Method B Bonded and vulcanized.

2.2 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.

B. Testing: Test gate valves according to AWWA C509 and C515.

C. UL and FM approved.

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 400551 “Common Requirements for Process Valves” for compliance requirements.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in position from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. According to AWWA C500, C509, and C515.

B. As specified in Section 400551 “Common Requirements for Process Valves.”

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem above center of pipe or in accordance with contract drawings.

E. Install valve tags. Comply with requirements in Section 400553 “Identification for Process Piping” for valve tags.

3.3 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Engineer.
2. Repair damaged valve or provide new, undamaged valve.
3. After installation, inspect for proper supports and interferences.

B. Pressure Testing: As indicated in piping schedule.

C. Pressure test valves with piping.

3.4 CLEANING

A. Keep valve interior clean as installation progresses.

B. After installation, clean valve interior of soil, grit, loose mortar, and other debris

END OF SECTION 400561

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SECTION 400561.43 - KNIFE GATE VALVES (OWNER-SUPPLIED)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bonneted resilient seat design knife gate valves.

B. Resilient Seat Knife Gate Valves are to be supplied by the Owner as part of a pre-purchase agreement under separate contract. This specification is included for reference.

C. Related Requirements:

1. Section 400557.00 “Actuators for Process Valves and Gates.”
2. Section 400551 “Common Requirements for Process Valves” Administrative requirements and basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves” Submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C520.

B. Provide Installation Inspection and Operator Training per Section 400551.

C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 BONNETED METAL SEAT KNIFE GATE VALVES – Tag Type KGV3, VPKGV3

A. Manufacturers:

1. Pratt Figure F193
2. Hilton Model H-200-BV-T304.
3. Fabri-Valve F134R.

B. Description:

1. Normal Working Pressures: 15 - 35 psig.
2. Minimum Rated Working Pressure: 75 psig.
3. Maximum Fluid Temperature: 120 deg. F.
4. Design:

   a. Pressure-retaining bonnet that fully encloses the gate.
   b. Rising stem or non-rising stem per drawings and valve schedule
   c. Bonnet rated at the same pressure as the valve body; internal gate packing or gate wiper not permitted.
   d. Bi-directional shutoff resilient seat ring.
   e. 2 inch flush and drain ports same material as the wetted parts.
   f. 3/4 inch flush and drain ports same material as the wetted parts.
   g. Type 304 SS body cladding and face rings fully welded to the carbon steel body – "floating" body liners not permitted.
   h. Stainless steel welding pickled and passivated per ASTM A380, A967.
   i. Valves 20 inches and larger, provide hardened gate support strips for valve gates oriented on edge.
   j. Valves shall have nominal full port internal diameter which shall be unobstructed when in full open position.

5. Packing:

   a. Provide packing gland at the top of the bonnet to achieve a tight seal around the stem.
   b. Design Yoke to support the operator without any movement or twisting at the stall thrust capability of the operator
   c. Packing: replaceable without disassembling the valve or removing the valve from the pipeline.

6. Stem:

   a. Rolled Acme threads.
   b. Where shown in drawings, provide extended stem and floor stand

7. Seats:

   a. Fluoroelastomer seating, with 304 stainless steel ring raised seat face.
   b. Bi-Directional Resilient Seats for bubble tight shutoff from both directions.

8. End Connections:

   a. Raised face flanged:

      1) ANSI 125/150 drilling.
      2) Machine groove flange faces to comply with MSS SP-6.

3) Thread flange bolt holes.

9. Actuator:

a. Electric Actuator

1) Provide electric actuators for knife gate valves >24" according to project drawings and valve schedule.
2) Where shown in valve schedule and drawings, include extended stems and floor stands.
3) See Section 400557 "Actuators for Process Valves and Gates" for electric actuator requirements.
4) Electric actuators shall be provided as a matched assembly from the valve vendor to ensure correct torque and opening speeds are met.

b. Handwheel

1) For knife gate valves >= 24"
2) Chainwheel operators required for 24" knife gate valves as shown in project drawings. See Section 400557 "Actuators for Process Valves and Gates" for chainwheel requirements.
3) Handwheel sized to seat and unseat the knife gate valve at the specified operating pressure with a maximum rim pull of 40 lb.
4) If necessary to achieve 40 lb rim pull, provide a bevel gear operator.

a) Fully enclosed and permanently lubricated, with a sealed housing to prevent contamination.
b) Meet the requirements of 400551 - Common Requirements for Process Valves.
c) Provide a stem cover to protect the stem when the valve is in the open position.

C. Materials:

1. Body: Fabricated carbon steel
2. Gate: Type 316 stainless steel
3. Connecting Hardware: Fabricated steel
4. Stem: Type 316 stainless steel

a. Stem nut: acid resistant bronze.

5. Yoke: Carbon steel
6. Packing Gland & Bolts: Type 316 stainless steel

a. Nuts: naval bronze.

7. Wear Strip: UHMW with EPDM o-ring resilient seat
8. Gate Wiper: UHMW

D. Finishes:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Provide standard factory finish coating.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. As specified in Section 400551 “Common Requirements for Process Valves”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. As specified in Section 400551 “Common Requirements for Process Valves.”

B. According to Manufacturer’s Instructions.

END OF SECTION 400561.43

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SECTION 400562 - PLUG VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Eccentric plug valves.

B. Related Requirements:

1. Section 220523 “General-Duty Valves for Plumbing Piping”: Miscellaneous plumbing valves as required by Project.
2. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.
3. Section 400557 “Actuators for Process Valves and Gates”: Requirements for actuators.

1.3 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C517.

B. Provide Installation Inspection and Operator Training per Section 400551.

C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES – Tag Type PV1

A. Manufacturers:

1. DeZurik.
2. M&H Valve
3. Clow Valve Company; a subsidiary of McWane, Inc.
4. Henry Pratt Company; a Mueller brand.

5. Kennedy Valve Company; a division of McWane, Inc.
6. Val-Matic Valve & Manufacturing Corp.

B. Description:

1. As specified in Section 400551 “Common Requirements for Process Valves.
2. Type”:

    a. Offset disc type
    b. Non-lubricated
    c. Serviceable (able to be repacked) under full line pressure
    d. Eccentric.
    e. Capable of sealing in both directions at the rated pressure
    f. Unobstructed flow path when open
    g. Drop tight shut-off to the full valve rating with pressure on either side of the plug.

3. Body:

    a. 30,000-psi tensile strength
    b. Top entry, bolted bonnet
    c. Body shall be cast with integral piping connections

4. Plug:

    a. To be removable without removing the valve from the line.
    b. To have an integral upper and lower shaft:

        1) seals on the upper and lower journals to prevent entrance of solids into the journals.

    c. One piece for all valves.

5. Bearings:

    a. Permanently lubricated.

6. Working Pressure: 150 psig at 70 deg. F.

    a. At the above rated minimum working pressures, certified by the manufacturer as permitting zero leakage for a 5-minute duration with full pressure applied in either direction.

7. Maximum Process Fluid Temperature: 100 deg. F.
8. Ports:

    a. Minimum Port Area: 80 percent of nominal pipe area for valves 20 inches and smaller; 70 percent for valves larger than 20 inches.

9. Seats:

    a. Full 360 degree seating by contact of a resilient seating material on the plug mating with welded-in seating surface in the body.

b. Screw in body seats not acceptable.
c. Resilient and of the continuous interface type having consistent opening and closing torques.
d. Non-jamming in the closed position.

10. Stem Bearings: Self-lubricating.
11. Stem Seals:

a. Type: V-ring.
b. Externally adjustable and repackable without removing the bonnet from the valve, or self adjusting.

12. Packing and Gland: Accessible and externally adjustable.
13. End Connections:

a. Flanged: Comply with ASME B16.1 and B16.42.

C. Operation:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. A suitably sized steel actuator mounting bracket shall be provided to provide an air gap between the actuator and the valve stem seal. Under no circumstance shall the gear box be mounted directly to the top body flange such that leakage could directly enter the gear box.
3. Provide adjustable limit stops for both opening and closing and a clearly marked position indicator.
4. 4 Inches and Smaller: Manual, provided with its own securely attached lever.
5. Greater Than 4 Inches: Worm gear manual operators with handwheel.
6. Furnish chain wheel operators for valves mounted over **7** feet above floor.
7. Where shown on the process drawings, provide electric actuators in accordance with 400557 “actuators for Process Valves and Gates”.

D. Materials:

1. Body:

a. Ductile iron, ASTM A536
b. Lining: Epoxy, as recommended by valve manufacturer for service conditions.

2. Plug:

a. Ductile iron, ASTM A536, Grade 65-45-12
b. Lining: Resilient coating, as recommended by valve manufacturer for service conditions.

3. Seats: Stainless steel 316SS.
4. Stem: Type 316 stainless steel.
5. Stem Bearings: Stainless steel.
6. Seals: PTFE**.**
7. Connecting Hardware: Type 316 stainless steel

E. Finishes: As specified in Section 400551 “Common Requirements for Process Valves”.

2.2 ROUND, FULL PORT PLUG VALVES – Tag Type PV2

A. Manufacturers:

1. VAG/GA ECO Centric.
2. Pratt Ballcentric.
3. Milliken.

B. Round full port plug valves shall be equal in all respects as Tag Type PV1 except plug shape shall provide for a round, 100% open area viewing the open valve from the end.

2.3 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.

B. Testing: Hydrostatic Test Per ANSI B16.1 and B16.5.

C. Submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504-00, Section 5.2.4 and specifically list all exceptions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. According to AWWA C517.

B. Horizontal Piping: Stem horizontal, Plug opening to crown of body.

C. Vertical Piping: Plug at top when closed.

D. Plugs: On top when open and on pressure side when closed.

END OF SECTION 400562

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SECTION 400563 - BALL VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Two-piece brass body ball valves.
2. Thermoplastic ball valves.

B. Related Requirements:

1. Section 220523 “General-Duty Valves for Plumbing Piping”: Miscellaneous plumbing valves as required by Project.
2. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.

B. Provide Installation Inspection and Operator Training per Section 400551.

C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 TWO-PIECE BRASS BODY BALL VALVES 3-INCH AND SMALLER- Tag Type BV3

A. Manufacturers:

1. Apollo Valve.

2. Milwaukee Valve.
3. NIBCO Inc.

B. Description:

1. Standard: MSS SP-110
2. SWP Rating: 150 psi.
3. CWP Ratings for Valves NPS 1/4 to NPS 2: 600 psi.
4. CWP Ratings for Valves NPS 2-1/2 to NPS 4: 400 psi.
5. Body Design: Two-piece.
6. Body Material: Forged Brass.
7. Ends: Threaded or soldered joint.
8. Seats: PTFE.
9. Stem Material: 316 Stainless steel.
10. Stem Extension Sleeve Material: Aluminum to extend operating handle past pipe insulation.
11. Ball Material: 316 Stainless steel.
12. Port: Full.
13. Packing Material: PTFE.
14. Operator: Steel lever with zinc plating and vinyl grip.

2.2 THERMOPLASTIC BALL VALVES

A. Manufacturers:

1. Hayward Flow Control.
2. George Fischer
3. ASAHI,
4. Spears.

B. Description:

1. Working Pressure: 150 psig at 70 deg. F.
2. Maximum Process Fluid Temperature: 100 deg. F.
3. Ports: Full size.
4. End Connections:

a. Flanged: Comply with ASME B16.5
b. Union.

C. Operator: Hand lever

D. Materials:

1. Body and Ball: PVC, ASTM D1784 or CPVC, ASTM D1784. Material to match piping.
2. Seats: PTFE.
3. Seals: EPDM.

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2.3 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.

B. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 INSPECTION

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. According to AWWA C507.

B. As specified in Section 400551 “Common Requirements for Process Valves”.

END OF SECTION 400563

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SECTION 400565.13 - CONE VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Cone valves, to be used as check valves on the discharge line for the six influent pump station pumps.

B. Related Requirements:

1. Section 400551 "Common Requirements for Process Valves" for administrative requirements and basic materials and methods related to valves commonly used for process systems.
2. Section 406196 “Process Control Descriptions” for pump control logic during start-up and shut-down.
3. Section 432341 “End Suction Solids Handling Pumps”.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections as specified in other Sections and as indicated on Drawings.

1.4 SUBMITTALS

A. Product Data: Cone valves.

B. Shop Drawings: Drawings showing installation arrangement of major component assemblies.

C. Source Quality-Control Reports: For cone valves.

D. Qualifications Statement: For manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

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1.6 QUALITY ASSURANCE

A. Manufacturers Qualifications: Company specializing in manufacturing products specified in this Section with minimum 10 years' documented experience.

B. Valve, electro-hydraulic actuator, and controls are to be furnished as a fully integrated assembly by the valve manufacturer. The valve manufacturer shall be responsible for actuator sizing, system integration, assembly, factory testing, operation, and warranty of the complete valve-actuator-control system in accordance with AWWA C522.

1. Certified test reports to be provide upon request.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valves and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

1.8 WARRANTY

A. Furnish five-year manufacturer's warranty for cone valves.

PART 2 - PRODUCTS

2.1 CONE VALVES

A. Manufacturers.

1. Ross Valves

a. Model Ross RCV.

2. DeZURIK, Inc.

a. Willamette AWWA Rotary Cone Valves – Model VMC.

B. Description:

1. Manufactured in accordance with AWWA C522.
2. Conical Plug Type, consisting of:

a. A valve body having waterway inlet and outlet diameters equal to the nominal size of the valve.
b. A fully skirted conical plug having a clear waterway diameter equal to the nominal size of the valve.
c. A cover to enclose the plug in the body.
d. A valve operating mechanism mounted on the cover.
e. A flange body housing with flanged inlet and outlet waterways and flange opening.

1) Provide flange opening with removable plug.

3. Designed for use in horizontal pipeline as indicated on the Drawings.

4. Suitable for pump start-up, shutdown, and throttling service without significant cavitation or excessive vibration. The valve shall operate in the fully opened and in throttling positions without noticeable drifting or vibration of the plug and shall be free of backlash or loose connections in the operating mechanism, linkage, and shaft connections.

5. Operation:

a. Axial motion to unseat the plug; then
b. Rotary motion to open/close the valve; then
c. Axial motion to reseat the plug.
d. During rotation of the plug, provide clearance between the plug and body seat rings at all times so that no contact occurs.

6. Size: As indicated on Drawings.
7. Process Fluid: Screened raw sewage.
8. Maximum Working or Rated Pressure: 150 psig

C. Cone Valve Construction:

1. Body:

a. Materials: Ductile iron; ASTM A536 Grade 65-45 12.
b. Body Flange:

1) Comply with ASME B16.1.
2) Class: 125
3) Flange face: [Flat].

c. Seat: Four Seat Plug.
d. Seats and Seat Rings: Monel.

1) Electrically fused to valve body.
2) Mating seat electrically fused to conical plug.

2. Valves:

a. Provide sleeve-type bearings.

1) Plug Bearings: Stainless Steel, ASTM A756

2) Minimum Bearing Compressive Strength: 2000 psi

b. Provide high strength 17-4PH stainless steel operating shaft.
c. Provide Chevron/V-type packing at shaft seal at head cover.
1) Allow for packing removal via stainless steel or manganese bronze packing gland.
2) Capable of being repacked after the valve is installed.
d. Provide mechanical stops on both ends of the operating mechanism to prevent over travel.

3. All valve components weighing more than fifty pounds shall be provided with lifting eye bolts.
4. Provide inspection opening ample in size to facilitate ease of inspection.
5. Covered access ports shall be provided for lubrication purposes.

D. Cone or Plug:

1. Material: Ductile iron; ASTM A536 Grade 65-45-12.
2. Configuration:

a. Full port plug type.
b. Conical.
c. Replaceable without removing valve from piping.

3. Trunnions:

a. Integrally cast.
b. Body & Head Cover Bushings: Bronze; ASTM B584.
c. Pivot Bearing: Bronze, ASTM B271/B271M.
d. Dowel or taper pin: AISI 420 stainless steel

E. Head Cover:

1. Materials:

a. Material: Ductile iron; ASTM A536 Grade 65-45-12.
b. Inner and Outer Seals: As recommended by manufacturer.

F. Design Criteria

1. Location: Main Equipment Building (B) El. 15.50
2. Application: Influent pump cone check valves
3. Tag #s: Pump #s P1-P6
4. Type of units: Self-contained, rotary actuators
5. Number of units: 6
6. Voltage/phase/HZ: 230V/3ph/60hz
7. Opening time: Between 10 and 30 seconds. Reference Section 406196 “Process Control Descriptions”.
8. Closing time:
a. Normal: Between 10 and 30 seconds, adjustable up to 180 seconds.
b. Loss of power: 10 seconds.
c. Reference Section 406196 “Process Control Descriptions”.

9. Rated torque output: (based on valve OEM)
10. Fail-safe Requirement: Fail closed on loss of power in approximately 10 seconds.
11. Manual override: Hand-pump/Handwheel/drill-drive
    a. All hand pump components shall be Type 316 stainless steel.
    b. A 2" nut shall also be provided to manually operate the valve via electric drill or in similar fashion.
    c. Any manual directional valve shall be stainless steel and/or bronze.
12. Cables and Tubing: 100 Feet or Less
13. Area Classification: Unclassified
14. Requirements for supports for the valves, actuators, piping, and accessories to be coordinated with the delegated design. See Section 400507 "Hangers and Supports for Process Piping".

G. Actuation:

1. Description: Lift, rotate, and lower valve.
2. Shaft and Guides Rods: Stainless steel, 17-4.
3. Linkage: Steel.
4. Lifting Nut: Bronze.
5. Valve Position Indicator:
    a. Include electric limit switches to indicate full valve closure and opening.
    b. Provide non-contact magnetostrictive linear position transducers integrated within the hydraulic cylinder or other approved equal technology to provide continuous feedback on valve position.
    c. Mechanical pointer shall be included on the valve to indicate the position of the valve plug at all times during plug rotation.

H. Actuator:

1. Electric-hydraulic actuator.
2. Provide as a complete assembly that includes a hydraulic actuator, electronics enclosures, motor drive, power supply, dedicated programmable microprocessor controller, field wiring terminals, interconnecting control components, door-mounted HMI, and cables connecting the aforementioned components.
3. Manufacturer:

    a. REXA,
    b. Dezurik,
    c. Or approved equal.

4. Speed: Refer to Design Criteria listed herein.
5. Finishes: manufacturer's standard.
6. Hydraulic Specifications:

    a. Consists of a linear, double-acting hydraulic cylinder connected to the cross head of the cone valve.
    b. Capable of being mounted as shown in the Contract Documents.
    c. Provide sufficient force throughout the entire stroke to overcome breakaway/seating friction and process dynamics.
    d. Design to operate at a standard internal hydraulic operating pressure of 2,000 psi, but will only generate the amount of internal psi required to transfer hydraulic

volume into force capable of overcoming the torque required to move the valve as required at any given moment.

e. Contains pressure limiting devices that allow the user to limit the internal pressure build-up of the hydraulics to 2,200-2,300 psi maximum, and field adjustable to lower values, in order to protect the internals of the hydraulics.

f. Hydraulic actuators that operate at a constant, standard internal pressure greater than 3,000 psi will not be accepted.

g. Actuator shall be rated for continuous-duty open-close and modulating service without restrictions on operating frequency, duty cycle, or number of starts and stops. Actuators requiring thermal cool-down periods or starts-per-hour limitations will not be accepted..

h. Hydraulic Fluid

1) The system shall be designed to use a premium grade; petroleum based hydraulic fluid with minimum flash point of 300 deg F. Hydraulic fluid shall be DTE 24 as manufactured by Exxon Mobil or approved equal. Design temperatures shall be 40 to 115 deg F. The oil shall contain oxidation and rust inhibitor and shall have excellent resistance to foaming with ready release of entrapped air. The hydraulic fluid shall provide a high level of wear protection for high-pressure, high-output hydraulic pumps and shall provide freedom from deposit formation.

2) The hydraulic fluid shall be specifically suited for use in conjunction with all components furnished as part of the hydraulic actuator in accordance with the recommendations of the manufacturers of the various equipment components.

3) The hydraulic fluid shall be as specified by the Hydraulic Power Unit manufacturer. The manufacturer shall submit a statement in writing that wetted parts of the hydraulic system are suitable for extended operation with the hydraulic fluid.

4) Hydraulic filtration to be provided where recommended by the actuator manufacturer.

i. Fail-Safe-Action – As defined below

1) Upon loss of primary power, the actuators shall fail-closed via a charged accumulator system. Accumulator will be dedicated to each valve application, isolated from the normal hydraulic circuit and only activated upon a fail-safe condition.

j. Manual Override: Means shall be provided to manually operate the cone valve in the event of loss of electrical power.

k. Employ a hydraulic circuit that is double-acting, transferring oil from one side of the operating cylinder to the other during normal operation.

1) Oil shall not be transferred to or removed from a reservoir when the actuator makes a position change.

2) Centralized hydraulics employing active reservoirs (used during normal operation) will not be acceptable.

3) Systems that use accumulator-based hydraulics for normal operation shall not be allowed: accumulators shall be used solely for fail-safe operation.

4) Spring-opposed based hydraulic systems will not be allowed.

l. The hydraulic power drive/module assembly must consist of a drive train apparatus containing a bi-directional gear pump and a hydraulic circuit regulating equal volumes of oil flow into and out of the hydraulic cylinder.

1) Provide dual action circuit, acting as a check valve in one direction and throttling valve for the hydraulic pump in the opposite direction.
2) The valves shall direct flow from the pump to cause the actuator to stroke in the direction indicated by the controller.

m. The hydraulic power drive/module assembly must also contain a motor that is directly coupled to the pump within the hydraulic manifold.

1) The motor shall only operate when a valve position change is required. Continuously running motors are not acceptable.
2) Motors shall be of a brushless servo or stepper motor design.
3) Induction motors will not be acceptable.

n. During normal operation, when the motor/pump is stopped, the hydraulic circuit must be closed, securely locking the actuator in place.

o. A pressurized oil expansion chamber integral to the hydraulic manifold with an indicator button to show oil level shall be provided as part of the hydraulic assembly.

1) The expansion chamber shall be isolated from the normal hydraulic circuit by suction check valves and only be used for thermal expansion and contraction of oil in the closed-loop system.
2) The expansion and contraction of oil in the closed-loop system.
3) The expansion chamber shall be under a minimum of 20 psi positive pressure to eliminate atmospheric ingress.
4) A thermostatically controlled cartridge heater shall be included in the hydraulic manifold assembly in order to maintain appropriate oil viscosity in the event ambient temperatures should fall below 40° F.
5) Heaters supplied are only allowed for the purposes of maintaining oil viscosity and shall not be employed as condensation heaters. Condensation heaters are not allowed.

p. Hydraulic seals shall be rated for ~ 1 million full stroke cycles (~ 10 million “dither” cycles defined as <1.0% step changes) before recommended replacement for preventative maintenance.

1) Hydraulic actuators designed for lower duty cycles with recommended seal upgrades for services less than 50,000 full stroke cycles are not allowed.

q. Hydraulic lines shall be hard piped with 316SS per ASTM A269. All tube fittings shall be 316SS. All tube connections shall be straight thread with an O-ring seal.

1) Hydraulic line design and routing shall be a designated design provided by the manufacturer.
2) Installation shall be done by Contractor.

7. Electrical Specifications

   a. Actuators shall be 230V 3ph power.

8. Quality Assurance

   a. The actuators specified under this Section shall be furnished by a single manufacturer with a minimum of 5 years of experience designing and manufacturing actuators in the North American municipal market. Assemble, test, and ship the actuator with the valve as a unit.
   b. The manufacturer shall show evidence of satisfactory operation of 5 separate installations of the same model actuators similar in size & scope, including emergency close functionality, that have been operating for 5 years minimum in a wastewater treatment plant.
   c. Installations that do not meet the minimum duration or that are from other industries will not be accepted as experience. References shall be given, upon request.
   d. Actuators must be supplied as a complete assembly from a single manufacturer, whereby said supplier has a dedicated manufacturing space & process within their facility for providing said product to the field.
   e. Documentation to prove out a dedicated manufacturing process for said product that has existed for 5+ years shall be provided.
   f. Actuators made solely of buy-out sub-assemblies that are not regularly assembled as part of a standard product offering by said supplier will not be accepted.
   g. The actuator must adhere to ANSI/ISA-96.06.01-2014.
   h. The actuator supplier must be ISO 9001 certified and provide documentation to confirm.
   i. Product manuals shall be provided during the submittal phase to confirm said product is a regularly manufactured system.

9. Coordination
   a. The cone valve manufacturer shall procure, mount, test, warranty and ship the cone valves and hydraulic actuators as a unit. The cone valve manufacturer will facilitate all start-up, training and support required for operation of the valve system. The valve manufacturer shall do all necessary coordination with the hydraulic actuator OEM necessary to accomplish this and shall provide the ability for a factory witness test of the valve./actuator.
   b. The cone valve manufacturer and actuator manufacturer shall both provide written confirmation that all torque requirements necessary for design and sizing of the actuator were coordinated. Report the maximum operator torque and maximum allowable stem/seating torques both with and without manufacturers' recommended safety factors in submittals.
   c. The cone valve and actuator manufacturers shall coordinate requirements for hardware to mount the actuator to the valve.
   d. The actuator shall be connected to the valve at the valve OEM, where the actuator will be used to move the valve for any required valve testing. The valve OEM shall not connect the actuator to the valve until a certified technician employed directly by the actuator manufacturer is on-site at the valve OEM to oversee the proper connection of the actuator to the valve. The actuator technician must be on-site for minimum of one full day for each valve.

e. The actuator OEM shall also send a technician to the installation site to oversee and commission the installation of the actuators. Start-up of these actuators shall not commence until the technician is on-site. The actuator technician must be on-site for minimum of one full day for each valve.

I. Finishes: As specified in Section 400551 "Common Requirements for Process Valves."

J. Accessories:

1. Fasteners: stainless steel.

2.2 SOURCE QUALITY CONTROL

A. Testing:

1. Hydrostatically test valve at twice rated pressure for 30 minutes without leakage.
2. Test valve according to AWWA C522.
3. Perform an operational test per AWWA C522.
4. Cone valve shall be pressure tested at 150 psig. The test pressure shall be maintained for a minimum of ten minutes. Acceptable hydrostatic test limits include the absence of visual external body leakage and the structural integrity of the valve body, plug, and associated mechanisms during all hydrostatic tests
5. Cone valve shall be pressure tested at the working pressure. Internal leakage past the closed valve with the working pressure applied alternately to either side of the plug shall not exceed 0.4 fluid ounce per minute per inch of nominal valve size per AWWA C522-22

B. Inspection: Ensure that body and plug seat properly when closed, and are drip tight per AWWA C522.

C. Owner Inspection:

1. Make completed valve assembly available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

D. Owner Witnessing:

1. Allow witnessing of factory inspections and tests at manufacturers' factories.
2. Notify Owner at least seven days before inspections and tests are scheduled.

E. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Thoroughly clean valve before installation.

B. Clean surfaces to remove loose rust, mill scale, and other foreign substances.

3.3 INSTALLATION

A. According to manufacturer instructions.

B. Dielectric Fittings: Provide between dissimilar metals.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Inspection:

1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Architect/Engineer.
2. Repair damaged valve or provide new, undamaged valve.
3. After installation, inspect for proper supports and interferences.

C. Pressure Testing: Pressure test valves with piping.

D. Conduct Functional and Acceptance Testing in conjunction with Section 432341 “End Suction Solids Handling Pumps”.

E. Manufacturer's Field Services: Furnish the services of a qualified representative of each of the various manufacturers as required herein.
1. Representatives shall inspect the installation of equipment, field test the equipment, make any necessary adjustments, field calibrate the equipment upon completion of the installation of each actuator and valve, and place it in initial operation. In addition, the representative shall instruct the operating personnel in the operation, calibration, trouble-shooting, and maintenance of the equipment.
2. Reports: Submit a report from the manufacturer of each visit to the site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction, and all other pertinent information.

F. Tests

1. After installation of the cone valve systems and all appurtenances, subject the units to a field running test under actual operating conditions as required herein and in the Contract Documents.
2. Test cone valves, and hydraulic cylinder actuators in accordance with the approved testing plan, and including the following. The field tests shall be witnessed by the engineer.
    a. Have each actuator open and close the valve through the full range of travel at least four times.
    b. Automatic switch to standby pump operation following duty pump failure.
    c. Emergency close in 10 seconds or less during loss of power.
    d. Demonstrate ability to operate the gate using the accumulator, hand pump or portable operator.
    e. The field tests shall demonstrate that all equipment, controls and monitoring operate as specified and within the allowable leakage rates.
    f. Field test the manual overrides to demonstrate that they can seat and unseat each cone valve

3.5 CLEANING

A. Keep valve interior clean as installation progresses.

B. After installation, clean valve interior of soil, grit, and other debris.

END OF SECTION 400565.13

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SECTION 400567.36 - PRESSURE-REGULATING VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pressure-reducing valves for:

a. Seal water panel at Influent Pump Station.

B. Related Requirements:

1. Section 099679 “Atmospheric Protection and Plant Service Areas Coatings”: Coating and touchup of shop-primed surfaces with primer.
2. Section 400507 “Hangers and Supports for Process Piping”: Anchors and supports.
3. Section 400551 “Common Requirements for Process Valves”.
4. Section 400582 “Solenoid Valves for Process Service”

1.3 COORDINATION

A. Coordinate with installation of process piping and equipment connections as specified in other Sections and as indicated on Drawings.

1.4 SUBMITTALS

A. Comply with Section 400551 “Common Requirements for Process Valves”.

B. Product Data: Submit manufacturer catalog information.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit special procedures and setting dimensions.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

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1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of pressure-regulating valves.

1.6 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 400551 “Common Requirements for Process Valves”.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Furnish two-year manufacturer's warranty for pressure reducing valves.

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PART 2 - PRODUCTS

2.1 PRESSURE-REDUCING VALVES – Tag Type PRV

A. Manufacturers:

1. Ross Valve Manufacturing Co., Troy, NY (Series EP or Series T);
2. Golden Anderson Company (GA Industries), Mars, PA (Model 43-D);
3. Approved equal.

B. Description:

1. Normally open valves to maintain constant downstream pressure regardless of changing flow rate or varying inlet pressure.
2. Type: Direct acting, pressure balanced, spring-loaded, globe body.

C. End Connections:

1. Threaded, ASME B1.20.1.

D. Performance and Design Criteria:

1. Flow Rate:

a. Maximum: Per seal manufacturer.
b. Minimum: Per seal manufacturer.

2. Upstream Pressure:

a. Maximum: 110 psig.
b. Minimum: 60 psig.

3. Set Point Downstream Pressure:

a. Per seal manufacturer.
b. Range: Field adjustable from near zero to 110 percent.

E. Materials:

1. Body: Bronze or brass.
2. Seat: Buna-N or polyurethane.
3. Trim: Stainless steel.
4. Stem, Nut, and Spring: Bronze or stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

3.2 PREPARATION

A. Thoroughly clean end connections before installation.

B. Close pipe and equipment openings with caps or plugs during installation.

C. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. According to manufacturer instructions and local code requirements.

B. Install with nameplate and test cock accessible.

3.4 FIELD QUALITY CONTROL

A. After installation, inspect for interferences and proper supports.

B. Testing:

1. Hydrostatic: Test each assembled valve, except control piping, hydrostatically at 1-1/2 times rated working pressure for minimum five minutes.
2. Leakage:

    a. Test each valve for leakage at rated working pressure against closed valve.
    b. Test Duration: Minimum 15 minutes.
    c. Permitted Leakage: Zero.

3. Perform functional test on each valve to verify specified performance.

C. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

A. Keep interior of valves clean as installation progresses.

3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400567.36

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SECTION 400567.39 - PRESSURE-RELIEF VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Spring-loaded pressure-relief valves.
2. Note: Weight-loaded pressure-relief valves and hydrostatic pressure-relief valves will not be accepted.

B. Related Requirements:

1. Section 400551 – Common Requirements for Process Valves

1.3 COORDINATION

A. Section 013100 “Project Management and Coordination”: Requirements for coordination.

B. Section 013513.24 “Special Procedure for MOPO and Construction Sequence”

C. Coordinate Work of this Section with installation of influent pumps and piping.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Section 400551 – Common Requirements for Process Valves.

C. Product Data: Submit manufacturer catalog information.

D. Shop Drawings: Indicate materials, size, accessories, and other details.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer Instructions: Submit special procedures and setting dimensions.

G. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

I. Qualifications Statement:

1. Submit qualifications for manufacturer.

J. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 017700 “Closeout Procedures”: Requirements for submittals.

B. Project Record Documents: Record actual locations of pressure-relief valves.

1.6 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.

B. Perform Work according to State, Local, and County standards.

C. Maintain one copy of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 400551 – Common Requirements for Process Valves.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

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1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Section 017700 “Closeout Procedures”: Requirements for warranties.

B. Furnish five-year manufacturer's warranty for pressure-relief valves.

PART 2 - PRODUCTS

2.1 PRESSURE-RELIEF VALVES, SPRING LOADED– Tag Type PRV2

A. Manufacturers:

1. DeZURIK APCO: Model 3000A
2. Golden Anderson: 624-D
3. Ross: SWR
4. Substitutions: Or Equal.

B. Description:

1. Size: As indicated on Drawings
2. Spring opposed, angle-pattern design with adjustable relief pressure and locking nut.
3. Performance and Design Criteria:

a. Flow Capacity: 4.3 mgd (estimated).
b. Open Pressure Setting: 40 psig.
c. Pressure Setting Available Range: 20 psig.
d. Closure time: 2 seconds minimum (adjustable).

4. Materials:

a. Body: Ductile Iron.
b. Trim: Type 316 stainless steel.
c. Spring: ASTM A125 steel and isolated from process flow.
d. Seat: EPDM, NPR.
e. Lining: Fusion-bonded epoxy.

5. End Connection: Flanged

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

3.2 PREPARATION

A. Thoroughly clean end connections before installation.

B. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. According to manufacturer instructions and local code requirements.

B. Repair damaged coatings with material equal to original coating.

C. Section 400551 – Common Requirements for Process Valves

D. Installation Standards: Install Work according to State, Local, and County standards.

3.4 FIELD QUALITY CONTROL

A. Testing: Test each valve for leak tightness at 75 percent of set point according to API 2000.

B. After installation, inspect for interferences and proper supports.

C. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

A. Keep interior of valves clean as installation progresses.

3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

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SECTION 400576 – HOT TAPPING VALVES AND LINE STOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes

1. Hot-tapping in-service pipelines.
2. Temporary and permanent line stopping/plugging pipelines.
3. Delegated design.

B. Related Requirements:

1. Section 013513.24 for “Special Procedure for MOPO and Construction Sequence”
2. Section 015000 for “Temporary Facilities and Controls”
3. Section 017419 for “Construction Waste Management and Disposal”
4. Section 024119 for “Selective Demolition”

1.3 SCOPE OF WORK

A. This section covers the mandatory requirements for hot tapping and line stopping (plugging) on pipelines that cannot be removed from service or have construction sequencing constraints that require hot tapping the pipeline during construction. An installation narrative and detailed sequence of construction is described in the following paragraphs. More detailed descriptions of the field installation requirements are included in Part 3.

B. In the text that follows, a “tapping valve” shall be defined as the gate valve that will remain in the line after the work of this section is complete.

C. Preparation and installation of equipment and materials for line stopping shall be in accordance with the Sequence of Construction specified in Section 013513.24, Special Procedures for Maintenance of Plant Operation and Sequence of Construction. Installation of line stopping shall be weather constrained as defined in Specification Section 013513.24.

D. Hot tapping and line stopping shall be used to temporarily plug the existing 48-inch cast iron/ductile iron discharge headers for the influent pumps at two locations, as shown on the drawings, to facilitate removal of the existing pumps, piping, and valves and installation of new pumps, piping, and valves. The two hot taps and line stops will be conducted at separate times, in accordance with Specification Section 013513.24.

E. While they are in place, line stops at each location shall be monitored 24/7 by the Line Stop Contractor.

F. The pipeline locations to be tapped and plugged are in the lower level of the Main Equipment Building Influent Pump Station. The Contractor shall field verify the existing clearances and identify/confirm any other room and equipment dimensions and distances required for preparing an installation plan for hot tapping and line stopping. It is preferred that the tapping equipment be located in the lower level of the influent pump station. The results of the field verification shall be submitted to the Engineer.

G. It is part of the responsibilities of the Contractor to field verify the outside diameter of the existing pipe, and any ovality, or other abnormal dimensional characteristics measured in the pipe, that must be accounted for in the design and fabrication of the hot tap/line stop fitting. The results of the field verification shall be submitted to the Engineer.

H. Prior to performing any work, the Contractor shall determine the wall thickness of the existing cast iron or ductile iron pipe at the tap locations by using ultrasonic testing as described in Section 3.01.A. The results of the testing shall be submitted to the Engineer.

I. The line-stop shall be accomplished utilizing a powered mechanical tapping and plugging system. The system shall consist of a line stop fitting, to be attached to the pipeline, until the pipeline is demolished; gate valve and blind flange cover; sandwich-style temporary tapping gate valves; a powered wet tapping machine; adapter head having the proper joint configuration required to mate with the tapping valve; The line stop shall be accomplished using an inflatable plug system with launch cylinder and inflation ram. The components of the hot tapping and line stopping system shall be designed for a pipeline operating pressure of 35-psi.

J. Tapping machine shell cutters and coupon-retaining pilot drills shall be fitted with removable or permanently-mounted carbide teeth, each installed specifically for this project, having a sharp durable edge. The shell cutter and teeth shall be treated with cutting lubricant to permit efficient cutting and removal of the pipe coupon without binding or seizing. The wet tap operation shall permit the continuous operation of the existing pumping units during the removal of the pipe coupon.

K. All temporary valves, piping, couplings, dewatering, coring, rigging and other necessary work required for successful plugging of the pipeline shall be furnished and installed by the Contractor.

1.4 PRESINSTALLATION MEETINGS

A. Retain "Preinstallation Conference" Paragraph below if Work of this Section is extensive or complex enough to justify a conference.

B. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include detail drawings, material descriptions, dimensions of individual components and profiles, and finishes for all components.
2. Include design pressure rating of the line stop fitting, tapping machine, and line stop equipment.

B. Shop Drawings:

1. Indicate existing pipelines.
2. Indicate proposed installation of the line stop.

    a. Indicate proposed method of supporting existing pipeline if required.

3. Installation plans.

    a. Step-by-step description of installation of tapping and line-stop fittings.
    b. Detailed procedures for inserting, maintaining, and removing line-stops.

4. Certification indicating the design pressure rating of the line stop fitting, tapping machine, and line stop equipment.

C. Product Schedule: For.

1. (2) 48” x 18” bolt-on line stop fitting
2. (2) 18” taps and tapping valves for line stop
3. (2) single line stops on (2) 48” cast iron, screened wastewater lines
4. (2) 8-12” valves for draining and re-filling the forcemains
5. Any additional items required for a fully installed system not mentioned here.

1.6 DELEGATED DESIGN SUBMITTALS

A. Delegated-Design Submittal: For Line Stops; Section 014000 “Quality Requirements” for additional delegated design requirements.

B. Qualifications Statement: Submit qualifications for licensed professional.

1.7 QUALIFICATIONS

A. The Contractor shall employ a specialty subcontractor to perform the wet tap and line stop work. Subcontractor must have demonstrated experience of 10 years with tapping and line stopping work and provide a detailed reference list including at least five (5) successfully performed minimum 18 inches diameter hot taps on a minimum 48” cast iron or ductile iron pipe, including line plugging of pipe, performed under a pressure of 50 psi. The subcontractor’s qualifications including at least 5 projects of similar size pipe, pipe material and complexity must be submitted for approval prior to proceeding with the initiation of any portion of this work. This is also a requirement of the bid.

1. Field Technician Qualification

    a. Hot Tap – Field Technician Qualifications: Hot tap technician actually operating the machinery shall have, as a minimum, a three (3) year continuous employment

history with the Subcontractor and have performed at least 2 hot taps on similar size pipe and pipe material. Subcontractor shall be required to furnish employment history for this technician along with a safety and other operational training summary. In no case shall a technician without proper supporting documentation and qualifications be permitted to work on the job site.

b. Hot tapping field technicians must have as a minimum:

1) 40 hours HAZWOP safety training
2) 10 hours OSHA construction training
3) Technician's safety training records must be provided to the Engineer prior to the start of field operations

2. Field Performance Qualifications

a. Subcontractor must have demonstrated experience of 10 years with tapping and line stopping work and provide a detailed reference list including at least five (5) successfully performed minimum 18 inches diameter hot taps on a minimum 48" cast iron or ductile iron pipe, including line plugging of pipe, performed under a pressure of 50 psi.

b. Reference List Must Include:

1) Project owner for whom the Work was performed
2) Contact name, phone number and email address
3) Date of the field operation
4) Location of the field operation
5) Header size of the operation
6) Operating pressure of the operation
7) Operating temperature of the operation
8) Product used

1.8 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Line Stops and hot-tapping valve assemblies, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

B. Qualification Data: For manufacturer.

C. Retain "Welding certificates" Paragraph below if retaining "Welding Qualifications" Paragraph in "Quality Assurance" Article.

D. Product Certificates: For each type of assembly.

E. Requirements in first paragraph below are for test reports for products on which tests are performed either by independent testing agencies or by manufacturers in their own labs. Retain first option if testing is likely to be performed in manufacturer's facilities and witnessed by a qualified testing agency; retain second option if testing is performed by the testing agency.

F. Retain "Preconstruction Test Reports" Paragraph below if specifying preconstruction testing in "Preconstruction Testing" Article as Contractor's responsibility.

G. Source quality control reports.

H. Field quality control reports.

I. Sample Warranty: For manufacturer's warranty.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For hot-tapping valve to include in operation and maintenance manuals.

1.10 QUALITY ASSURANCE

A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the jurisdiction of the project location.

B. Retain one of two "Installer Qualifications" paragraphs below.

C. Installer Qualifications: Employ a specialty subcontractor to perform the wet tap and line stop work.

D. Section 014000 "Quality Requirements" covers general requirements for testing agency qualifications including defining "NRTL" and "NVLAP." Retain one of two "Testing Agency Qualifications" paragraphs below if referring to standard specifications and practices that focus directly on the kinds of materials and testing involved.

E. Retain "Welding Qualifications" paragraphs below if shop or field welding is required. If retaining, also retain "Welding certificates" Paragraph in "Informational Submittals" Article.

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."

G. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Do not disassemble factory assembled parts and components for shipment unless written permission received from Engineer.

B. Inspection: Accept materials on Site in Manufacturer’s original packaging and inspect for damage. As necessary, provide inspection report to Manufacturer identifying any damage and rework necessary prior to installation.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to Manufacturer’s instructions.

3. Protect unpainted finished iron and steel surfaces to prevent rust and corrosion.
4. Protect finished surfaces of exposed flanges with wood or equivalent blank flanges.
5. Protect bearings against formation of rust in accordance with bearing manufacturer's recommendations. Apply lubricant or corrosion inhibiting treatment during transportation, storage, handling, installation, and lapse of time prior to start-up. Intermittently manually rotate equipment prior to start-up to ensure distribution of lubricant/protection.

D. Retain this article only if providing detailed requirements that apply to Work of this Section and that supplement general provisions in Division 01.

1.12 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace each line-stop permanent assembly that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 3 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. JS Barry Industries, Manchester, NH.
2. TDW Services, Inc., Tulsa, OK.
3. Or an approved equal.

B. Initial Investigations

1. Prior to the placement of material orders for this portion of the project, the Contractor will be required to obtain certain job site data to facilitate the proper manufacture of components needed to complete the work of this section on an operating outfall pipe under pressure.

    a. All job site data listed herein and required by the contractor to perform the work of this section will be submitted to the Engineer a minimum of 90 days prior to the required mobilization of the specialty fittings, equipment, and tapping and line stop technicians to the work site. The Engineer will review the required data and return approved documents to the General Contractor within 30 calendar days.
    b. Prior to fabrication of materials required for the hot tapping and/or line stopping process, the contractor will perform field investigations to determine, the actual conditions of the existing cast iron pipe at the location where the work is to take place and to develop the tapping and line plugging plan and implement the plan.

C. Steel Reinforcing Tapping Saddles for Welded Steel Branches

1. Provide reinforcing saddles for tapping saddles where access is limited.

2. Tapping branches 3-inch diameter and larger to be per ASTM A324, WPD carbon steel reinforcing saddles and meet the requirements of ASME B31.3 and MSS-SP-97.

D. Resilient Wedge Tapping Valves

1. Construct the reinforcing saddles of A106, Grade B or ASTM A516 Grade 70 forged steel.
2. Provide valves that meet the requirements of AWWA C509 or AWWA C515
3. Provide iron body, solid resilient wedge gate.

    a. Compose valve body, bonnet, stuffing box, and disc of grey iron or ductile iron.
    b. Provide stainless steel bolts and nuts for the stuffing box and bonnet.
    c. Working water pressure: 150 PSI minimum.
    d. Flanged valves:

        1) Face-to-face dimension per ANSI B16.10
        2) Flanges per ANSI B16.1

4. Non-rising stem gate valves:

    a. Provide stems made of bronze or stainless steel.
    b. Provide at least one thrust washer above and below the stem collar to reduce operating torque.
    c. Factory lubricate thrust collar.
    d. Use permanent lubricant for long term ease of operation.
    e. Provide O-ring sealed stuffing box, one ring below and two rings placed above the stem thrust collar.
    f. Isolate thrust collar and o-rings from waterway and outside contamination.
    g. Design non-rising stem such that if excessive input torque is applied, stem failure occurs above the stuffing box at such a point as to enable the operation of the valve with a pipe wrench or other readily available tool.
    h. Fully encapsulate valve wedge and guide lugs in rubber material.
    i. Provide cast iron hand wheel with permanent labeling of “OPEN” and an arrow showing opening direction counter-clockwise.
    j. Coat valve interior and exterior ferrous surfaces with fusion bonded epoxy per AWWA C550.
    k. Hydrostatically test all valve bodies to twice the rated working water pressure.
    l. Seat test valves bi-directionally at the rated working pressure.

        1) Seat leakage not to exceed one fluid ounce per inch of valve diameter per hour.

5. Determine if valves specified have a bore large enough to accept the shell cutters for the tapping machine.
   Fire-test-response characteristics in first two paragraphs below are generally included to ensure compliance with regulatory requirements. Place characteristics here if they are applicable to all products in this Section and their performance, once installed, is part of a fire-rated assembly. Place characteristics in individual product descriptions if each product has different characteristics and performance, or locate overall criteria, including test methods and listing requirements, here and product-specific performance values in

each product description. Never use terms such as "fire-hazard classification" or others implying some degree of fire-risk assessment.

E. Bolts and Nuts

1. Flange nuts.

a. Manufactured of ASTM A194 grade 2H steel.
b. Course thread, class 2A fit per ANSI B16.2.
c. Square or hexagonal dimensions per ANSI B18.2.1.

2. Flange bolts.

a. Install using nickel anti-seize compound.
b. Degrease of protective oils and excess anti-seize compound prior to field application of coating system.

F. Non-Insulation Flange Gaskets

1. Compressed non-asbestos aramid fiber.

a. 1/8 inch thick.
b. Ring-type configuration with interior and exterior dimension as required by pipe size.
c. Adhesive-backed gaskets are acceptable.

G. Insulation Flange Gaskets and Accessories

1. Dielectric insulating gaskets.

a. Furnish as kit, including:

1) Dielectric gasket.
2) Mylar bolt sleeves with a dielectric strength of 4000 volts/mil minimum.
3) Phenolic resin insulating washers with a dielectric strength of 400-500 volts/mil

b. Install where flanged joints transition from steel to ductile or gray iron.
c. Install where exposed piping transitions to buried piping.
d. Install as shown on Drawings.

2. Insert requirements for mill testing and inspecting for compliance with specified fabrication tolerances.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Perform an initial field inspection of the pipe under the supervision of the Engineer to verify the location of the line stop.

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B. Determine the condition of the existing pipeline and exact dimensions (outside diameter, ovality, wall thickness, or other abnormal dimensional characteristics) prior to shop fabrication of the line stop fitting. Accurate measurement of the pipe dimensions may require insulation and lead paint removal.

C. On steel, gray, cast iron, and ductile iron pipe, verify the actual thickness of the pipe wall at the location of the tap by ultrasonic thickness testing.

1. Testing to be performed by an ASNT Level II NDE Inspector.

D. Contractor to provide either 3/76/230 or 3/38/480 electrical supply within 50 ft of electric/hydraulic unit placement and electric/hydraulic unit must be located within 50 ft of tap location.

E. Contractor to confirm pipe sizing, material, and classification.

F. The contractor is responsible for ensuring the bolt-on line stopping fitting (to remain on the line) meet any applicable code requirements.

G. The contractor is to supply man-lift/staging to reach line stopping locations.

H. Contractor to provide rigging/assistance for all tapping/line stopping equipment from the service vehicle to the tapping location, mounting of the tapping/line stopping equipment at the job location, and back to the service vehicle when the project is complete.

I. Contractor to provide any support/reinforcement to existing piping to support total weight of fitting/equipment/valve.

J. Contractor to provide support for line stopping equipment while it is in use (supporting the neck of the fitting and/or launch cylinder)

K. Contractor to backfill/equalize pressure on the drain side of the line after work is complete and prior to flow being reinitiated within the system.

L. Valve placement needs to take place on a section of pipe free of any welds, joints, fittings, etc. It is not recommended to perform a tap over an existing weld on a pipe (damage to the pipe and tapping machinery can occur).

M. Contractor to provide 110V/15Amp electricity and ½” water supply within 100 feet of tapping/line stopping locations.

N. Contractor to provide a controlled means to drain and verify the effectiveness of the intended outcome of the line stop(s).

O. Contractor to confirm there is no leakage in the drain side of the pipeline prior to disassembling the pipe. Contractor to provide a means to control any leakage through the line stop once the drain side of the line pipe is disassembled.

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3.2 INSTALLATION

A. Install line stop as indicated by manufacturer. If fitting is installed by welding, notify the Engineer at least 48-hours prior to performing the work to allow time to schedule NDE examination of welds by Owner's inspection consultant.

1. While in place, monitor line stops 24 hours a day until the pipe is ready to be put back in service, before removal.
2. After the tapping saddle is successfully inspected and prior to the installation of the tapping valve, conduct a leakage test using the 1-in diameter outlet connection included in the nozzle section of the hot tap/line stop fitting.
3. Carry out the leakage test using water at a pressure of 40 psi for ½ hour.

    a. Notify the Engineer prior to allow witness of the leakage test.

B. After a successful leakage test, install the tapping valve and tapping machine.

C. Design the tapping machine cutting components (shell cutter and pilot drill) to provide a clean cut at the pipe wall, and retain the cut coupon for removal.

D. Upon approval from the Engineer, perform the tap and withdraw the cutter.

END OF SECTION 400576

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SECTION 400578.21 - AIR RELEASE VALVES FOR WASTEWATER SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Air release valves for wastewater treatment facilities.

B. Related Requirements:

1. Section Manufacturer’s standard: Preparing, priming, and painting surfaces, including field-applied and equipment finishing.
2. Section 400507 “Hangers and Supports for Process Piping”: Anchors and supports.
3. Section 400551 “Common Requirements for Process Valves”: Typical product and installation requirements for valves specified in this Section.
4. Section 404213 “Process Piping Insulation”: Insulation applied to process piping systems.

1.3 COORDINATION

A. Coordinate Work of this Section with installation of process piping.

1.4 PREINSTALLATION MEETINGS

A. Section 400551 “Common Requirements for Process Valves”.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer catalog information.

B. Shop Drawings: Indicate on assembly drawings materials, dimensions, weights, and end connections.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit special procedures and setting dimensions.

E. Source Quality-Control Submittals: Indicate results of tests and inspections and provide required certifications.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

H. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.

I. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of air release valves.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Furnish standard manufacturer's warranty for air release valves.

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PART 2 - PRODUCTS

2.1 AIR RELEASE VALVES FOR WASTEWATER SERVICE – Tags ARV-0050-1 through ARV-0050-6

A. Manufacturers:

1. DeZURIK (APCO) 4” Model 400
2. Or Equal.

B. Description:

1. Stems and Bodies: Long-float type to minimize clogging.
2. Small orifice assembly air release valves shall automatically release air accumulations from pipe while under positive pressure. When valve body fills with air, float mechanism shall fall to open small orifice and exhaust air to atmosphere. When air has been exhausted, float mechanism shall be buoyed up and shall tightly close small orifice.
3. Shall be specifically designed for grit and sewage service.
4. Air release valves shall be supplied with shutoff ball valves.

C. Materials:

1. Body and Cover: Type 316 Stainless steel or Ductile iron, ASTM A536
2. Float: Type 316 stainless steel
3. Seat: Buna-N
4. Internal Trim: Type 316 stainless steel
5. Hardware: Type 316 stainless steel

D. Normal Working Pressures: See minimum operating pressure and design pressure on valve schedule in Drawings.

1. Provide softer durometer seats as necessary to prevent leakage.

E. Pressure Rating: 150 psig.

F. Minimum Orifice Diameter: 5/16”

G. Size: As indicated on Drawings.

H. End Connections:

1. Size 1/2 to 3 Inches: Threaded.
2. Size 4 Inches and Larger: Flanged.

I. Backflush kit for each valve:

1. Minimum 2 brass shut-off valves
2. Minimum 5 feet of hose with galvanized steel quick disconnects
3. 316 stainless steel piping sized pursuant to manufacturer recommendations of sufficient length for flushing inlet and outlet quick connections to reach within 5 feet above the finished floor or grating below

2.2 FINISHES

A. Prepare piping appurtenances for field finishes as specified in Manufacturer’s standard.

2.3 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Owner Inspection:

1. Make completed air release valve assembly available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolthole configurations or design, and verify that new pipe and flanges mate properly.

3.2 PREPARATION

A. Thoroughly clean end connections before installation.

B. Close pipe and equipment openings with caps or plugs during installation.

C. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. According to manufacturer instructions.

B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.

C. Vent the valve properly and pipe outlet to nearest drain or as directed by the Engineer.

3.4 FIELD QUALITY CONTROL

A. Inspect for interferences and proper supports.

B. Testing:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Demonstrate operation without undue noise or vibration.

C. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than eight hours on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.

D. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.
3. Repair damaged coatings with material equal to original coating.

E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

A. Keep interior of air release valves clean as installation progresses.

3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.21

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SECTION 400578.29 - COMBINATION AIR VALVES FOR WASTEWATER SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Combination air valves for wastewater treatment facilities.

B. Related Requirements:

1. Manufacturer’s standard: Preparing, priming, and painting surfaces, including field-applied and equipment finishing.
2. Section 400507 “Hangers and Supports for Process Piping”: Anchors and supports.
3. Section 400551 “Common Requirements for Process Valves”: Typical product and installation requirements for valves specified in this Section.
4. Section 404213 “Process Piping Insulation”: Insulation applied to process piping systems.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Section 013100 “Project Management and Coordination”: Requirements for coordination.
2. Coordinate Work of this Section with installation of process piping.

B. PREINSTALLATION MEETINGS

1. Section 400551 ”Common Requirements for Process Valves”.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Indicate materials, dimensions, weights, and end connections on assembly drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Product Data: Submit manufacturer catalog information.

C. Manufacturer Instructions: Submit special procedures and setting dimensions.

D. Source Quality-Control Submittals: Indicate results of tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections and provide required certifications.

F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

G. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.
3. American Iron and Steel(AIS): Submit certification indicating compliance with AIS requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of combination air valves.

1.7 QUALITY ASSURANCE

A. Manufacturer Quality Management System: Certified to ISO 9001.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

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1.10 FIELD CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. Furnish five-year manufacturer's warranty for all air valves.

PART 2 - PRODUCTS

2.1 COMBINATION AIR VALVES FOR WASTEWATER SERVICE – Tag Type CAV

A. Manufacturers:

1. DeZURIK (APCO) 4” Model 440
2. Or Equal.

B. Description:

1. Type:

a. Fully automatic, float operated.
b. Body: Single.
c. Throttled.

2. Comply with AWWA C512.
3. Size: As indicated on Drawings.
4. Suitable for sewage service.
5. Normal Working Pressures: See minimum operating pressure and design pressure on valve schedule in Drawings.

a. Provide softer durometer seats as necessary to prevent leakage.

6. Pressure Rating: 150 psig
7. Minimum Orifice Diameter: 7/32”
8. Combination air valves:

a. Perform the functions of an air/vacuum valve (exhaust large quantities of air on start-up, admits air on shut-down) and air release valves (release air continuously during operation) to maintain system efficiency and prevent pipeline surges.

C. Materials:

1. Body and Cover: Type 316 Stainless steel or Ductile iron, ASTM A536.
2. Float: Type 316 stainless steel.
3. Seats: Buna-N.

4. Seals: Buna-N.
5. Hardware: Stainless steel

D. End Connections - Single Body:

1. Size 4 Inches and Smaller:

a. Threaded, NPT.
b. 1-Inch Valves: Furnish 2-inch inlet.
c. Engineer approved equal.

2. Size 4 Inches and Larger: Flanged, ASME B16.1.

a. Engineer approved equal.

E. Backflush kit for each valve:

1. Minimum 2 brass shut-off valves
2. Minimum 5 feet of hose with galvanized steel quick disconnects
3. 316 stainless steel piping sized pursuant to manufacturer recommendations of sufficient length for flushing inlet and outlet quick connections to reach within 5 feet above the finished floor or grating below

2.2 VACUUM BREAKER/AIR RELEASE VALVE – Tag Type VBV and Tags ARV-0056-1 through ARV-0056-4:

A. Manufacturers:

1. DeZURIK (APCO) Model 4” 1500A/2” 400 ARV.
2. Val-Matic Valve & Manufacturing Corp Model 4” 1804VBS /2” 48A.
3. Substitutions: As specified.

B. Description:

1. Type:

a. VB with center guided spring loaded disc.

1) Spring shall be designed to withstand 100,000 cycles without failure.
2) Valve shall open when a vacuum/pressure differential exceeds 0.25 psi.

b. SARV Fully automatic, float operated.
c. Body: Dual.

2. Size: 4” VBV and 2” SARV.
3. Suitable for sewage service.
4. Normal Working Pressures: See minimum operating pressure and design pressure on valve schedule in Drawings.

a. Provide softer durometer seats as necessary to prevent leakage.

5. Minimum Orifice Diameter: 3/16”
6. Pressure Rating: 150 psig.
7. Maximum Operating Temperature: 180 degrees F.
8. Vacuum breaker valves shall perform the functions of an air inlet valve upon vacuum (admits large quantities of air upon vacuum condition) and air release valves (release air continuously during operation) to maintain system efficiency and prevent pipeline surges.

C. Materials:

1. Body and Cover: Type 316 Stainless Steel or Ductile Iron.
2. Float: Type 316 Stainless steel.
3. Seats: Buna-N.
4. Seals: Buna-N/Nitrile.
5. Trim: Stainless steel.
6. Hardware: Stainless steel.

D. End Connections:

1. Size 1/2 to 3 Inches: Threaded.

2. Sizes 3 inches and larger: Flanged, ASME B16.1.

E. Backflush kit for each valve:

1. Minimum 2 brass shut-off valves
2. Minimum 5 feet of hose with galvanized steel quick disconnects
3. 316 stainless steel piping sized pursuant to manufacturer recommendations of sufficient length for flushing inlet and outlet quick connections to reach within 5 feet above the finished floor or grating below

F. Accessories:

1. Accessories, including inlet shutoff valve.
2. Epoxy lining.

2.3 INSULATION

A. As specified in Section 404213 “Process Piping Insulation”.

2.4 FINISHES

A. Prepare piping appurtenances for field finishes as specified by manufacturer’s standard.

2.5 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Owner Inspection:

1. Make completed air release valve assembly available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

3.2 PREPARATION

A. Thoroughly clean end connections before installation.

B. Close pipe and equipment openings with caps or plugs during installation.

C. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. According to manufacturer instructions.

B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.

C. Vent the valve properly and pipe outlet to nearest drain or as directed by the Engineer.

3.4 FIELD QUALITY CONTROL

A. Inspect for interferences and proper supports.

B. Testing:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Demonstrate operation without undue noise or vibration.

C. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than eight hours on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.

D. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.
3. Repair damaged coatings with material equal to original coating.

E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

A. Keep interior of air release valves clean as installation progresses.

3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.29

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SECTION 400582 - SOLENOID VALVES FOR PROCESS SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Solenoid valves for process applications.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.
2. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with process piping Work as specified in other Sections and as indicated on Drawings. Note that solenoid valves may be shown on Electrical and/or Mechanical Drawings, or may only be specified, but provide if so specified or shown. Provide solenoid valves located in hazardous classified areas with electrical enclosures which satisfy the electrical classification as specified or shown on the electrical drawings.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information, indicating materials of construction, wiring diagrams, and compliance with indicated standards.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

B. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.6 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Section 017700 “Contract Closeout”: Requirements for warranties.

B. Furnish one-year manufacturer's warranty for solenoid valves.

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PART 2 - PRODUCTS

2.1 SOLENOID VALVES (SLOW CLOSING) – Tag Type SV

A. Manufacturers:

1. ASCO Valve Inc., Division of Emerson Industrial Automation, Florham Park, NJ (ASCO Series 8210).
2. Versa Products Company, Paramus, NJ (Series V and T).
3. Fluid Controls Division, Parker Hannifin Corporation, New Britain, CT (Gold Ring Series 22, 23, 24, and 28).

B. Description:

1. Type: Two-position, two-way pilot-operated slow closing solenoid valves.
2. Valve body: Equipped with a pilot and bleed orifice, which uses the line pressure to lift and lower the diaphragm for opening and closing the valve.
3. Snubber: Included to slow the disc closing speed and reduce water hammer as classified in FCI 82-1.

C. Materials:

1. Valve body: ASTM B584 high-strength yellow brass with female NPT threaded connections in accordance with ASME B1.20.1.
2. Seals and discs: NBR rubber and polytetrafluoroethylene (PTFE).
3. Core tube and springs: ASTM A276, Type 305 stainless steel.
4. Piston: Stainless steel or brass, manufacturer’s standard alloy.
5. Body assembly cap screws: Type 316 stainless steel.

D. Solenoids:

1. One-piece molded epoxy design.
2. Operate on 120V, 60Hz/110V, 50Hz power, unless otherwise scheduled and have a continuous duty rating regardless of the application.
3. Meet the requirements of NEMA ICS 6, and have a “General Use” listing in the UL Gas and Oil Equipment Directory; and/or the UL Hazardous Location Equipment List.
4. Solenoids scheduled with Type 4X enclosure rating (watertight, corrosion resistant): As defined in NEMA 250, as a minimum. Furnish Type 4X solenoids with “Hirschman” style pinned connectors in accordance with DIN 43650.
5. Solenoids installed in spaces requiring a Type 7 rating in accordance with NEMA 250: Meet the requirements of UL 698 and/or UL 1002, and the requirements of this Section.
6. Insulation:

    a. NEMA Class F insulation for ambient temperatures up to 125 degrees F. Ensure process fluid temperatures used with valves having NEMA Class F insulation does not raise the surface temperature of the solenoid coil in excess of 300 degrees F.
    b. NEMA Class H insulation for temperatures up to 140 degrees F. Ensure process fluid temperatures used with valves having NEMA Class H insulation does not raise the surface temperature in excess of 350 degrees F.

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2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. As specified in Section 400551 “Common Requirements for Process Valves”.

B. Install protective strainers upstream of solenoid valves, pressure-reducing valves, and pressure-sustaining valves.

3.2 FIELD QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.

END OF SECTION 400582

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SECTION 400593.13 - MEDIUM-VOLTAGE MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes medium-voltage, three-phase motors for application on equipment provided under other Sections.

B. Manufacturer of driven equipment shall provide the associated motor.

C. Related Requirements:

1. Section 260573 “Power System Studies”.

1.3 ALLOWANCES

1.4 DEFINITIONS

A. DE: Drive end.

B. ODE: Opposite drive end. See NDE.

C. NDE: Non-drive end. See ODE.

D. NETA ATS: Acceptance Testing Specification.

E. ODG: Open Drip-Proof, Guarded.

F. ODP: Open Drip-Proof.

G. RTD: Resistance Temperature Detector.

H. TEAAC: Totally-Enclosed Air to Air Cooled.

I. TEPV: Totally-Enclosed Force Ventilated.

J. TEWAC: Totally-Enclosed Water to Air Cooled.

K. TEXP: Totally-Enclosed, Explosion-Proof.

L. THD: Total harmonic distortion.

M. VFC: Variable-frequency motor controller. See VFD.

N. VFD: Variable-frequency drive. Used interchangeably with the term VFC.

O. WPI: Weather Protected, Type I (1).

P. WPII: Weather-Protected, Type II (2).

1.5 ACTION SUBMITTALS

A. Product Data: For each type and rating of motor indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include nameplate data, compliance with specified standards, electrical ratings and characteristics, physical dimensions, frame size, weights, mechanical performance data, support points and the following:

    a. Descriptive bulletins, including full description of insulation system.
    b. Bearing design data.
    c. Efficiency at ½, ¾ and full load.
    d. Power factor at ½, ¾ and full load.
    e. Conduit entry points and sizes.
    f. Special features and accessories (i.e. space heaters, temperature detectors, etc.).

B. Shop Drawings: For each type of rating of motor indicated.

1. Include a tabulation of installed devices with features and ratings.
2. Include dimensioned plans and elevations.
3. Include a plan view and cross section of equipment base showing clearances, manufacturer's recommended work space, and locations of penetrations for grounding and conduits. Show location of anchor bolts and leveling channels.
4. Include details of equipment assembly. Indicate dimensions, weights, loads, required clearances, method of field assembly, and location and size of each field connection.
5. Include copy of nameplate.
6. Wiring Diagrams: Power and low-voltage.

C. Copy of this specification, confirming compliance with each paragraph. Clearly note exceptions.

D. System testing plan for functional demonstration upon completed installation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which, the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around motors and the driven process equipment.
2. Show process equipment layout and relationships between electrical components and adjacent structural and mechanical elements. Include location of light fixtures, sprinkler piping and heads, HVAC ducts and diffusers.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For manufacturer.

C. Seismic Qualification Certificates: For each motor, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of motor from manufacturer.

E. Product Test Reports: For each motor unit assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data for motors and accessories as required in Section 017823 “Operation and Maintenance Data”.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Touchup Paint: Three half-pint containers of paint matching enclosure's exterior finish.

1.9 QUALITY ASSURANCE

A. Electric motors driving identical equipment shall be identical.

B. Testing Agency Qualifications: Member company of NETA.

1. On-site lead technician with NETA certification of a level 3 or higher, or equivalent certification.

1.10 DELIVERY, STORAGE AND HANDLING

A. Ship motor fully assembled, capable of being lifted in one piece. Comply with Section 016000, “Product Requirements” for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instruction.
2. Energize motors furnished with space heaters to prevent condensation throughout the storage and construction period. Perform periodic motor insulation resistance tests per manufacturer’s storage recommendations.
3. For extended outdoor storage, remove motors from equipment and store separately.
4. Maintain bearings during storage and construction period, and periodically rotate the motor shaft per manufacturer’s storage recommendations.
5. Lubricate per manufacturer’s recommendations and inspect purged grease for water, rust, or other contaminants.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. WEG.
2. GE
3. Siemens

2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.

B. Comply with the latest revision of the following as applicable:

1. NEMA MG 1, “Motors and Generators”.

C. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, including conditions imposed by reduced voltage starting methods, and without exceeding nameplate ratings or considering service factor.

D. Horsepower rating: Size for operation within the full load nameplate rating without applying the service factor, throughout the full range of mechanical or hydraulic operating condition.

E. Specific motor application data such as Hp, rpm, enclosure type, accessories, etc., are specified under the detailed process equipment specification.

F. Nameplates: Engrave or emboss on 316 stainless steel fastened to the motor frame with stainless steel screws or drive pins with information per NEMA MG 1.

G. Space heater: Include 120-volt space heater for moisture control on all motors.

H. Service Factor: 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40 degrees C ambient, unless otherwise noted.

I. Motors and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Product Selection for Restricted Space: Drawings indicate maximum dimensions for process equipment and associated motors, including clearances between equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.

K. Torsional critical speed: First or second torsional critical speed shall be outside the operating speed range for all VFC controlled motors.

L. Starting intervals: Per NEMA MG 1.

M. Cooling provisions: Maintain temperature rises at design levels while operating at the lowest constant torque operating condition and throughout the speed range. Provide auxiliary cooling fans if required.

N. Motors connected to VFCs: Comply with NEMA MG 1, Part 31.

O. Motor Requirements:

1. Motor Type: Induction.
2. Physical Orientation: Vertical.
3. Operating System Voltage and Configuration: 4160 V, three-phase, 60 Hz, delta.
4. Maximum Horsepower: 700 HP.

5. Synchronous Speed: 509 RPM.
6. Service Factor: 1.15.
7. Guaranteed Efficiency: 92.4 percent at 60 Hz, full load.
8. Minimum Power Factor: 72.7 percent at full load.
9. Duty: Continuous
10. Ambient Temperature Rating: 40 degrees C.
11. Altitude Rating: Not exceeding 3300 feet (1000 m).
12. Enclosure: WP1**.**
13. Starting Method: Reduced voltage - Autotransformer.
14. Space heaters for condensation control.
15. Accessories: Per process equipment Section.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Motors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the motor will remain in place without separation of any parts when subjected to the seismic forces specified and the motor will be fully operational after the seismic event."
2. Component Importance Factor is 1.0.
3. Component Amplification Factor: 2.5.
4. Component Response Modification Factor: 6.0.

2.4 INDUCTION MOTORS

A. Enclosure and Frame:

1. NEMA enclosure type as specified in the process equipment specification.
2. NEMA frame for the associated horsepower.
3. Motor frames: Cast iron or welded heavy plate steel box frame construction, stiff enough to withstand the rotating forces and torques generated and designed to limit or avoid harmonic resonances.
4. Provide lifting lugs or provisions on motor frame.
5. Hoods, baffles, and ducts: Corrosion-protected steel.
6. Access covers: Aluminum, cast iron or sheet metal and easily removable for maintenance.
7. Condensate drain openings: Locate drain openings and breathers for removal of accumulated moisture.
8. Hardware: Corrosion resistant machined bolts, screws, and other hardware shall be standard UNF/C thread, hex head type and shall be stainless steel. Metric hardware is not allowed.
9. Nameplates: Engraved or embossed stainless steel plates fastened to the motor frame with stainless steel screws or drive pins. Clearly indicate all items of information listed in the applicable part of NEMA MG 1.
10. Main terminal box: Fabricated steel with bolted and gasketed cover with handles, oversized for stress cone terminations and specified accessories such as lightning arresters, surge capacitors, and differential current transformers. Include provisions for equipment grounding conductor termination. Mount box as shown on process drawings.

11. Bearing housings: provide machined surfaces for attaching a magnet mounted accelerometer to monitor the motor vibration in the vertical, horizontal, and axial directions at each bearing housing.
12. Frame grounding: provide motor frame grounding pad or threaded stud where supplemental grounding to frame is indicated on the drawings.
13. Corrosion resistant mill and chemical duty paint.
14. Air filters for WPI and WPII enclosures: Reusable, washable type inlet air filters with corrosion resistant stainless steel screens. Provide air differential pressure switch for the detection of clogged air filters.

B. Windings:

1. Copper.
2. Vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance.
3. Insulation rating: Class H.
4. Temperature rise: Class B at 1.0 SF, Class F at 1.15 SF.

C. Motor Leads:

1. Same insulation class as windings.
2. Sized for motor nameplate amperes at 1.0 SF.
3. Permanent identification marking, corresponding to nameplate identification.

D. Stator:

1. Built-up core using high grade, low loss silicon steel laminations keyed or dovetailed to the stator frame and securely held in place at each end.
2. Class F or better glass reinforced polyester for coil slot wedge material.

E. Rotor:

1. Forged or rolled steel shaft, machined, smooth finish, with sufficient strength for operation including 25 percent overspeed condition.
2. Shaft end coordinated with driven equipment coupling.
3. Rectangular copper or copper alloy rotor bars, tightly fitted in the slots and permanently locked in slot, brazed to resistance rings at each end of rotor.
4. Rotor end rings to be free of circumferential joints.
5. Entire assembly coated with protective coating.

F. Vertical Bearings: per manufacturer, thrust type.

1. Bearings: Manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements.
2. Life: Rated for an in-service L 10 life of 100,000 hours, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft currents: Provide mitigation per process equipment specification.

5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

2.5 STANDARD ACCESSORIES FOR ALL MEDIUM VOLTAGE MOTORS

A. Space heaters: Silicone rubber strip type, accessible for inspection, rated 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads brought out to a separate terminal box. Emboss the heater wattage and voltage on the motor nameplate.

B. Shaft grounding ring/device for motors connected to variable frequency controllers.

C. Stator temperature sensors: Six 100 Ohm platinum (PT 100), three-wire resistance-type temperature detectors (RTDs) embedded in the stator windings, two per phase, symmetrically installed between stator coils where highest temperature will occur. RTD leads brought out to separate terminal box on the motor frame. One RTD set in each phase to be operational and one RTD set to be spare.

D. Accessory terminal boxes: Separate cast iron motor mounted terminal boxes for RTDs, space heaters, and other specified accessories, arranged to rotate in 90 degree increments to accommodate conduit entry from any quadrant.

E. Grounding: Minimum of two copper faced pads on motor frame, grounding terminal mounted in the main terminal box.

2.6 ADDITIONAL ACCESSORIES

A. Bearing temperature sensing: Number, type, and location for motor and driven equipment per process equipment specification.

1. RTD: Replaceable 100 Ohm platinum (PT 100) three-wire RTD's, with spring loaded tip. Mount RTD as close as possible to outer surface of each bearing. RTD includes conduit connection head, terminal block, and cabling brought out to a common terminal box.
2. Dial type thermometer.
3. Temperature relay, furnished with indicating scale.
4. Iron or copper constantan thermocouple.

B. Bearing vibration sensors: Number, type, and location for motor and driven equipment per process equipment specification. Sensor cabling brought out to a common terminal box.

1. Proximity type.
2. Accelerometer.

C. Differential motor protection: Provide three window-type current transformers (one per phase), mounted in the main terminal box to provide self-balancing differential protection. Pass each phase motor lead through individual current transformers. Transformer ratios per contract drawings.

D. Surge protection:

1. Surge Arresters: Comply with IEEE C62.11, Distribution Class; metal-oxide-varistor type, with ratings as indicated, one per phase, mounted in the main terminal box.
2. Surge Capacitors: Non-PCB type, used in conjunction with a surge arrester and mounted in the main terminal box.

E. Anti-backspin device: Provide shaft mounted, mechanical non-reverse ratchet rated at 100 percent of motor full load torque for immediate protection against reversing due to phase reversals or from backspin at shutdown.

F. Acoustical attenuation: As required to meet the specified sound pressure level.

2.7 POWER FACTOR CORRECTION CAPACITORS

A. Select the Power Factor Correction Capacitor (PFCC) rating to provide an operating power factor of the motor between 93 to 95 percent at full load and 95 to 98 percent when partially loaded. The capacitor current shall not exceed the motor no-load magnetizing current.

B. Provide the required capacitor and capacitor information to the medium voltage motor controller manufacturer for inclusion inside the controller package.

C. Capacitors: UL listed, NEMA rated and tested, three phase dry film or non-PCB dielectric liquid insulated, with three current limiting fuses rated for 100kA interrupting capacity at 5kV, equipped with internal discharge resistors and fuse loss indicators, mounted in hermetically sealed steel enclosure suitable for conduit connection. Covers shall be gasketed, bolt-on type.

2.8 IDENTIFICATION

A. Nameplates

1. White background / black lettering, 1-inch high lettering.
2. Identify all motor termination boxes with voltage rating.
3. Identify all motor accessory boxes with accessory designation.

2.9 SOURCE QUALITY CONTROL

A. Induction Motor Factory Testing: Prior to shipment perform manufacturer’s standard tests in accordance with NEMA MG 1 and IEEE 112.

B. Include all travel costs for two personnel (one Owner and one Engineer representative) to witness the factory tests. Travel costs include but are not limited to sufficient days/nights necessary for transportation, lodging, meals, and expenses to complete successful testing of all motors. Notification and scheduling of tests: minimum three weeks prior to test.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

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3.1 EXAMINATION

A. Upon delivery of motor and prior to unloading, inspect equipment for damage.

B. Comply with DELIVERY, STORAGE, AND HANDLING article within this specification.

3.2 INSTALLATION

A. Prepare rigid foundation or mounting surface to minimize vibration and maintain alignment between motor and load shaft.

B. Install the motors per manufacturer's installation instructions.

C. Anchor motor base to load bearing surface with grade 5 steel bolts or better.

D. Align the motor shaft with driven equipment according to manufacturer’s written instructions. Adjust axial position of motor frame with respect to load shaft.

E. Accurately adjust flexible couplings for direct drive according to machine manufacturer’s guidelines. Check alignment to minimize vibrations. Coupling spacing shall be according to coupling manufacturer guidelines.

F. Install motor branch circuit conduits and conductors in accordance with NEC and local code requirements.

G. Terminate the motor leads as shown on the connection diagrams.

H. Ground equipment according to Section 26056, “Grounding and Bonding for Electrical Systems”.

I. Tighten electrical connections and terminals according to manufacturers' published torque values.

J. Install conduit and wiring between motor auxiliary devices and associated indicators, controllers and protective devices in accordance to installation drawings.

K. Connect devices sensitive to electromagnetic interferes such as RTD's, thermistors, thermal protector switches, vibration sensors with shielded instrumentation wiring per installation drawings.

L. Comply with NECA 1.

M. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553, "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each motor terminal box with engraved nameplate.

3.4 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until motors are ready to be energized and placed into service.

B. Lubrication and Shaft Rotation: Lubricate parts and rotate shaft periodically according to manufacturer’s written instructions until motors are ready to be energized and placed into service.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Perform inspections and tests for induction motors according to the Inspection and Test Procedures for Rotating Machinery stated in NETA Acceptance Testing Specification paragraph 7.15.1. The following optional tests are required: alignment checks: air-gap spacing, manual rotation of rotor and shaft, shaft extension runout measurement; insulation power-factor or dissipation factor; vibration.

E. Perform inspections and tests of other applicable motor major components (instrument transformers, surge arresters, etc.) in accordance with NETA ATS for that component. Optional tests listed in NETA ATS are required.

F. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

G. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each motor exterior for detection of hot spots in stator or bearings.
2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor 11 months after date of Substantial Completion.
3. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

H. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

I. Motors will be considered defective if they do not pass tests and inspections.

J. Prepare test and inspection reports, including a certified report that identifies the motor and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP AND ADJUSTMENT

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions. Confirm motor is structurally, mechanically, and electrically ready for start-up. Checks include support system, vibration isolation, alignment, lubrication system, and cleanliness.

C. Verify correct phase rotation at motor with driven equipment uncoupled. Correction for phase rotation to be made in the motor terminal box.

D. Prepare inspection and test reports. Include adjustment settings made.

3.7 DEMONSTRATION / SYSTEM FUNCTION TESTS

A. Run motor for system testing as required in motor controller and driven equipment specifications.

B. Confirm correct operation of all protective and metering devices. Confirm correct polarity on current transformers.

C. Measure voltage and motor running current and evaluate relative to load conditions and nameplate full load amperes. Corrective action is required for any current imbalance 10 percent or greater.

D. Prepare driven equipment system testing report. Include results of all tests and check made, meter readings and recordings, and summary adjustments made. Clearly identify any discrepancies and concerns.

END OF SECTION 400593.13

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SECTION 404213 - PROCESS PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Process piping insulation.
2. Jacketing.
3. Accessories.

B. Related Requirements:

1. Section 078400 “Firestopping” for product requirements for firestopping and placement by this Section.
2. 099679 “Atmospheric Protection and Plant Service Areas Coatings” for execution requirements for painting insulation jackets and coverings as specified by this Section.

1.3 PREINSTALLATION MEETINGS

A. See Section 013100 “Project Management and Coordination” for preinstallation meeting requirements.

B. Convene minimum one week prior to commencing Work of this Section.

1.4 ACTION SUBMITTALS

A. See Section 013300 “Submittal Procedures” for submittals requirements.

B. Product Data: Product description, thermal characteristics, list of materials, and thickness for each service and location.

C. Samples: Submit two samples of representative size, illustrating each insulation type.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Manufacturer's Instructions: Manufacturer's published literature indicating recommended installation procedures.

C. Qualifications Statements:

1. Qualifications for manufacturer and applicator.
2. Manufacturer's approval of applicator.

1.6 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame-spread index of 25 and maximum smoke-developed index not exceeding 50, according to ASTM E84.

B. Comply with ASTM C585 for inner and outer diameters of pipe insulation.

C. Factory-fabricated fitting covers according to ASTM C450.

D. Perform Work according to standards set by authorities having jurisdiction.

E. Maintain a copy of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Applicator: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. See Section 016000 “Product Requirements” for transporting, handling, storing, and protecting products requirements.

B. Accept materials on-Site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Inspection: Accept insulation on-Site in manufacturer's packaging. Inspect for damage.

D. Store insulation according to manufacturer's instructions.

E. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.9 AMBIENT CONDITIONS

A. See Section 015000 “Temporary Facilities and Controls” for ambient condition control facilities for product storage and installation requirements.

B. Install insulation only when ambient temperature and humidity conditions are within ranges as recommended by manufacturer.

C. Maintain recommended temperature and humidity before, during, and after installation for minimum of 24 hours, or longer if required by the product manufacturer’s instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. See Section 017700 “Closeout Procedures” for warranties requirements.

B. Furnish five-year manufacturer's warranty for human-made fiber.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass Fiber and Mineral Fiber Insulation:

B. Manufacturers:

1. CertainTeed LLC; Saint-Gobain North America.
2. Johns Manville; a Berkshire Hathaway company.
3. Knauf Insulation.

C. Closed-Cell Elastomeric Insulation:

D. Manufacturers:

1. Aeroflex USA.
2. Armacell LLC.
3. K-Flex USA.

2.2 PIPE INSULATION

A. Type P-2: Molded glass fiber.

1. Comply with ASTM C547. Comply with ASTM C795 for application on austenitic stainless steel.
2. Thermal Conductivity: 0.24 Btu-in./h-sq. ft.-deg. F at 75 degrees F.
3. Operating Temperature Range: Zero to 850 degrees F.

B. Type P-5: Flexible, closed-cell elastomeric and tubular.

1. Comply with ASTM C534, Type I.
2. Thermal Conductivity: 0.27 Btu-in./h.-ft.-deg. F at 75 degrees F.
3. Operating Temperature Range: Minus 70 to 180 degrees F.

2.3 PIPE INSULATION JACKETS

A. Vapor-Retarder Jacket: White kraft paper with glass-fiber yarn, bonded to aluminized film.

1. Comply with ASTM C921.
2. Water Vapor Permeance: 0.02 perms complying with ASTM E96.

B. PVC Plastic Pipe Jacket: One-piece, molded-type fitting covers and sheet material.

1. Color: Off-white.
2. Comply with ASTM D1785.
3. Thickness: 15 mils.
4. Connections: As recommended by the insulation manufacturer.

C. Aluminum Pipe Jacket:

1. Comply with ASTM B209.
2. Sheet Thickness: 0.016 inches .
3. Finish: Embossed.
4. Joining: Longitudinal slip joints with 2-inch laps.
5. Fitting Covers: Description: Die-shaped, with factory-attached protective liner.

    a. Thickness: 0.016 inches .

6. Metal Jacket Bands:

    a. Width: 1/2 inches .
    b. Thickness and Material: 0.015 inches aluminum.

2.4 PIPE INSULATION ACCESSORIES

A. Vapor-Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2-Inch Diameter and Smaller:

1. Galvanized-steel insulation protection shield.
2. Comply with MSS SP-69, Type 40.
3. Length: Based on pipe size and insulation thickness.

D. Piping 2-Inch Diameter and Larger:

1. Wood insulation saddle, hard maple.
2. Inserts Length: Not less than 6 inches.
3. Thickness and Contour: Match adjoining insulation.

E. Closed-Cell Elastomeric Insulation Pipe Hangers:

1. Polyurethane insert with aluminum single-piece construction and self-adhesive closure.
2. Thickness: Match pipe insulation.

F. Insulating Cement:

1. Comply with ASTM C195.
2. Hydraulic setting on mineral wool.

G. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. See Section 017300 “Execution” for examination and installation requirements.

B. Verify that piping and equipment has been tested before applying insulation materials.

C. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Fire-Rated Penetrations:

1. Continue insulation through penetrations of building assemblies or portions of assemblies having fire-resistance rating of one hour or less.
2. Provide intumescent firestopping when continuing insulation through assembly.
3. Finish at supports, protrusions, and interruptions.

C. Piping Systems Conveying Fluids Below Ambient Temperature:

1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
2. Jacketing:

a. Furnish factory-applied or field-applied vapor-retarder jackets.
b. Secure factory-applied jackets with pressure-sensitive adhesive with self-sealing longitudinal laps and butt strips.
c. Secure field-applied jackets with outward-clinch expanding staples, and seal stapled penetrations with vapor-retarder mastic.

3. Fittings, Joints, and Valves:

a. Insulate with molded insulation of like material and thickness as adjacent pipe.
b. Finish with glass cloth and vapor-retarder adhesive or PVC fitting covers.

D. Inserts and Shields:

1. Piping 1-1/2 inch Diameter and Smaller: Install galvanized- steel shield between pipe hanger and insulation.
2. Piping 2 inch Diameter and Larger:

   a. Install insert between support shield and piping, and under finish jacket.
   b. Insert Configuration: Minimum long, of thickness and contour matching adjoining insulation; may be factory fabricated.
   c. Insert Material: Compression-resistant insulating material suitable for planned temperature range and service.

3. Piping Supported by Roller-Type Pipe Hangers: Install galvanized- steel shield between roller and inserts.

E. Closed-Cell Elastomeric Insulation:

1. Push insulation onto piping.
2. Miter joints at elbows.
3. Seal seams and butt joints with manufacturer's recommended adhesive.
4. If application requires multiple layers, apply with staggered joints.
5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

F. Prepare pipe insulation for finish painting as specified in “099679 “ Atmospheric Protection and Plant Service Areas Coatings”.

3.3 ATTACHMENTS

A. Process Piping Insulation Schedule:

1. Protected Water:

   a. Type P-2 or P-5.
   b. Thickness: 2 inches

END OF SECTION 404213

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SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes procurement of the services of a Process Control System Supplier (PCSS) to provide all materials, equipment, labor, and services required to achieve a fully integrated and operational system as specified herein, in “Related Requirements” under this Article, and in related drawings, except for those services and materials specifically noted.

B. Under this contract, the PCSS will also serve as the Applications Engineer System Supplier (AESS).

C. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on the Drawings or not.

D. All equipment and installations to satisfy applicable Federal, State and local codes. Refer to Electrical drawings for area classifications for Class and /Division ratings.

E. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.

F. Related Requirements: The XX in the numbers below indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference, e.g. Section 4062XX “Sections for Computer System Hardware”:

1. Section 4062XX “Sections for Computer System Hardware.”
2. Section 4063XX “Sections for Control System Equipment.”
3. Section 4066XX “Sections for Network and Communication Equipment.”
4. Section 4067XX “Sections for Control System Equipment Panels and Racks.”
5. Section 4068XX “Sections for Process Control Software.”
6. Section 406863 “Configuration of HMI Software.”
7. Section 406866 “Configuration of Controller Software.”
8. Section 407000 “Instrumentation for Process Systems.”
9. Section 4071XX “Sections for flow measurement.”
10. Section 4072XX “Sections for level measurement.”
11. Section 4073XX “Sections for pressure, strain, and force measurement.”

12. Section 4077XX “Sections for position and motion measurement.”

G. HMI screen display configuration to match the characteristics (font style, size, color, symbols, etc.) of the existing plant-wide system and be developed in accordance with the current Nassau County SCADA standards. Coordinate with Client’s Operator and tie required signals into the existing HAHC WIMS system.

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.

1.4 PREINSTALLATION MEETINGS

A. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to 4 hours.

B. Conduct a submittal review coordination meeting after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS.

1. Proposed agenda items should include, but are not limited to:

a. Review comments made on the submittal package
b. Refine scheduled deadline dates
c. Coordinate equipment installation activities
d. Provide a forum for any further required coordination between the PCSS and AESS.

2. The meeting will last up to 4 hours.

C. Conduct a testing coordination meeting at least two weeks prior to factory testing occurring.

1. Proposed agenda items should include, but are not limited to:

a. Discuss the specifics of the proposed tests
b. Provide a forum for coordination between hardware, software, and cybersecurity testing being performed.

D. Attendance at General Contractor’s MOPO workshop.

E. The plant's existing SCADA system must continue to operate during transition between existing plant facilities and new facilities provided under this contract.

1. Coordinate with the plant and contractor to ensure that work on existing SCADA system allows Operations to view and control existing equipment for the duration of this project.

F. The PCSS will conduct a meeting to discuss the control philosophy for restarting and sequencing the plant equipment following a power outage.

1. Required Attendees:

a. General Contractor,
b. Major equipment vendors impacted by the restart,
c. Generator Vendor

2. General guidance is included in 406196 "Process Control Descriptions," which must be updated to reflect specifics of equipment installed for this project.

G. Monthly on-site or conference call coordination meetings with Engineer, Contractor, and Vendors, as required prior to any field start-up or activity testing begins.

H. Schedule the mandatory coordination meetings as described herein. Hold the meetings at the Owner's designated location and include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the AESS Project Engineer, if applicable. Other Division 40 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Schedule the meeting for a minimum of one week before the requested meeting date.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, mountings, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of control equipment, control panels, and instrumentation as specified herein.
4. Include diagrams for power, signal, and control wiring.

C. Qualifications Submittal:

1. For non-listed PCSS', submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to indicate compliance with the Quality Assurance requirements of this Section. The Qualifications submittal is required to be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements is grounds for rejection as a PCSS. The Qualifications Submittal to contain the following:

    a. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
    b. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
    c. Copy of UL-508 certificate for panel fabrication facilities.
    d. Project references for water or wastewater projects as defined in the "Quality Assurance" paragraphs.
    e. Documentation to demonstrate the ability to complete this project including resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

D. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. Submit for approval the Project Plan before further submittals are accepted. The Project Plan to contain the following:

    a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications.
    b. Preliminary list of HMI software, PLC software, and PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. The review and approval of software and hardware systems as part of this Project Plan stage does not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer's approval.
    c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
    d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop drawings, control system architecture and I/O wiring diagrams.

2. Define Exceptions to the Specifications or Drawings in a Deviation List consisting of a paragraph-by-paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the

proposed substitution so that an evaluation may be made by the Engineer. Specifically state if no exceptions are taken to the specifications or drawings. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. The PCSS must coordinate their work with the General Contractor's overall schedule. PCSS schedule incorporates all PCSS milestones including but not limited to the following:

    a. Schedule for all subsequent project submittals. Include the time required for Contractor's submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
    b. Proposed dates for all project coordination meetings.
    c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
    d. Software purchasing and configuration (following approval of related submittals).
    e. Shipment of instrument and control system equipment.
    f. Installation of instrument and control system equipment.
    g. Testing: Schedule for all testing.
    h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
    i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
    j. Listing of all major graphics and PLC programs intended to be created or modified for this project. Indicate if graphic or program is new or existing.

4. Component and Wiring Identification and Tagging Plan:

    a. All components provided by PCSS require a tag, label, or nameplate. Review specifications and provide a plan indicating the tagging and labeling scheme used by the PCSS for the following:

        1) Instruments.
        2) Panel Hardware.
        3) Standalone hardware or communication equipment.
        4) Wires and communication cables.

    b. Provide detailed information so Engineer can review the following characteristics for each type of tag, label, or nameplate for the different types of components provided above:

        1) Size or range of size of the tag, label or nameplate.
        2) Font style.
        3) Material.
        4) Color(s).

E. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. Base the I/O list on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.

3. Submit the I/O list in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
4. Reflect all active and spare I/O points on the I/O list. Add points to accommodate spare I/O's as required in the specifications.
5. Arrange the I/O list so that each control panel has a dedicated worksheet, which includes the following information:

    a. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, break out the tag loop number to allow for sorting by loop.
    b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
    c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
    d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
    e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
    f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points is "1."
    g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
    h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
    i. P&ID - the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
    j. LOGICAL POINT ADDRESS: I/O address of each point.
    k. EXISTING or NEW I/O POINT: Indicate if point is existing (E) or new (N).
    l. CONDITION OF EXISTING SIGNAL: Condition of existing I/O signals to be noted as functional (F) if working properly or if not functioning (NF) with issue described.

6. Sort the I/O list in order by:

    a. Physical location.
    b. I/O Type.
    c. Loop Number.
    d. Device Tag.

7. Once the I/O list is approved, the PLC I/O addresses are not to be modified without approval by the Engineer.
8. Where multiple sets of mechanical equipment are provided for process redundancy, arrange their field connections to I/O modules so that the failure of a single I/O module will not disable the redundant system.

    a. This applies to all I/O types.
    b. The acceptability of the I/O arrangement is at the discretion of the Engineer.

9. For I/O layout requirements, refer to Section 406343 "Programmable Logic Controllers."

F. Field Instruments Submittal:

1. Refer to section 407000 “Instrumentation for Process Systems” for submittal requirements.

G. Control System Architecture**,** Hardware and Software Packages Submittal:

1. Refer to the sections below for equipment required as part of the Hardware and Software Packages submittal:

   a. Section 4062XX “Sections for Computer System Hardware.”
   b. Section 406343 “Programmable Logic Controllers”
   c. Section 406343 “PLC Hardware and Software.”
   d. Section 4068XX “Sections for Process Control Software.”
   e. Section 4066XX “Sections for Network and Communications Equipment.”
   f. Section 4067XX “Sections for Control System Equipment Panels and Racks.”

2. For each hardware and software packages component specified in the sections above, submit a cover page that lists date, specification number, product name, manufacturer, model number, location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
3. Complete system architecture drawing(s) showing in schematic form the interconnections between major hardware components including, control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels with PLCs, and networked peripherals such as power monitors, security cameras, etc. The PCSS is required to provide unique network architecture drawings for the following networks:

   a. SCADA
   b. Security
   c. HVAC
   d. Electrical/Power Monitoring.
   e. Cybersecurity Monitoring.

4. Develop the system architecture drawing(s) in accordance with the following information and guidelines:

   a. Show power connections to each piece of equipment or grouping of equipment with voltage and power sources noted such as 120VAC UPS battery, 24VDC battery, or 120VAC from LP (lighting panel). Indicate specific UPS number or circuit number whenever possible.
   b. All communication cable types should be uniquely identified with a specific linetype, and cable characteristics clearly indicated in a key or legend located on drawing(s). For example, 50/125-micron multimode mode fiber, or CAT6 Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing that states if no quantity exists above a linetype, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend to clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic

cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)

c. All communication cables need to be assigned a unique cable identification label and shown in either a table or above the communication line.
d. Identify network protocols for each communication path or for system indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP/IP, or DNP3.
e. Indicate which port or connection number the communication cable is terminating at any device that has multiple ports or connection points. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.
f. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing clearly references other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted at a later date.
g. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors (i.e. tower computer vs. desktop computer vs. rack mounted). Vendor CAD libraries are preferred for symbols.
h. Develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.
i. Use a minimum sheet size of 11"x17" and use of more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Clearly identify line continuations between drawings.

5. Coordinate with the information provided in these submittals with information provided in Cybersecurity related submittals provided as part of Section 408100 “Industrial Control System Cybersecurity.”
6. Provide a software schedule or spreadsheet which clearly indicates which software packages and operating systems are loaded onto which computers and servers.

H. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Panel Layout Drawings: Submit Drawings for all panels specified. Draw to scale panel assembly and elevation drawings, detailing all equipment in or on the panel. Use 11-inch by 17-inch sheet size for panel drawings and include the following:

a. Clearly indicate a legend sheet with all symbols used on drawings and with voltage, color and size of each wire and in accordance with requirements of Section 406733 “Panel Wiring.”
b. Interior and exterior panel elevation drawings to scale.
c. Nameplate schedule.
d. Conduit access locations.
e. Panel construction details.
f. Cabinet assembly and layout drawings to scale. Include a bill of material on the assembly drawing with each panel component clearly defined. Cross-reference the bill of material to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
g. Fabrication and painting specifications including color (or color samples).

h. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.

1) Where intrinsically safe systems are utilized to satisfy requirements for hazardous locations, comply with the NEC (NFPA 70 Art. 504). Provide intrinsically safe control drawings as required by NFPA 70 Art. 504.10. Intrinsically safe control drawings that follow the recommendations of ISA RP12.2.02-1996 are also acceptable.

a) Indicate the method for intrinsically safe wiring methods as required by Section 406717 “Industrial Enclosures.” Specifically note the methods of separation, clearances, and grounding and bonding utilized.

i. Submit evidence that all control panels are constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections are be borne by Contractor.

2. Wiring Diagrams Submittal:

a. PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. Include drawings in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.

b. Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring includes the device ISA-tag and a unique numeric identifier. Diagrams identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring numbered with rack number, slot number, and point number. Two-wire and four-wire equipment to be clearly identified, and power sources noted. Submit final wire numbering scheme. Provide panel drawings that are 11-inch by 17-inch in size.

c. Furnish Loop Drawings for each monitoring and control loop. Prepare Loop Drawings in accordance with the latest edition of ISA Standard S5.4, Instrument Loop Diagrams. Provide drawings sized 11 inches by 17 inches. Include all information required by the standard. Show separate partitions for field devices, junction boxes, marshalling cabinets, control panels, motor control centers, PLC panels, and PCS/SCADA cabinets, as applicable. Identify all interconnections,

cables, wire numbers, wire colors, terminal blocks, terminal numbers, grounding, shielding, power sources, network connections, and I/O assignments. Submit drawings in native AutoCAD (.dwg) and PDF formats. Include the following information for each loop:

1) Functional name and loop number.
2) ISA tag numbers as shown in the Specifications and on the Contract Drawings.
3) Functional description and manufacturer's model, product or catalog number for each item in the loop.
4) Surge suppressors and intrinsically safe devices.
5) Location of each device.
6) Analog signal ranges and engineering units.
7) HART, Modbus RTU, Modbus TCP/IP, EtherNet/IP, and other digital communication protocols and network interfaces, where applicable.
8) Junction boxes and terminations.
9) PLC, PAC, remote I/O, rack, slot, channel, and network addressing information, where applicable.
10) Identify the source of power for each device, including power supply or panel designation and voltage, where applicable. Power conductors shall be shown only to the extent necessary to identify the source of power. Detailed routing, sizing, and identification of power conductors shall be provided under Division 26 and are not required on loop drawings.
11) Show all loops in their entirety, including all field wiring, panel wiring, interposing relays, motor starters, eddy current drives, packaged equipment control panels, communication devices, and devices furnished under other Divisions. Identify all termination cabinets, marshalling cabinets, and panel terminal numbers, wire numbers, selector switch contact status for each switch position, and normally open or normally closed status of all relay and switch contacts.
12) Identify installed spare conductors and spare terminal block positions, where provided.

I. Human Machine/Operator Interface Submittals:

1. Refer to Section 406863 "Configuration of HMI Software" for specific submittal requirements.

J. Controller Program Submittal:

1. Refer to Section 406866 "Configuration of Controller Software" for specific submittal requirements.

K. Testing Plan Submittals:

1. Refer to Section 406121.20 "Process Control System Testing" for specific testing submittal requirements.

L. Industrial Control System Cybersecurity Submittals:

1. Refer to Section 408100 “Industrial Control System Cybersecurity” for specific submittal requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For any named PCSS, submit a statement on company letterhead indicating that the requirements in the “Quality Assurance” paragraph below are met by the firm.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all PCSS supplied hardware to include in operation and maintenance manuals.

1. Submit in accordance with Section 017823 “Operation and Maintenance Data.”
2. Include the following information on the operations and maintenance manuals:

a. Table of Contents:

1) Provide a Table of Contents for the entire manual with the specific contents of each volume clearly listed. Include the complete Table of Contents in each volume.

b. Instrument and Equipment Lists:

1) Develop the following lists in Microsoft Excel format:

a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
b) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

c. Equipment Operations and Maintenance Information:

1) Provide ISA-TR20.00.01-2001 (updated in 2004-2006) data sheets for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
2) Provide either new documentation written specifically for this project or modified standard vendor documentation to the vendor O&M

documentation for each device, piece of equipment, or OEM software. Indicate with arrows or circles all portions that apply to all standard vendor documentation furnished. Neatly line out or cross out all portions that do not apply. Remove groups of pages or sections that do not apply to the specific model supplied.

3) Provide the record documentation of the completed test forms with sign-offs.
4) Include instrument/equipment calibration and configuration forms.

d. As-Built Drawings:

1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. Include on the drawings all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Provide drawings in AutoCAD ".dwg" format and in Portable Document Format (".pdf") format. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
2) Include on as-built documentation information from submittals, as described in this Specification, updated to reflect the as-built system. Incorporate errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests.

B. Operations and Maintenance Data - Software Maintenance Manual:

1. Include these manuals as part of "Final System Documentation."
2. Software Listings and Databases – Submit hard copies of the same information required in the "Controller Program Submittal." Ensure all files are updated to reflect the as-built system . Include ".pdf" versions of these files on electronic media specified below.
3. PID Loop Tuning Parameters – Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops, submit charts showing response of the secondary loop with secondary setpoint on manual and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.
4. Supply hardcopies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.
5. Machine Readable Documentation – Provide two sets of as-built software documentation in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. Deliver documentation on modern portable media such as USB flash drives or secure cloud-based storage (e.g., SharePoint, OneDrive, or Engineer approved platforms). Ensure all files incorporate all changes made during or after testing, start-up, and commissioning.
6. Include final version of the system standards and conventions manual reflecting as-programmed conditions.
7. System Configuration Section:

a. Include a printout (or screen capture) of all configuration screens for every device requiring PCSS configuration. This includes, but is not limited to, the hardware firewall**,** site to site VPN routers**,** MES'**,** PLC processors**,** PLC redundancy**,**

EtherNet/IP and any other communication modules, as well as HMI software and any other software.

C. Operations and Maintenance Data - Operators' Manual:

1. Provide Operator's Manuals prior to final acceptance of the system.
2. Separately bind and include in the manual all information necessary for the operator to monitor and control the plant from the control system. Write the manuals in non-technical terms and organize for quick access to each detailed description of the operator's procedure. Include the following information:

   a. A comprehensive table of contents of the manual.
   b. A simple overview of the entire system indicating the function and purpose of major control system components described by area or building.
   c. A detailed description of the operation of the HMI and OIT including all appropriate displays. Including a screenshot of each HMI and OIT display screen and annotating each function in text is an acceptable format for presenting this information.
   d. Step-by-step procedures for starting up or shutting down critical component of the control system such as server or a control panel.
   e. Login / logout procedures for the operator interface system(s).
   f. Complete, step-by-step procedures for printing reports and entering manual data.
   g. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data and/or frequency system performs an automatic back-up with a listing of all applications that are backed up or need to be backed up.
   h. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Include in the description procedures for typical maintenance and troubleshooting tasks.
   i. A complete glossary of terms and definition of acronyms.
   j. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address.

D. Software and Firmware Operational Documentation:

1. Original Licensed Software:

   a. Submit original software licenses and keys for all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers, and related information. Provide licenses for all software under this Contract to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.

E. Electronic O&M Information:

1. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on USB flash drives or secure cloud-based storage (e.g., SharePoint, OneDrive, or Engineer approved platforms). Supply electronic documents in ".pdf" format.

2. Provide electronic files for all custom-developed manuals including training manuals. Supply text in Microsoft Office and ".pdf" formats.
3. Provide electronic files for all drawings produced. Supply drawings in AutoCAD ".dwg" and in ".pdf" formats. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4. Back up each computer system hardware device onto USB flash drives or secure cloud-based storage (e.g., SharePoint, OneDrive, or Engineer approved platforms) after Substantial Completion and turn over to the Owner.
5. If specified in the training section, provide digital copies of all training videos onto USB flash drives or secure cloud-based storage (e.g., SharePoint, OneDrive, or Engineer approved platforms).

F. Include information as specified in Section 017823 "Operation and Maintenance Data" on the cover and edge of each volume.

1.8 MAINTENANCE MATERIAL SUBMITTAL

A. Furnish extra materials from the same product run**,** that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Refer to individual specification sections in Division 40 for spare equipment requirements and provide one comprehensive spare parts submittal for project.
2. Submit unit and total costs for the additional spare items and test equipment specified or recommended for each subsystem.

B. Pack all spare parts and test equipment in individual cartons and label with indelible markings clearly indicating component(s) inside. Supply with the required spare parts complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable). Deliver and store the spare parts in a location directed by the Owner or Engineer.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: PCSS to hold a valid UL-508 certification for their panel fabrication facility.

B. Responsible for the technical supervision of the installation by providing on-site supervision to the installers of the various components.

C. The Process Control System Supplier (PCSS) to be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" means an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturer's training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software

proposed for this project. Key personnel to hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel includes, as a minimum, the lead field technician.

2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion is defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references for projects where the PCSS's contract was of similar size to this project.
3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

D. Maintain a permanent, fully staffed and equipped service facility within 150 miles of the project site with full-time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. Respond to on-site problems within 12 hours of notice. Provide an on-site response within four hours of notification starting at two months before scheduled startup to two months after startup completion.

E. Listed suppliers will not be required to submit a qualifications proposal (see “Informational Submittals”). Contractors interested in listing an equal to the above listed suppliers to submit PCSS' qualifications for review and approval as specified herein.

F. Select a PCSS from one of the following:

1. Aaron Associates – Waterbury, CT – Carmen Corvigno – (203) 753-1536
2. Allied Control Services, Inc. – West Point, PA – Paul Mamzic – (215) 699-2855
3. Automated Control Concepts Inc. – Neptune, NJ – Arlene Weichert – (732) 922-6611
4. Optimum Controls Corporation – Reading, PA – James Brunell – (610) 375-0990
5. PCS Integrators – Fairfield, NJ 07004 – Stephen Mirsky – (973) 575-7464
6. Or equal.

G. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.11 FIELD CONDITIONS

A. Environmental Requirements: Refer to Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Design equipment to operate at the project ground elevation.

C. Temperature:

1. Outdoor area equipment to operate between -4 to 122 degrees Fambient.

2. Equipment in indoor locations operate between 50 to 95 degrees Fdegrees ambient minimum.
3. Storage temperatures range from 32 to 122 degrees Fdegrees ambient minimum.
4. Furnish additional cooling or heating if required by the equipment specified herein.
5. Relative Humidity. Air-conditioned area equipment operate between 20 to 95 percent relative, non-condensing humidity. All other equipment operates between 5 to 100 percent relative, condensing humidity.

D. Do not ship control system equipment located in the control room until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

1.12 WARRANTY

1. Warranty Period: Two years from date of Substantial Completion unless noted otherwise in individual specification sections.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical Requirements for Control System:

1. Operate equipment on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above to be provided between power supply and interconnected instrument loop. Supply constant voltage transformers where equipment requires voltage regulation.
2. With the exception for field device network connected devices, all electronic instrumentation utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
3. Outputs of equipment that are not of the standard signals as outlined, have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
4. All switches have double-pole, double-throw (DPDT) contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Switches and/or signals indicating an alarm, failure or upset condition wired in a fail-safe manner as shown on the P&IDs**.** A fail-safe condition is when an open circuit generates an alarm state (i.e. contact opens).
6. Materials and equipment UL approved whenever such approved equipment and materials are available.
7. All equipment furnished designed and constructed so that in the event of power interruption, all systems specified go through an orderly shutdown with no loss of memory and resume normal operation without manual resetting when power is restored, unless otherwise noted.

8. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting performance of the Work.

B. Examine products or materials before installation. Reject products that are wet, moisture damaged, or mold damaged.

C. Examine walls, floors, roofs, and process area for suitable conditions where control panels and instrumentation will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. In addition to the scope of work within the Main Equipment Building, the PCSS shall trace, identify, label, disconnect, and reconnect existing control signals affected by the replacement of Sludge Gate Actuator SG-1 in the Influent Screenings Building. Existing PLC terminal blocks within the existing PMCP shall be reused where practical. The PCSS shall verify proper termination and operation of signal conductors. The PCSS shall modify the PMCP PLC program as required to maintain existing control, monitoring, alarm, status, and SCADA functions associated with SG-1. Upon completion of the Work, the PCSS shall perform I/O verification, loop checks, and functional testing of affected signals and demonstrate that the PMCP PLC and SCADA functionality has been fully restored and operates as intended.

B. The shield on each process instrumentation cable to be continuous from source to destination and be grounded at only one ground point for each shield.

C. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.3 IDENTIFICATION

A. Provide identification system for all PCSS provided hardware, instrumentation, and communication cabling.

3.4 FIELD QUALITY CONTROL

A. Refer to individual hardware and instrument specification sections.

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3.5 STARTUP SERVICE

A. Refer to Section 406121.20 “Process Control System Testing.”

B. Refer to Section 406126 “Process Control System Training.”

C. Engage a factory-authorized service representative to perform startup service as specified in individual hardware and instrument specification sections.

D. Weekly on-site coordination meetings with Engineer, Contractor, Vendors**,** and as required during active construction period.

3.6 PCSS MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service includes 12 months' full maintenance by skilled employees of systems and equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies to be manufacture's authorized replacement parts and supplies.

B. Provide a written proposal for a maintenance contract executed by the PCSS to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. Do not include the cost of this maintenance contract in the Contract Price.

C. Provide a proposal within 30 days after Substantial Completion for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Set forth standard per diem rates to provide breakdown service in the contract. Such rates to be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted to be firm for a minimum of 90 days from date of issue.

D. Include on maintenance contract all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment, instrumentation and software provided as part of the PCSS scope of work.

E. Provide software updates throughout the maintenance contract period. Provide latest official released version for all software provided under this Contract. Owner to have the latest software releases at the end of the maintenance contract period.

F. Include on maintenance contract a minimum of 4 preventive maintenance visits by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Include in each preventive maintenance visit routine adjustment, calibration, cleaning and lubrication of system equipment and verification of correct operation.

G. Visits to the sites to correct deficiencies under warranty are not included in this preventive maintenance service contract.

H. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit; however, they do not replace the work intended to be performed during a preventive

maintenance visit. The Supplier has full responsibility for the system hardware preventive and corrective maintenance.

I. Provide observation of maintenance operations by plant personnel and the instruction of said personnel in the details of the maintenance work performed during the one-year maintenance period.

3.7 SOFTWARE SERVICE AGREEMENT

A. Refer to individual hardware and software specifications for specific requirements.

END OF SECTION 406100

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SECTION 406121.20 - PROCESS CONTROL SYSTEM TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes process control system testing, where the Applications Engineering services are performed by the Contractor.

B. Related Requirements:

1. Section 019113 “General Commissioning Requirements.”
2. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
3. Section 408100 “Industrial Control System Cybersecurity.”

C. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

F. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

G. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 4061000 “Process Control and Enterprise Management Systems General Provisions.”

1.5 ACTION SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Testing Submittals - Submit, in one submittal, the following testing related documents:

1. Status signoff forms:

a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.

1) Example forms are shown in the Appendices.
2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
3) Submit testing forms prior to start of testing.

1. Testing Procedures:

a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, provide the following test procedures:

1) Network and Communications Testing.
2) I/O Testing.
3) UPS.
4) Control panel power, indicators, and hardwired logic tests.

b. Structure documents in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
c. Indicate in test procedures all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
d. Structure test procedures in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
e. Include in test procedures the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
f. Do not start testing until all Testing Submittals have been approved.

C. Test Documentation:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing is not considered complete until the signed-off

forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.6 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For Test Documentation of system:

1. Upon completion of each required test, document the test by submitting a copy of the signed-off Testing Status forms. Testing is not considered complete until the signed-off forms are submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.8 COST OF TRAVEL

A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for subsequent retests.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Track results of all testing on a project specific status sign-off form or similar document. The PCSS is responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.

C. Tests the PCSS is required to perform are as follows:

1. Factory Testing:

a. Unwitnessed Factory Test (UFT).
b. Witnessed Factory Test (WFT).

2. Field Testing:

    a. Operational Readiness Test (ORT).
    b. Functional Demonstration Test (FDT).
    c. Site Acceptance Test (SAT).

D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

E. PCSS to coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.

F. Do not ship equipment to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.

G. Engineer reserves the right to test or re-test any functions.

H. Correction of Deficiencies:

1. Correct deficiencies in workmanship and/or items not meeting specified testing requirements to meet specification requirements at no additional cost to Owner.
2. Repeat testing, as specified herein, after correction of deficiencies is made until specified requirements are met. Perform work at no additional cost to Owner.

I. Separate factory tests for panel enclosure hardware and software may be performed if submitted and approved by the Engineer. If this option is proposed by the PCSS the following must be indicated:

1. General description of why the PCSS is requesting hardware and software tests to be performed separately.
2. General overview of the tests to take place.
3. Information on what measures will be taken to ensure that there will be no impact to the overall test quality.
4. Confirmation that payments provided for panels delivered to the site prior to completion of software test will be partial and reflected in the schedule of values.

3.2 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Purpose of UFT is for PCSS to check system prior to Engineer and/or Owner attending factory testing. This type of testing is part of any quality firm's internal QA/QC procedures.

B. Temporary network connections are required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.

C. Hardware to be tested includes all control system devices shown on System Architecture drawings and provided by PCSS.

D. Perform these tests, but not limited to the following. Address each of these tests in the Test Procedure submittal.

1. All panels and enclosures provided to undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Prove documentation of audit at factory test and submit as part of O&M Manual Documentation:

    a. For each workstation and server, list of all software installed (including the operating system), with software revision number, software improvement modules or patches installed, license number and owner registration information, warranty period, vendor and local distributor names and contacts.
    b. For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)

3. Perform panel wire pull tests to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.
4. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Perform testing of UPS to determine if they have been sized correctly to maintain specified run time during field testing.
5. Perform a 100 percent I/O point checkout to verify proper operation of input/output points from panel terminations to HMI and OIT nodes. At a minimum, I/O checkout consists of four steps.

    a. Jumper discrete input signals at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
    b. Connect analog input signals to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and verify signals are at zero percent, 50 percent, and 100 percent of full scale.
    c. Test discrete output signals by switching equipment to manual control at HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
    d. Test analog output signals by switching the equipment to manual control at HMI and OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.

6. Verify all control strategies using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.

7. For each hardware enclosure, include with inspection, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
8. For each subpanel, include with inspection, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
9. All other control panel circuitry.
10. Perform the following systems tests:

    a. Demonstrate ability to share data between operator workstations and servers.
    b. Demonstrate ability of each workstation to print reports on all designated report printers.
    c. Demonstrate ability for each workstation to read and write designated files from servers and other workstations on the network.
    d. Demonstrate operability of all back-up and mass storage equipment.
    e. Demonstrate communication failure and recovering self-healing ring testing.
    f. Demonstrate total power failure and recovery. Remove the UPS for this test.
    g. Demonstrate capabilities of the historical server.
    h. Demonstrate failover capabilities of the redundant HMI servers.
    i. Demonstrate failover capabilities of the redundant PLCs.

E. Upon successful completion of UFT, PCSS to submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner to schedule a test date within 30 days of receipt of this submittal.

3.3 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

A. Purpose of WFT is to allow Engineer or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT to be run by PCSS and conducted at PCSS's facility.

B. Required Documents for Test:

1. Clean set of approved panel drawings and wiring diagrams.
2. Set of Contract Documents - all drawings and specifications.
3. All design-change related documentation.
4. Master copy of the PCSS developed factory testing signoff forms.
5. Testing procedures.

C. Operate the system continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. Correct and re-test all deficiencies identified during these tests prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.

D. Perform these tests during the WFT, but not be limited to, the following:

1. A repeat of all tests specified in the UFT.

E. Daily schedule during these tests to be as follows:

1. Morning meeting to review the day's test schedule.
2. Scheduled tests and sign-offs.
3. End of day meeting to review day's test results and to review or revise next day's test schedule.
4. Unstructured testing period by witnesses.

F. Upon successful completion of WFT, PCSS to submit a record copy of test results as specified in PART 1.

3.4 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test determines if equipment is ready for operation.

B. This test to take place prior to FDT and startup. Prior to starting this test, install relevant process equipment and mechanically test instruments installed, control panels installed, and field wiring complete.

C. Required Documents for Test:

1. Master copy of the PCSS developed field testing sign-off forms.
2. Testing procedures.
3. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found to be corrected by PCSS prior to commencement of Functional Demonstration Test.

E. PCSS to maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.

F. Perform the following tests as part of ORT:

1. Instrument calibration, configuration, and set-up.
2. Input/Output (I/O) Testing to HMI and OITs.
3. Testing of control strategies.

G. Instrument calibration, configuration, and set-up:

1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
2. Calibration form:

a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this

information. These forms provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.

b. Add this information to Instrument data sheet and to a copy of manufacturer's standard "Configuration Sheet", or create a separate form.

1) If a separate form, list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.

c. Some examples of required information are:

1) For Discrete Devices: Actual trip points and reset points.
2) For Instruments: Any configuration or calibration settings entered into instrument
3) For Controllers: Mode settings (PID).
4) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).

d. Maintain a copy of these forms in field during testing and make them available for inspection at any time.

e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

H. I/O Testing:

1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. PCSS in conjunction with Contractor to test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
3. Perform the following I/O tests:

a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.

b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.

c. Test discrete output signals by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.

d. Test analog output signals by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

I. Testing of Automatic Control Strategies:

1. Verify all automatic control strategies using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.

J. Repeat all systems tests specified under factory testing.

K. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off-line power to UPS and verify if they maintain specified run time.

L. For all panels with enclosures modified by this Contract, test internal control panel temperature under full running conditions to ensure proper cooling/ventilation is being provided.

M. Upon successful completion of ORT, PCSS to submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.5 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. After facility is started-up and running treatment process in automatic control to extent possible, perform a Functional Demonstration Test. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.

B. Required Documents for Test:

1. Set of panel drawings and wiring diagrams from ORT with corrections noted.
2. Set of Contract Documents - all drawings and specifications.
3. All design-change related documentation.
4. Signed-off master copy of the PCSS developed field testing signoff forms.
5. Testing procedures.
6. Copy of completed calibration forms.
7. One copy of all O & M Manuals for PCSS supplied equipment.

C. Perform a witnessed FDT on each process area. To extent possible, repeat testing performed during ORT.

D. Follow specified daily schedule during factory tests and FDT.

E. After coordinating with Operations, perform a "Black Start" of the plant to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to

the plant and turning it back on. Perform separate tests by recovering the plant while on generator (if a generator is specified) and while on utility power.

F. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS to perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS to submit a record copy of test results as specified in PART 1.

3.6 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, perform a test on the system as defined in Section 019113 “General Commissioning Requirements.”

B. While this test is proceeding, Engineer and Owner have full use of system. Only allow plant operating personnel to operate equipment associated with live plant processes. Plant operations remain the responsibility of Owner and decision of plant operators regarding plant operations are final.

C. During this test, PCSS personnel to be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site, PCSS to provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

D. PCSS to analyze and correct any malfunctions during test. In event of rejection of any part or function, PCSS to perform repairs or replacement within 5 days.

E. Throughout duration of SAT, do not make software or hardware modifications to the system without prior approval from Owner or Engineer.

END OF SECTION 406121.20

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APPENDIX **40 61 21-**A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX **40 61 21**-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own. These forms need to be generated for both factory and field tests.

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8-Jun-11

[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Field Testing.
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS
Wiring Complete - Signal wired from field device to PLC
I/O Tested - Signal tested from field device to SCADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instrument Alarm Setpoint	Calibrate, config.. and Wiring complete	Date	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0								
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1								
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2								
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3								
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4								
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5								
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A								
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0								
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1								
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2								
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5								
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0								
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1								
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2								
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3								
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4								
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5								
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6								
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	MIC	12/29/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8								
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9								
PLC-SC	YCI-4100-1	RAS Pump No. 1 in Remote	In Remote	14	DI	3	1	10								
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11								
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12								
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13								
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14								
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15								
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1								
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2								
PLC-SC	HSS-7000-2	Sludge Holding Tank Blower No. 2 Start Command	Start	17	DO	4	6	3								
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5								
PLC-SC	HSS-4105-1	Secondary Scum Pump No. 2 Start/Stop	Start	15	DO	4	6	6								
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7								
PLC-SC	7160-FQI-1	Sludge Lookout LCP Pumping Indicator	Pumping	17	DO	4	6	8								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9								
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11								
PLC-SC	HSO-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12								
PLC-SC	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13								
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15								

Page 1 of 1

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4-Jun-14

[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies. - Loop operational in Automatic as defined in Control Stategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

Page 1 of 1

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[Client Name] – [Project Name]
Appendix B – Automatic Control Strategies Sign-Off Form

Checked?

LOOP 0330-1, -2 PUMPS NO. 1 & 2

Drawing Number: I-6

PLC: PLC-02

General: There are two (2) booster pumps that start and stop to maintain a tank level while in the automatic mode.

Control:

Local (LCS):

Hand: When the Hand/Off/Auto selector switch is in the "Local" position, the pump shall be started/stopped and have its speed controlled from the LCS.

Off: When the Hand/Off/Auto selector switch is in the "Off" position, the pump shall be stopped.

Auto: When the Hand/Off/Auto selector switch is in the "Auto" position, the starting, stopping, and speed control of the pump is transferred to the SCADA PLC/HMI. ☐

SCADA PLC/HMI:

Software Interlocks:

If level in the storage tank is low (detected by the ultrasonic level sensor), the pump shall stop and not be allowed to start. ☐

Manual Control:

The pump can be manually started, stopped, or have its speed controlled by the operator at the HMI. ☐

Automatic Control:

The pumps will operate in a duty/standby sequence. ☐

The pumps will adjust speed to maintain level in the tank.

Comments:

_____
_____
_____
_____

EXAMPLE

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SECTION 406126 - PROCESS CONTROL SYSTEM TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes process control system training for provided devices and systems.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.4 ACTION SUBMITTALS

A. Preliminary Training Plan Submittal:

1. Prior to preparation of Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.

B. Final Training Plan Submittal:

1. Upon receipt of Engineer's comments on preliminary training plan, submit specific proposed training plan with the following:

a. Definitions, objectives, and target audience of each course.
b. Schedule of training courses including proposed dates, duration, and locations of each class.
c. Complete copy of proposed handouts and training materials bound and logically arranged with materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

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1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Directly relate the training and instruction to the system being supplied. Training program represents a comprehensive program covering aspects of the operation and maintenance of the system.

B. Coordinate training schedules with and at the convenience of Owner, including shift training required to correspond to Owner's working schedule.

C. All onsite instructors must be intimately familiar with the operation and control of Owner's facilities.

D. Provide detailed training manuals to supplement the training courses including specific details of equipment supplied and operations specific to the project. Provide the manuals in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.

E. Make use of teaching aids, manuals, or slide/video presentations as required. After training services, deliver training materials to Owner.

F. Owner reserves the right to videotape custom training sessions. Training tapes become sole property of Owner.

G. Cost of Travel for off-site training:

1. Cost of Travel for off-site training is paid directly by entity employing the staff doing the traveling.

3.2 TRAINING SUMMARY

A. Provide following training courses listed in the summary table below:

Description	**Minimum Course Duration (hours)**	**Maximum Number of Trainees per Course**	**Number of Times Course to be Given**	**Intended Audience**
Onsite Training				
Control System Overview Seminar	Covered in AESS scope of work			

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Operator Control System Training	Covered in AESS scope of work			
System Reports and Historian Implementation	Covered in AESS scope of work			
Installed Control System	2	4	2	Maintenance, Administrator
PLC Hardware/Software	2	4	2	Maintenance
Instruments	8	4	2	Maintenance
Instruments - Operator familiarity	2	8	2	Operations

B. Definitions of Audience Roles:

1. Administrator: Personnel responsible for maintaining the HMI / SCADA system.
2. Maintenance: Personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operations: Personnel responsible for daily plant operations.
4. Management: Non-daily operations personnel.

3.3 MANUFACTURER'S TRAINING

A. Human Machine Interface (HMI) Software:

1. Provide manufacturer's standard training courses for Owner's personnel in configuration, programming, and installation of supplied HMI software. Conduct this course in separate beginner and advanced training sessions.
2. Conduct training no more than two months before Witnessed Factory Test (WFT).
3. Provide training on the following:

    a. Database generation.
    b. Display generation.
    c. Alarm system and configuration.
    d. Historical data system configuration.
    e. Report generation.
    f. Security system.
    g. Trending system.
    h. Remote communications.
    i. Software configuration.
    j. OLE applications.
    k. Test, adjustment, and calibration procedures.
    l. Troubleshooting and diagnosis.

4. Include classroom and hands-on instruction such that a student with experience in process instrumentation can configure the HMI with no guidance or with only minimal supervision when attempting complex problems.

B. Historian:

1. Provide manufacturer's standard training courses for Owner's personnel in configuration, programming, and installation of the Historian software supplied.
2. Conduct training no more than one month before the Witnessed Factory Test (WFT).
3. Provide the following training:

    a. Database generation and configuration.
    b. Trending system.
    c. Using data exporters.
    d. Report generation.
    e. Troubleshooting and diagnosis.
    f. Managing historian Servers & data collectors.
    g. Configuring clients.
    h. Security.
    i. Alarm and Event configuration and archiving.

4. Include classroom and hands-on instruction such that a student with experience in process instrumentation can configure the Historian with no guidance or with only minimal supervision when attempting complex problems.

C. Programmable Logic Controller (PLC) Hardware and Software:

1. Provide manufacturer's standard training courses for Owner's personnel in operation, configuration, programming, installation, and maintenance of the PLC hardware and software supplied. Conduct this course in separate beginner and advanced training sessions.
2. Conduct training no more than two months before the WFT.
3. Provide the following hardware training:

    a. Hardware maintenance for the PLC equipment provided.
    b. Test, adjustment, and calibration procedures.
    c. Troubleshooting and diagnosis.
    d. Component removal and replacement.
    e. Periodic maintenance.

4. Provide the following software training:

    a. System configuration.
    b. Application specific program development/programming.
    c. Uploading/downloading programs.
    d. Documenting program/configuration.
    e. System backups and reload procedures.
    f. TCP/IP addressing procedures.
    g. Network communications configuration.

3.4 ONSITE TRAINING

A. Training personnel are required to be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel are required to command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system

operation, and programming, and capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training:

1. Provide training for Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. Conduct training before Functional Demonstrator Test (FDT), but not more than two months before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system.
4. Provide detailed training on the actual configuration and implementation for this Contract covering aspects of the system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. Provide training covering the following subjects:

    a. System overview.
    b. System hardware components and specific equipment arrangements.
    c. Periodic maintenance.
    d. Troubleshooting and diagnosis.
    e. Network configuration, communications, and operation.
    f. TCP/IP addressing procedures for Ethernet devices.

C. Programmable Logic Controller (PLC) Hardware and Software:

1. Provide training for Owner's personnel in operation, maintenance, troubleshooting, etc. with PLC hardware and software system. Conduct the training before FDT, but not more than two months before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system. Provide detailed training on the actual configuration and implementation for this Contract covering aspects of PLC system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to PLC system. Provide training covering the following subjects:

    a. PLC system overview.
    b. PLC system architecture.
    c. PLC system hardware components and specific equipment arrangements.
    d. PLC system startup, shut down, load, backup, and PLC failure recovery.
    e. Periodic maintenance.
    f. Troubleshooting and diagnosis down to the I/O card level.
    g. PLC configuration, communications, and operation.

D. Instrument Manufacturer Training:

1. Provide manufacturer instrument training for those instruments where specifically indicated in the Instruments section. This is on-site training provided by an authorized representative of the manufacturer. Manufacturer's representative is required to be fully knowledgeable in equipment operation and maintenance.

E. Instrument Training:

1. Provide instruction on the maintenance of the field and panel instrumentation for Owner's instrumentation technicians. Conduct this training before FDT, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Training program is required to include the following elements:

    a. Training in standard hardware maintenance for the instruments provided.
    b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
    c. Testing, adjustment, and calibration procedures.
    d. Troubleshooting and diagnosis.
    e. Maintenance and frequency.

F. Instruments - Operator familiarity:

1. Provide operator level instruction on the use of the field and panel instrumentation for Owner's operations staff.

    a. Conduct training before the 30-day site acceptance test, but no more than 1 month before and at a time suitable to Owner.

        1) Training to take place at Owner's facility.
        2) Include hands on demonstration of information each transmitter indicates, and method used to retrieve operator information from transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

G. Fiber Optic Training:

1. Provide instruction on maintenance of fiber optic system for Owner's instrumentation technicians. Conduct training before the FDT, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Provide training covering the following topics:

    a. Fiber cable layout and basic of cable construction.
    b. Termination procedures.
    c. "Jumper" installation.
    d. Testing procedures.
    e. Troubleshooting and diagnosis.

END OF SECTION 406126

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SECTION 406196 - PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Applications Engineer System Supplier (AESS) Programming Scope

1. Develop the control system applications to implement the process control descriptions for new and existing systems. This Section is provided to define control strategies to be used for PLC programming of the system.
2. The Contract Documents are a single integrated document, and as such, Drawings, Specifications Divisions and Specifications Sections apply. It is the responsibility of the Contractor and Subcontractors to review Sections to ensure a complete and coordinated project.
3. The PCSS is cautioned to read this Section and related Sections and their entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section with the specific requirement called out in the individual control strategy. Implement these general strategies throughout this Contract unless specifically directed otherwise in the individual loop process control descriptions.
4. Follow loop and device tagging criteria shown on the Drawings without exception unless approved by the Engineer.
5. Establish programming approach and database/variable identification standards prior to performing any programming work. Review the proposed standards and conventions with the Owner during the coordination workshop required by Section 406863 “Configuration of HMI Software.”

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406863 “Configuration of HMI Software.”
3. Section 406866 “Configuration of Controller Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the SCADA system used for device level control and monitoring.

E. Operator Workstation (OWS): A hardware component of the SCADA system used for supervisory level control and monitoring.

F. Process Control System Supplier (PCSS): The entity responsible for providing materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

G. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

H. Supervisor Control and Data Acquisition (SCADA): Hardware and software components used for high-level supervisory monitoring of industrial processes. Typical devices that are part of the SCADA network include computers (OWS), PLCs, Ethernet switches, OITs, and HMIs.

I. VTMP: Vibration and Temperature Monitoring Panel.

J. VTMS: Vibration and Temperature Monitoring System (one per set of three pumps, as shown).

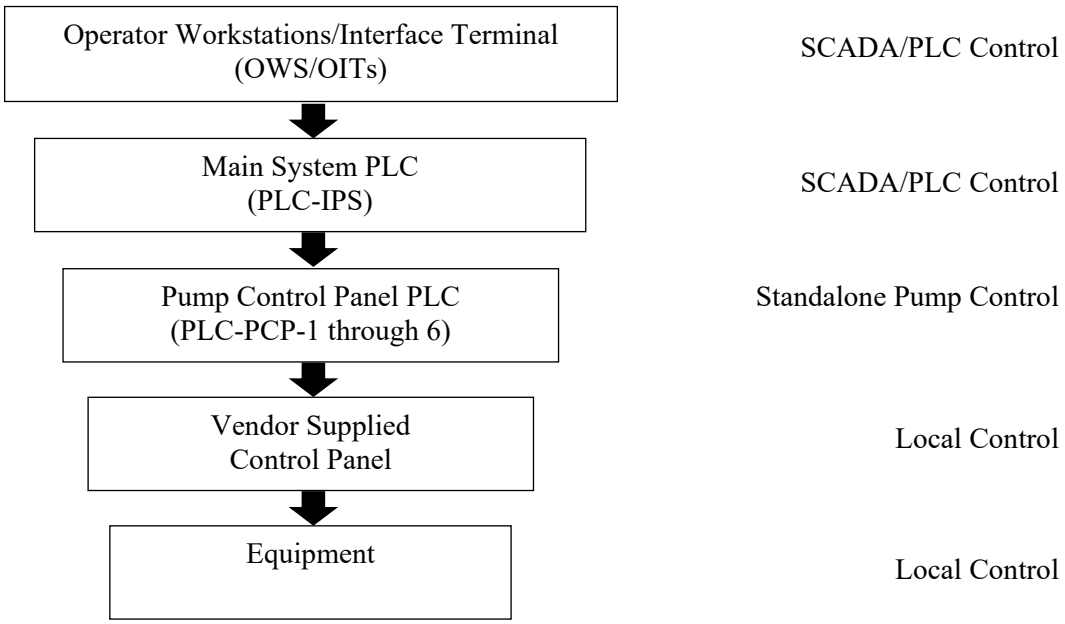
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Control System Hierarchy

1. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loop is shown in Figure 1.



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Figure 1. Control System Hierarchy

B. Loop Numbering:

1. Control descriptions are separated into areas and sorted by loop number. The loop index has four columns associated with it; Process Area, Area Number, Loop Number, and Drawing(s). The following is a list of areas and the loop numbers associated with each area.

Process Area	Area Number	Loop Number	Drawing (s)
Screened Wastewater Wet Wells	00	20	I-005 / I-006
Wastewater Pumping	00	50	I-005 / I-006 / I-007
Miscellaneous or Auxiliary Systems (Seal Water)	00	40	I-007
Miscellaneous or Auxiliary Systems	00	60, 70	I-005 / I-006 / I-007
Miscellaneous or Auxiliary Systems	00	90	I-007

2. The loop numbering for each system would be the above numbers, with -99 added onto the end of the area designation. For example, loop numbers associated with the Influent Pumping System would be 0050 to 0099.

3.2 GENERAL CONTROLS AND MONITORING

A. Overview:

1. Hardware and/or software functions noted by this paragraph reference are to be implemented in the PLC control system.
2. Setpoints, as defined by this section, refer to numerical values adjustable from the HMI.
3. The PLC is responsible for resetting command bits sent from the HMI to the PLC. If the commanded state cannot be achieved for any reason, the PLC resets the bit to allow the operator to set the command bit again. For example, when pressing the AUTO button on the HMI, the PLC resets the AUTO command from the HMI after the device is in the AUTO Mode. If the AUTO Mode is not available for any reason, the PLC resets the bit, so the AUTO button can be selected at the HMI once AUTO control is available.
4. Unless otherwise specified, when equipment is placed in LOCAL or HAND mode, control shall be transferred to local control devices and SCADA control outputs shall be disabled.

B. Interlocks:

1. Hardwired interlocks will interlock the controls locally, at the associated vendor provided Control Panels (PLC based and/or Relay logic based), at the respective Pump Control Panel PLC (PLC-PCP) and at the Influent Pumping System Control Panel PLC (PLC-IPS) where required. If the interlock occurs, the shutdown will cause the equipment to be inoperable at all levels of control.
2. Software interlocks are represented in a particular layer of the operation description and interlock the controls in that layer and the layers above it. However, the interlock does not interlock the commands in the layer before it. For example, a software

interlock implemented at the SCADA/PLC level will not stop equipment from being controlled locally.

3. Interlocks that shutdown (stop a piece of equipment and prevent it from being restarted or moved) are displayed on the faceplate pop-up graphic for that piece of equipment.
4. Vendor-supplied equipment protection relay logic based timers shall override software interlock timers programmed at PLC-PCP and PLC-IPS. Timing must be coordinated to prevent conflicts between software timers and PLC logic during equipment operation.

C. Motors / Motor Starters / Drives:

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Motors can be started manually by the operator at the Motor Starter, the HMI, or automatically by the control strategy.
4. Automatic control strategies are defined in individual loop descriptions.
5. If the motor is in OFF or LOCAL, SCADA start/stop controls shall be disabled.
6. If a motor stops for any reason, it cannot be restarted automatically once the problem with the motor has been resolved. A manual reset from the OWS or OIT is required to resume operation.
7. The LOCAL-OFF-AUTO (LOR) selector, shall indicate to the operator when the equipment operating in the LOCAL mode. When operating in LOCAL mode, equipment shall be controlled by the Motor Starter or Drive local controls. When operating in REMOTE, the SCADA PLC outputs shall control the equipment. The SCADA system stops a motor or drive, if one of its software interlocks trips.

D. Valves:

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Valves with only full travel capability can be opened or closed manually by the operator at the HMI, or automatically by the control strategy.
4. Modulating valves with position feedback can be positioned between 0% and 100% open manually by the operator at the HMI, or automatically by the control strategy.
5. Automatic control strategies are defined in individual loop descriptions with their corresponding process variable used for control.

E. Analog Instruments:

1. Analog instruments refer to indicating devices capable of providing a continuous output relative to time.
2. Provide monitoring of the analog signals shown on the P&IDs.
3. Analog signals may be a continuous voltage (-10V to 10V, 0V to 5V, 0V to 10V) or current (0 mA to 20mA, 4mA to 20mA) as determined by the output of the field instrument. The output range corresponds to the minimum and maximum full-scale measurement.
4. The PLC will linearly scale the output range (voltage or current) to the equivalent values in engineering units.
5. Provide cutoff deadbands for when the analog signal is approaching the minimum or maximum full-scale measurement.

    a. An analog signal measuring less than or equal to 2% of full-scale will be forced to zero after an adjustable time delay.

b. An analog signal measuring greater than 100% of full-scale will be clamped at 100%.

6. Provide a CALIBRATION mode with an adjustable time setpoint (in hours).

a. When entering CALIBRATION mode, the last good value is held prior to CALIBRATION mode being activated. The value is held until the calibration time setpoint expires.
b. The Operator may enter a calibration value, which will be the value held until the calibration time setpoint expires.
c. When active, clearly indicate the instrument is in CALIBRATION mode on any local OITs and in the HMI system.

F. Discrete Instruments:

1. Discrete instruments refer to indicating devices with any number of non-continuous defined states (e.g., ON/OFF, 0 or 1)
2. Provide monitoring of the discrete signals shown on the P&IDs.

a. When a contact or status from the instrument is true, the PLC will receive power to its input channel. The PLC registers this as a binary bit of 1.
b. When a contact or status from the instrument is false, the PLC will receive no power (open circuit) to its input channel. The PLC registers this as a binary bit of 0.

G. PLC Hardware:

1. Monitor status and communication faults at the HMI.

a. Implement watchdog timers to monitor CPU and I/O module health, and execution time for PLC routines.
b. Generate an alarm at the HMI if any watchdog timer expires.

2. Program the system time for PLCs to synchronize with a Network Time Protocol (NTP) server once every 24 hours.

H. Input Validation:

1. Provide input validation for setpoints used in process control (e.g., wet well level setpoints, pump flow setpoints).
2. The PLC will verify that the HMI setpoint is within an acceptable predefined range.
3. Out of range values will be rejected by the PLC and the current value will be retained.

3.3 HISTORICAL DATA COLLECTION

A. Provide historical data collection for analog inputs, process control setpoints, flow totals, equipment runtimes, and discrete equipment statuses (ON/OFF), unless otherwise stated in the individual loop descriptions. Historical data collection is as follows:

Collection Options	
Collection Type:	Polled
Collection Interval:	1 minute
Collection Offset:	0 seconds

Collection Options	
Time Resolution:	Milliseconds
Compression:	Enabled
Collector Deadband:	0.5 Percent Range
Collector Compression Timeout:	15 minutes

3.4 ACCUMULATORS AND TOTALIZERS

A. Accumulators:

1. Display accumulated run time for equipment with a RUNNING status. Each run time accumulation is resettable from the HMI with a reset push button.
2. The PLC will update the flow totals at 12:00 a.m. local time.

Runtime	Display Format
Current Day:	XX.XX Hrs.
Yesterday:	XX.XX Hrs.
Current Month:	XXX.X Hrs.
Previous Month:	XXX.X Hrs.
Accumulated Total:	XXXXXX Hrs.

B. Flow Totalizers:

1. Totalize flow indications.

   a. If the flowmeter provided has a configurable pulse output for totalized flow, perform flow totalization using the pulse output. The PLC calculates totalized flow by multiplying the number of pulses by the volume per pulse.
   b. If the flowmeter provided does not have a configurable pulse output for totalized flow, perform flow totalization using the analog 4-20mA signal.

      1) Do not totalize if the analog signal is outside the 4-20 mA range.
      2) Do not totalize if the value of the flow input is less than 2% of the full range of the input.
      3) Do not totalize if a discrete status exists that can be used to determine if flow is present (for example, no flow can be present unless a pump is running).

2. Each flow totalization is resettable from the HMI/OIT with a reset push button.
3. Display totalized flow in million gallons (MG), thousands of gallons (kGal), or Gallons (Gal) in accordance with the following:

Totalizer	MG Format	kGal Format	Gal Format
Current Day:	X.XXX	XXX.XX	XXXX.X
Yesterday:	X.XXX	XXX.XX	XXXX.X
Current Month:	XXX.X	XXX.X	XXXX
Previous Month:	XXX.X	XXX.X	XXXX
Accumulated Total:	XXXX	XXXX	XXXX

4. Use appropriate flow totalizer units for the total volume anticipated for the time period. Unless requested by the Owner, water process flows are totalized in million gallons (MG) and chemical flows are totalized in gallons (Gal). Auxiliary flow (e.g., backwash) units are determined based on the total flow for the day.

3.5 ALARMING AND EQUIPMENT FAILURES

A. Analog Alarms:

1. Provide analog alarming capability for analog signals monitored by the PLC.
2. Supervisor level users can set a common time setpoint (initially set to 5 seconds) that is used to generate alarms. The following alarms (setpoints to be Supervisor adjustable) are generated based on the analog feedback value. Each alarm includes the ability for individual enabling and disabling.

    a. High-High.
    b. High.
    c. Low.
    d. Low-Low.
    e. Loss of Signal.

3. LOSS OF SIGNAL alarm is generated when an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card. The following SCADA programming occurs:

    a. If the analog signal is used in a control loop or ratio control loop, that loop is placed into MANUAL.
    b. If the analog signal is used in a calculation, that calculation uses the last good analog signal. If the calculation is used in a control loop, that loop is placed into MANUAL.

4. SETPOINT REJECTED alarm is generated at the HMI when an analog setpoint is out of range and rejected by the PLC.

B. Discrete Alarms:

1. Program discrete alarm signals wired to the PLC (float switches, pressure switches, overload alarms) to alarm after an HMI adjustable time delay expires.
2. The maximum alarm delay for Safety related alarms (e.g., E-stop) is 500ms. Set each alarm timer during startup.

C. Motor Failure Alarms:

1. Supervisor level users can set a common elapsed time setpoint for each scenario below:

    a. Motors being remotely controlled generate a FAIL-TO-START alarm when the PLC sends the START command to the motor and it does not receive a RUNNING status from the motor after a supervisor adjustable time setpoint. When a FAIL-TO-START alarm is generated, the START output command from the PLC is deenergized and the motor is prevented from starting until a reset is issued from the HMI.

b. Motors being remotely controlled generate a FAIL-TO-STOP alarm when the PLC sends the STOP command to the motor and it continues to run after a supervisor adjustable time setpoint.
c. Motors with adjustable speed control generate a SPEED DEVIATION alarm when the motor is running and the PLC sends a speed setpoint to the motor and it does not reach the desired speed (within a deadband, initially set to 10%) within a supervisor adjustable time setpoint. The motor remains running if the SPEED DEVIATION alarm is activated.

D. Valve Failures:

1. Supervisor level users can set a common time setpoint for each type of valve that is used to generate the following alarms. When a valve position alarm is active, the PLC output is maintained unless explicitly stated in the individual loop descriptions (e.g., a fail to open alarm does not trigger the PLC to close the valve).

a. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-OPEN alarm when the PLC sends the OPEN command to the valve and it does not reach the OPENED limit within a supervisor adjustable time setpoint.
b. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-CLOSE alarm when the PLC sends the CLOSE command to the valve and it does not reach the CLOSED limit within a supervisor adjustable time setpoint.
c. All modulating valves (POSITIONING) being remotely controlled generate a FAIL-TO-POSITION alarm when the valve feedback does not match the PLC commanded position within a supervisor adjustable time setpoint.

3.6 AUTOMATIC CONTROLS

A. Lead/Lag and Standby Strategy:

1. Pump Priority:

a. When pumps are called to run by the automatic sequence, the order of their priority is determined by the following mode selection.

1) Operator Mode: The operator manually selects the priority of each pump (LEAD/LAG1/LAG2/LAG3/STANDBY/OFFLINE) using radio buttons on a popup display. The order can be changed at any time, but no two pumps can be selected to have the same priority. The pump cannot run in automatic mode or be used in any of the following automatic sequences if placed OFFLINE.
2) Sequential Mode: Used for groups of three or more pumps (e.g., LEAD/LAG1/LAG2/LAG3/STANDBY). The pumps are inserted into the sequence in ascending numerical order and the PLC rotates the pumps using a revolving queue. After an adjustable time setpoint expires, the LEAD pump becomes the STANDBY, the previous LAG1 pump becoming the new LEAD, the previous LAG2 becoming the new LAG1, and the previous LAG3 becoming the new LAG2.
3) Timed Mode: The pump priorities are determined by the runtime of the pump. The pump with the lowest runtime becomes the LEAD pump. The second lowest runtime becomes the LAG1 pump. This pattern continues until pumps are assigned a priority. The PLC determines the

pump priority when either pumps are stopped by the strategy, or when the pumps have been running for longer than an adjustable time setpoint.

2. Semi-Automatic Operation:

   a. If the individual loop description requires that the pumps operate in the LEAD/LAG1/LAG2/LAG3/STANDBY mode, the Plant Operator shall manually start the required LAG pump after a prominent indication (pop up) on the OITs (OIT-IPS) and SCADA, and when the following conditions are met after a time delay. If more than one LAG pump is included in the strategy (LEAD/LAG1/LAG2/LAG3/STANDBY), the sequence repeats.

      1) The LEAD pump is running at maximum speed for an adjustable length of time.
      2) The process variable being controlled is more than 5% from the target value. For example, in level control, the level must be 5% above the target.

   b. If multiple pumps are called to run by the automatic logic, the pumps will control the respective drive to run at the same speed.
   c. If the automatic strategy determines that a pump is needed and the pump for the required sequence position is unavailable, the pump with the next highest position is prompted to be manually started.

B. PID Control:

1. When individual control loops require PID control, use the PLC manufacturer's standard PID control functions. Provide a PID faceplate with the following parameters:

   a. Setpoint (SP): Reference to the setpoint. This is the setpoint entered (either manually from the HMI or via program logic, as required by the individual loop description) and is maintained by the PID controller.
   b. Process Variable (PV): Reference to the process variable. The process variable is the feedback from a field device or instrument for comparison to the SP by the PID controller.
   c. Output (CV): Reference to the controlled variable. This is the signal varied by the PID controller in order to maintain the PV at the desired SP.

2. PID controller accepts inputs for proportional (P), integral (I), and derivative (D) setpoints used to tune the controller response. PID tuning parameters can be entered manually by the Operator at the HMI or calculated automatically if the PID controller supports autotuning functionality.
3. Operator can place the PID controller in MANUAL or AUTOMATIC mode.

   a. In MANUAL, the Operator will enter the desired output (CV). The PID controller will use setpoint tracking to write the process variable (PV) to the controller setpoint (SP) to ensure bumpless transfer when the controller is switched from MANUAL to AUTO.
   b. In AUTO, the PID controller adjusts the output (CV) to hold the process variable (PV) at the setpoint (SP).

4. Configure PID controller to prevent reset windup when operating in MANUAL mode or when the output (CV) has reached maximum limit.

C. Cascade Level Control for Variable Speed Pumps

1. Cascade level control requires two PID controllers used in series to manipulate one process variable (PV).
2. The primary/outer PID is a level controller, where the setpoint (SP) to the PID controller is in engineering units (feet, inches) and adjustable from the HMI. The output (CV) of the level PID controller is a flow, which becomes the remote flow setpoint (SP) to the secondary/inner PID.
3. The secondary/inner PID is a flow controller, where the flow setpoint (SP) is the output (CV) calculated from the level PID controller. The output (CV) of the flow PID controller is a pump speed (%).

3.7 INDIVIDUAL CONTROL DESCRIPTIONS AND CONTROL SEQUENCES

LOOP No. LOOP DESCRIPTION PAGE No.
LOOP 0020-X - WET WELLS LEVEL 10
LOOP FSL-0050-X - SEAL WATER FLOW 11
LOOP SV-0050-X - SEAL WATER SOLENOID VALVE 12
LOOPS GV-0050-X, KGV-0050-X – PUMP TRAIN ISOLATION VALVES 13
LOOP CV-0050-X - CONE VALVES 14
LOOP PDS-0050-X – CONE VALVE DIFFERENTIAL PRESSURE SWITCH 15
LOOP PIT-0050-X – PUMP DISCHARGE HEADER PRESSURE TRANSMITTERS 15
LOOP PIT-0060-X – COMMON HEADER PRESSURE TRANSMITTERS 15
LOOP P-0050-X – INFLUENT PUMPS NO. 1 TO NO.6 16
LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCES 18
LOOP LC-0050-X - WET WELL LEVEL CONTROL 21
LOOP FE-0065-X - SCREENED INFLUENT FLOW 25
LOOPS KGV-0054-1, KGV-0055-X, GV-0056-1, GV-0071-X, KGV-0073-X - GATE VALVES AND KNIFE GATE VALVES 26
LOOP MS-0050-1X - ELECTRICAL EQUIPMENT MONITORING 26
LOOP UA-0080 – VENTILATION EQUIPMENT MONITORING 27
END OF SECTION 406196 27

The character "X" is a variable that represents the multiple loops across the same type of equipment. E.g. Loop SV-0050-X contains control descriptions common for Loops SV-0050-1, SV-0050-2, SV-0050-3, SV-0050-4, SV-0050-5 and SV-0050-6

LOOP 0020-X - WET WELLS LEVEL

A. General:

1. Continuous monitoring of screened raw wastewater level by means of redundant radar level transmitters backed up with a pair of existing ultrasonic level transducers. Each wet well is provided with a radar and an existing ultrasonic transmitter. The level of the wet well(s) shall be used to control Influent Pumps No. 1-6 (Loops P-0050-1 through 6). See LOOP LC-0050-X - WET WELL LEVEL CONTROL below.
2. Under normal operating conditions both wet wells are connected and experience equal hydraulic conditions. This situation shall be monitored not only by comparing measurements from the level instruments, but also from the status of the actuator limit switches (open position) provided in the interconnecting gate actuators GV-0071-1 and GV-0072-1.

3. The level transmitters shall be ranged on the field to measure level from EL. -36.50 to EL. -11.50.

B. Control:

1. PLC-IPS:

a. Software selector switches at OIT-IPS and SCADA shall give the operator the ability to choose the primary level measurement device for automatic level control. Under normal operating conditions, the radar level transducers shall be used for control of the pumps. The operator shall have the ability to choose radar 1, radar 2, or average of both radar readings. For backup operation, the operator shall have the ability to choose ultrasonic 1, ultrasonic 2 or the average of both ultrasonic readings.
b. Regardless of the instrument chosen for the level control logic, there shall be an operator adjustable deviation programmed between the radars and ultrasonic instruments to indicate a “high deviation”.
c. There shall be no automatic failover of a level reading to the alternate level reading, only alarms with system holding last good value. Operator intervention is required to use the backup level transducers.
d. Under certain circumstances one wet well may be out of service. In that case, the operator shall select which wet well remains in-service via software controls on the HMI. Readings from the level instruments associated with the out-of-service wet well shall not be used for level control.
e. The PLC shall stop the running pump(s) when a user adjustable Low Level set point initially set to EL-21.65 is measured by the active level measurement transducer(s).
f. Signals from the pressure switches installed upstream of the isolation gates (GV-0071-1 and GV-0071-2), shall be used to initiate a Pump Stopping Sequence as described in LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCES, below.

C. Alarms:

1. SCADA, OIT-IPS, OIT-PCP-1 through OIT-PCP-6:

a. Radar level indications (LI-0020-1, -2)
b. Radar levels average (LI-0020-3)
c. High radar level alarm (LAH-0020-1)
d. Ultrasonic level indication (LI-0011-1, -2)
e. Ultrasonic levels average (LI-0011-3)
f. High ultrasonic level alarm (LAH-0011-1)
g. Low-Low level alarm (LAL, Field determine. Initially set to EL -20.65)
h. High-High level alarm (LAH EL, Field determine. Initially set to -16.05)
i. Emergency level alarm (LAHH, Field determine. Initially set to EL -15.55)
j. Radar level deviation alarm (DLA-0020-3)
k. Ultrasonic level deviation alarm (DLA-0011-3)
l. Radar/Ultrasonic level deviation alarm (DLA-0020-2)

LOOP FSL-0050-X - SEAL WATER FLOW

A. General: There is a thermal dispersion seal water flow switch that confirms seal water flow for the respective pump. Seal water system low flow signal is wired to the Motor Starter and relayed to the respective PLC-PCP immediately after detection.

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B. Control:

1. PLC-PCP-X

a. PLC-PCP shall confirm seal water flow as a permissive for operation of the pump.
b. Failure Scenarios:

1) During a pump start sequence, a loss of seal water flow shall initiate a timer initially set to 5 seconds. If the timer expires before the loss of flow condition is cleared, the starting sequence shall be aborted and the associated Cone Valve commanded to close.
2) During ongoing pump operation, once the low flow signal is received and the ECD clutch is disengaged (impeller is in motion), the PLC shall start a timer initially set to 5 seconds. Once the timer expires, and the signal remains active, the PLC shall initiate a stopping sequence.

2. PLC-IPS

a. Monitors the seal water system operation for the complete influent pumping system.

C. Alarms / Monitoring:

1. SCADA, OIT-IPS, OIT-PCP-1 through OIT-PCP-6:

a. Low flow (FAL)
b. Low flow condition shall initiate a pump stopping sequence and provide a prominent pop-up notification to Operators (on the OITs and SCADA), informing Operators of the initiation of a pump stopping sequence to safeguard the integrity of the pump.

2. Historical Data Collection:

a. Provide historical data collection as described in "Historical Data Collection" Article of this section.
b. Provide the motor control, monitoring, runtime accumulation, and failure alarming. as described in "General Controls and Monitoring", "Accumulators and Totalizers,' and "Alarming and Equipment Failures" Articles specified in this section.

LOOP SV-0050-X - SEAL WATER SOLENOID VALVE

A. General: There is a seal water solenoid actuated valve that opens to provide seal water to the respective pump.

B. Control: via hardwired relay logic contained in the associated pump Motor Starter.

1. Commands the solenoid valve to open and provide seal water to the pump.
2. Part of pump starting sequence (see LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCES, below)

C. Alarms / Monitoring:

1. Provide the motor control, monitoring, runtime accumulation, and failure alarming, as described in “General Controls and Monitoring”, “Accumulators and Totalizers,” and “Alarming and Equipment Failures” Articles of this section.
2. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOPS GV-0050-X, KGV-0050-X – PUMP TRAIN ISOLATION VALVES

A. General: Valves provided with OPEN/STOP/CLOSE (O/S/C) and LOCAL/REMOTE (L/R) hand switches at the respective actuator. The actuator’s L/R selector switch shall be left in “Remote” during normal operation. These actuator pairs shall also be provided with accessible controls and indicating lights mounted on the respective Pump Control Panel, providing functionality regardless of the health of the PLC inside of the PCP. Under normal operating conditions, the L/R selector switch at both the actuator and on the PCP shall also be placed in the “Remote” position.

B. Control:

1. Local (at Actuator):

   a. Remote/Local Switch
   b. Open/Close Switch

2. Remote, at the respective PLC-PCP-X Control Panel, on the ground level:

   a. Remote/Local Switch
   b. Open/Close switch

3. PLC-PCPs:

   a. When the selector switches for the isolation gate valves in a pumping train are set to "Remote" on both the actuator and its corresponding PCP hand controls, the PLC-PCP controls and monitors these actuators.
   b. When the selector switches at both the actuator and its associated LCS, are in “Remote”, the actuator is controlled by the respective PLC-PCP-X. The respective PLC-PCP-X will monitor the open and close limit switch signals regardless of the position of the L/R selector switches.
   c. When the pump control is in automatic mode and control of pumps is either manual or automatic from the SCADA system, the pumps shall not start unless it’s corresponding isolation gates are opened as confirmed by the respective limit switches. This permissive shall not be in place when pumps are manually operating locally from the equipment.
   d. Part of pump starting sequence (see LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCES, below).
   e. The isolation valves shall be commanded to close upon failure of the associated Cone Valve. I such case, a modified pump stopping sequence similar to what is described in LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCES, below is to be initiated. In this situation, instead of modulating the cone valve to close, the isolation discharge knife gate shall be commanded to close. As the KGV closes the Eddy Current drive shall modulate its speed to match the pressure on its header with the one measured at the common discharge header. Once the Gate is confirmed Closed the suction gate valve shall be commanded to close.

4. PLC-IPS

    a. PLC-IPS shall monitor the open and close limit switch signals of actuators regardless of the position of the L/R selector switches.

C. Alarms/Monitoring:

1. Remote
2. Overload
3. Opened
4. Closed
5. Data Collection: Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP CV-0050-X - CONE VALVES

A. General: Cone valves are used to prevent backflow of wastewater from downstream processes during pump starting and stopping sequences.

B. Control:

1. PLC-PCP-X. Part of pump starting sequence (see LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCES, below)
2. Local Control Panel (By Vendor):

    a. The user interface provides three means of operation (at Cone Valve Control Panel):
    b. Setup: Calibration mode. Used for maintenance and troubleshooting.
    c. Auto: Remote mode. Standard mode of operation. Used for automatic pump starting and stopping sequences.
    d. Manual: Local Mode. Overrides Auto mode and provides operators with local control of the cone valve.

C. Alarms/Monitoring:

1. Remote
2. Malfunction
3. Opened
4. Closed (both from vendor controller, and auxiliary limit switch)
5. Trip
6. Warning
7. Position
8. Failed to Close (with a prompt to Operator to Close the associated Pump Isolation Valves)

D. Data Collection: Provide historical data collection as described in “Historical Data Collection” article of this section.

E. Failure scenarios:

1. Cone valve failure shall initiate a modified pump stopping sequence similar to what is described in LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCES, below. In this situation, the modified stopping sequence instead of modulating the cone valve to close, shall command the isolation discharge knife gate

to close. As the KGV closes the Eddy Current drive shall modulate its speed to match the pressure on its header with the one measured at the common discharge header. Once the Gate is confirmed Closed the suction gate valve shall be commanded to close.

LOOP PDS-0050-X – CONE VALVE DIFFERENTIAL PRESSURE SWITCH

A. General: The differential pressure switch measures pressure between the upstream and downstream piping connected to the associated cone valve. Once equal pressure conditions are met (differential pressure contact is energized), the cone valve is permitted to open during a pump start sequence.

B. Control:

1. PLC-PCP-X. Part of pump starting sequence (see LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCESE, below).
2. Differential Pressure Setpoint used for pump startup sequence: The pressure measured at the Cone Valve inlet side (high pressure leg) shall be equal to the pressure measured on the outlet side (low pressure leg) of the Cone Valve, **PLUS** a field determined offset value (calibrated in the field device, and initially set to 11.5ftH_2O ~ 5psi).

C. Alarms/Monitoring:

1. Differential Pressure (PD)

LOOP PIT-0050-X – PUMP DISCHARGE HEADER PRESSURE TRANSMITTERS

A. General:

1. Pressure transmitters mounted on the pumps discharge header between the Pump and the Cone Valve, continuously monitor pressure and used during the automatic Stopping Sequence.

B. Control:

1. SCADA, OIT-IPS, OIT-PCP-1 through OIT-PCP-6:

a. Part of pump stopping sequence (see LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCESE, below)

C. Alarms/Monitoring:

1. Pressure PAH
2. Out of range

LOOP PIT-0060-X – COMMON HEADER PRESSURE TRANSMITTERS

A. General:

1. Pressure transmitters mounted on the pumps discharge common header continuously monitor pressure at the East and West force mains.

B. Control:

1. SCADA, OIT-IPS, OIT-PCP-1 through OIT-PCP-6:

a. Part of pump starting sequence (see LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCESE, below)
b. Software selector switches at OIT-IPS and SCADA shall give the operator the ability to choose the primary pressure measurement device for pump starting sequence control. The operator shall have the ability to choose PT-0060-1, or PT-0060-2, or average of both pressure readings.
c. Regardless of the instrument chosen for pump starting sequence logic, there shall be an operator adjustable deviation programmed between the pressure transmitters to indicate a “high deviation”.
d. There shall be no automatic failover of a pressure reading to the alternate pressure transmitter, only alarms with system holding last good value.

C. Alarms/Monitoring:

1. Pressure PAH
2. Out of range

LOOP P-0050-X – INFLUENT PUMPS NO. 1 TO NO.6

A. General: The dry well's vertical shaft influent pumps, equipped with variable speed (Eddy current) drives, transfer screened sewage water from both East and West wet wells to a common discharge header, which then feeds the respective forced mains. Each wet well is provided with three pumps: Pumps No.1 through No.3 serving the East Wet Well, and pumps No. 4 through No.6 serving the West Wet Well. The pumps shall have the ability to operate locally from the respective Pump Control Panel (PLC-PCP-1 through PLC-PCP-6), or remotely from the HMI. When controlled from the HMI, the Operator shall have the ability to control the pumps either manually or in an automatic level control mode. In Manual mode, the operator shall have the option to start, stop, and change the speed of the controlled pump. In Automatic mode, the operator shall be able to configure lead/lag designation and enable automatic wet well level control. Pump speed modulation shall be automatic; however, pump start and stop sequences shall remain operator-initiated as described in LOOP LC-0050-X.

B. The Vibration and bearing Temperature Monitoring System (VTMS) shall communicate additional pump information to the PLC-IPS using data communications protocol over Category cabling. This information shall not be used for software control interlocks and only be used for alarm and monitoring purposes. High vibration and/or high bearing temperature conditions shall be alarmed and recorded in the plant SCADA historian accordingly.

C. Automatic Wet well level control shall be based on the operator selection for primary control variable as described in LOOP LC-0050-X - WET WELL LEVEL.

D. Control:

1. Hardwired Interlocks (PLC-PCP-1 through PLC-PCP-6): Critical pump and motor fault signals shall be wired to the respective Pump Control Panel PLC to initiate a stop sequence or prevent the initiation of a start sequence of the respective pump.

a. Critical pump and motor fault signals include:

1) Emergency stop pushbuttons
2) Motor High Winding Temperature.
3) Eddy current drive malfunction
4) Cone valve malfunction
5) Cone valve limit switch closed (ZSC-0050-1 through 6).
6) Seal water no flow.

2. Software Interlocks:

a. When the wet wells are hydraulically connected, the SCADA system stops the running pump(s) when a user configurable low level (initially set EL -21.65) is measured by the active level instrumentation.
b. When one of the wet wells is out-of-service, as selected by Operator:

1) Operators shall be provided with means to select which wet-well is out-of-service as required.

a) The pumps associated with the out-of-service wet well shall be forbidden from running in automatic mode. Manual operation shall be retained to assist during tank drainage procedures if acceptable by the Operator.
b) The pumps associated with the remaining (in-service) wet well shall be permitted to automatically control level in either LEAD/LAG1/LAG2 or LEAD/LAG1/STAND-BY configuration as selected by the operator, Or to manually control the pumps.

2) Pumps in the in-service wet well shall stop when low level (LOOP 0020-X - WET WELLS LEVEL) is measured by the selected level transducers.
3) Software interlocks shall be disabled when the L/O/R selector switch at the associated equipment is in the "Local" position. Software interlocks remain active in Remote mode regardless of Auto/Manual selection.
4) A pump shall not be permitted to start unless its corresponding isolation knife gates are opened. A message shall pop-up to alert the operator to open these valves prior to starting pump. However, the Operator shall be provided with password-protected override capability to allow manual initiation of a pump start sequence.

3. Medium Voltage Motor Starter:

a. Local: When the L/O/R switch is in the "Local" position, the Motor Starter is started/stopped through local pushbuttons on the Motor Starter Cabinet.
b. Remote: When the L/O/R switch is in the "Remote" position, the Motor Starter is Start and Stop controls are transferred to the RESPECTIVE PLC-PCP-X . In this mode, the respective PLC-PCP logic monitors the operation of the Motor Starter and provides control.
c. Off: When the L/O/R switch is in the "Off" position, the start/stop features both at the Motor Starter cabinet and at remote locations (OITs, SCADA) shall be disabled.
d. Alarming and historical data recording functionality shall be provided at the SCADA level regardless of the position of the L/O/R selector switch on the Motor Starter cabinet.
e. The Motor Starter is provided with internal hardwired relay logic overriding PLC-based control functionality.

4. Eddy Current Drive Control Panel:

    a. Local: When the L/O/R switch is in the "Local" position, the eddy current drive is started/stopped through local pushbuttons on the eddy current drive control panel. The speed of the eddy current drive shall be adjustable locally on the eddy current drive control panel.
    b. Remote: When the L/O/R switch is in the "Remote" position, speed control of the drive is transferred to the RESPECTIVE PLC-PCP-X .
    c. Off: When the L/O/R switch is in the "Off" position, the start/stop features at the eddy current drive control panel and remote operation will be turned off.

E. Alarms/Monitoring:

1. The following signals are to be transmitted to the SCADA PLC over Ethernet connection and are typical for each Vibration and Temperature Monitoring Panel (VTMP) as shown on the drawings:

    a. Motor Winding 1 Temperature
    b. Motor Winding 2 Temperature
    c. Motor Winding 3 Temperature
    d. Motor Winding 4 Temperature
    e. Motor Winding 5 Temperature
    f. Motor Winding 6 Temperature
    g. Motor Bearing 1 Temperature
    h. Motor Bearing 2 Temperature
    i. Motor High Temperature
    j. Top of Motor Vibration (X – Axis)
    k. Top of Motor Vibration (Y – Axis)
    l. Top of Motor Vibration (Z – Axis)
    m. Base of Motor Vibration (X – Axis)
    n. Base of Motor Vibration (Y – Axis)
    o. Motor High Vibration

2. Pumps shall indicate starts per hour on OIT-IPS, OIT-PCP and SCADA. The motors and pumps run the risk of overheating and present premature failure if they start more than a user configurable (password-protected) number of times per hour, initially set this parameter to once per hour. An alarm shall be announced at 2 or more starts per hour.

F. Data Collection: Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP PC-0050-X - PUMP CONTROL – START AND STOP SEQUENCES

A. General:

1. This loop defines complete pump start, and pump stop sequencing logic, including the use of differential pressure switches (DPS-0050-X) pressure transmitters (PIT-0050-X, PIT-0060-X), operator pressure-source selection, deviation handling, fallback timer behavior, Eddy drive speed control, and cone-valve opening.
2. Differential pressure switches (DPS-0050-X) and discharge header pressure transmitters (PIT-0050-X) serve distinct functions in the pump control sequences. DPS devices are used exclusively during pump starting sequences to verify acceptable pressure differential conditions across the cone valve prior to opening. PIT

devices are used during pump stopping sequences to monitor and control discharge pressure for coordinated pump speed reduction and cone valve closure.

3. The PLC shall determine when a pump start or stop sequence is required and identify the applicable pump based on the configured LEAD/LAG/STANDBY sequence. The Operator shall be prompted to initiate either a Pump Starting Sequence or a Pump Stopping Sequence.

B. PLC-IPS logic:

1. If the separation gate valve (GV-0054-1) is fully closed as confirmed by its closed limit switch signal, Operators shall be prompted to acknowledge that PIT-0060-1 will be used in the logic for Pumps 1 through 3 and PIT-0060-2 in the logic for Pumps 4 through 6.

C. PLC-PCP-X logic:

1. Operators shall either manually designate one of the two headers' pressure transmitter signals (PIT-0060-1 or PIT-0060-2) or opt to use the averaged values from both instruments provided the separation gate valve (GV-0054-1) is fully open as confirmed by its opened limit switch signal. The selected signal shall be used by the respective PLC-PCP-X as a reference against the respective Pump Discharge Pressure transmitter (PIT-0050-X) in the Pump Starting and Stopping sequences described below.
2. Logic shall confirm a clear path of flow through the Main Discharge header connections by confirming open status from the Associated Knife Gate Valves installed on the 48in common discharge headers (GV-0054-1, GV-0055-1, GV-0055-2, and GV-0055-3)
3. Automatic Pump Start Sequence logic:

    a. Once the pump start sequence is initiated, the following sequence shall happen:

        1) Logic shall confirm that the Pump Train Isolation Valves (LOOPS GV-0050-X, KGV-0050-X – PUMP TRAIN ISOLATION VALVES, above), are fully open. If either valve is not confirmed 100% open by the respective open limit switch, the Operator shall be prompted to field verify the position of the valve(s) before continuing with the Pump Starting Sequence. If Operator does not confirm continuation of the Pump Starting Sequence within one minute, the Pump Start Sequence logic shall not continue.
        2) The seal water system solenoid is commanded to open (via relay logic contained in the Low Voltage Motor Starter), to permit seal water to enter the pump.
        3) Seal water flow signal shall be confirmed using the associated seal water flow switch before continuation of the Starting sequence. If the seal water low flow signal is not cleared, the Starting sequence shall be aborted and the seal water solenoid commanded to close.
        4) A timer (determined during startup) shall be provided for the motor to reach full speed. Once both the timer expires, and the seal water flow conditions are satisfied, the respective PLC-PCP shall command the Eddy current drive clutch to engage, effectively initiating motion of the pump impeller.
        5) Once the Eddy Current Drive clutch is engaged:

            a) The speed of the pump shall be commanded to speed up gradually and until the Differential Pressure Switch setpoint is met (see

LOOP PDS-0050-X – CONE VALVE DIFFERENTIAL PRESSURE SWITCH, above). Once the Differential Pressure condition is satisfied, the Cone Valve shall be commanded to open.

b) If there is any other pump already running (as referenced via communications from PLC-IPS), the drive shall modulate the pump speed to match the speed of the running pump(s), and then gradually speed up until the Differential Pressure Switch setpoint is met (see LOOP PDS-0050-X – CONE VALVE DIFFERENTIAL PRESSURE SWITCH, above).

c) Integrator shall coordinate software based timers with the relay timers provided in the Motor Starter. Motor Starter relay timers shall be considered as last mean of protection. Coordination shall ensure that there are no timing conflicts between the two.

4. Automatic Pump Stop Sequence logic:

   a. Once the pump stop sequence is initiated, the following sequence shall happen:

      1) The cone valve shall be commanded to close.
      2) When the Cone Valve begins its closing operation, a temporary increase in its upstream pressure is anticipated. As the Cone Valve closing motion continues, the PLC-IPS PLC shall command the Eddy Current Drive to modulate the speed of the pump to match the pressure measured the on the pump discharge header (LOOP PIT-0050-X – PUMP DISCHARGE HEADER PRESSURE TRANSMITTERS, above), with the pressure measured on the common discharge header (LOOP PIT-0060-X – COMMON HEADER PRESSURE TRANSMITTERS, above).
      3) Once the Cone valve is confirmed fully closed, the PLC-PCP shall command the Eddy current drive to disengage the clutch.

         a) Relay logic in the Low Voltage Motor Starter commands the motor to stop once the Cone Valve is confirmed closed.
         b) Timer-based relay logic in the Low Voltage Motor Starter commands the seal water system solenoid valve to close once the impeller is fully stopped.

5. Emergency Stopping procedure:

   a. Once an E-Stop is activated, the associated pump shall be commanded to immediately initiate a Pump Stopping Sequence.
   b. An E-Stop active signal shall prevent initiation of a pump starting sequence until the situation is resolved and the field distributed E-Stop pushbuttons are reset.

6. Each PLC-PCP-X shall be configured to accept pump starting and stopping sequence commands from PLC-IPS, when their associated main selector switch is in REMOTE. Once a PLC-PCP-X receives the start sequence command, the PCP shall run at the speed determined by PLC-IPS.
7. Failure Scenarios:

   a. If the reference pressure signal (see 1, above) is not available, or if PLC-IPS is unavailable or fails, and the respective PLC-PCP-X cannot determine the Operator selected reference pressure, or determine if another pump is already

running, or it cannot determine the speed of the running pump(s), an alarm shall be announced at the respective PLC-PCP-X. Under these conditions, the Pump Starting Sequence shall be inhibited when the automatic Wetwell Level Control is active (see LOOP LC-0050-X - WET WELL LEVEL CONTROL, below). Nevertheless, the Operator shall retain manual control of the pump and be able to initiate a starting sequence from the respective PLC-PCP-X if so required.

b. During startup, a user configurable timer initially set to 30 seconds shall be started. If the timer expires, and the associated Cone Valve has not become unseated from the closed limit switch as confirmed by both the analog signal from the Cone Valve Control Panel and from the limit switch signal relayed from the Motor Starter, then a Cone Valve failure is alarmed. At this moment, the pump shall be called to shut down immediately.

c. If the pump is started successfully and the Cone Valve becomes unseated from the closed position for a configurable timer initially set to four minutes, but does not reach the open limit switch or its analog signal does not reach a user configurable setpoint initially set to 95% opened, within a configurable timer initially set to 18 minutes, then a "Jam Alarm" shall be generated and the pump shall remain running. In this event, the operator shall determine whether to keep the pump running or to stop it.

d. Failure of any selected Lag pump, when a pump is selected as part of the Lead/Lag sequence and a failure condition occurs, operation shall continue automatic level control operation with the available and already selected pumps. Operator shall be notified that the affected lag pump will not participate in the sequence and shall be prompted to select a different Lag pump for operation. If no additional lag pump is available, Operators shall be notified that automatic level control will be stopped, and that the running pump(s) speed will be maintained at the current speed.

e. If a pump starting sequence is interrupted by operator by either switching any component to their manual position or by aborting the procedure altogether (E.g. LOOP FSL-0050-X - SEAL WATER FLOW operator initiated abort, above), the Cone Valve shall be commanded to close. If the Cone valve is the device that was switched from remote to hand by operator, the isolation valves shall be called to close and the pump be called to stop once either Closed limit switch is made.

LOOP LC-0050-X - WET WELL LEVEL CONTROL

A. General:

1. Continuous monitoring of screened raw wastewater level by means of level transmitters.
2. Under normal operating conditions both wet wells are connected and experience equal hydraulic conditions. This situation shall be monitored not only by comparing measurements from the level instrumentation, but also from the status of the actuator limit switches (open position) provided in the interconnecting gate valves GV-0071-1 and GV-0072-1. The automatic wetwell level control descriptions outlined herein shall be enabled only when these conditions are satisfied.
3. Low level conditions shall be monitored by Pressure Switches installed on the 48-inch pipes interconnecting the two wetwells as shown. The switches setpoint shall be field determined and calibrated so that the elevation in the active wetwell(s) does not fall below the elevation of the pump volute. The switches shall be hardwired to the Motor Starter, where relay logic will either prevent a pump from starting, or automatically stop the motor. Additionally, the low level signal transmitted from the

Motor Starter to the PLC-PCP shall initiate the appropriate Pump Stopping Sequence or prevent a Pump Starting Sequence from being initiated.

4. The PLC Logic shall be used to automatically control pumps speed, while operators retain manual control of initiating pump start and stop sequences.
5. Operators shall be provided with an option to disable Automatic wetwell level control, such an impending significant weather event, deems it risky and where manual control is preferred.
6. Hardwired protection devices shall act as the final safety interlock. PLC-based control shall provide normal process shutdown prior to activation of hardwired protection.

B. Control:

1. Automatic wet well level control shall be defined as a semi-automatic control mode consisting of the following:

   a. Pump Speed Control (Automatic): When one or more pumps are running in AUTO mode with the associated equipment in REMOTE, the PLC shall automatically modulate the speed of all running pumps in unison to maintain the wet well level within the active control band. Pump speed shall increase or decrease proportionally to the wet well level as described herein.
   b. Pump Start (Operator Initiated): When the control logic determines that an additional pump is required to maintain wet well level (based on level bands, p
   c. ump speed, or other configured criteria), the PLC shall not automatically start the next pump. Instead, the PLC shall:

      1) Generate a prominent operator prompt at the OIT-IPS and SCADA HMI indicating that an additional pump is required.
      2) Identify the next pump in the LEAD/LAG/ STANDBY sequence.
      3) Await operator confirmation.

2. The operator shall initiate the pump starting sequence. Upon operator confirmation, the PLC shall execute the full pump starting sequence as defined in LOOP PC-0050-X.

   a. Pump Stop (Operator Initiated): When the control logic determines that a pump should be removed from service (based on decreasing wet well level, minimum speed conditions, or level band thresholds), the PLC shall not automatically stop the pump. Instead, the PLC shall:

      1) Generate a prominent operator prompt at the OIT-IPS and SCADA HMI indicating that a pump stop is required.
      2) Identify the pump to be stopped based on the LEAD/LAG/ STANDBY sequence.
      3) Await operator confirmation.

3. The operator shall initiate the pump stopping sequence. Upon operator confirmation, the PLC shall execute the full pump stopping sequence as defined in LOOP PC-0050-X.

   a. Operator Responsibility: The operator is responsible for initiating all pump start and stop sequences during Automatic Wet Well Level Control mode. Failure to respond to prompts may result in wet well levels exceeding normal operating limits.
   b. System Operation Without Operator Response: If the operator does not respond to pump start prompts within a configurable time period, the system

shall alarm and notify the operator of potential overflow or system capacity exceedance conditions, as described in Failure

c. Scenarios below. The PLC shall not automatically start or stop pumps unless explicitly defined elsewhere for emergency conditions.

d. Definition of Automatic Mode: For the purposes of this specification, "Automatic Wet Well Level Control" refers to automatic modulation of pump speeds only. Pump start and stop actions remain operator initiated.

4. Control Logic PLC-IPS:

a. General: When the L/O/R switch at the respective Pump Control Panel (PLC-PCP-1 through 6) is in “REMOTE”, control is transferred to the PLC-IPS for Auto/Manual (A/M) control as described below.

b. Manual: When the L/O/R switch is in “Remote” (at the respective PLC-PCP-X), and the pump software A/M soft selector switch is in “Manual” (at PLC-IPS), the operator shall be able to initiate starting and stopping sequences as well as adjust the speed of the pump(s) through the OIT-IPS and SCADA.

c. Auto: When the L/O/R switch is in “Remote” (at the respective PLC-PCP-X), and the pump software A/M switch is in “Auto”, the pump's operation is based upon the LEAD/LAG1/LAG2/LAG3/STANDBY1/STANDBY2 designation of each pump.

1) Operator shall receive a pop-up message with alarm if any of the pumps chosen for LEAD/LAG1/LAG2/LAG3/STANDBY1/STANDBY2 are not operating in “REMOTE” at the respective PLC-PCP-X.
2) Operator shall receive a pop-up message with alarm if any of the pumps chosen for LEAD/LAG1/LAG2/LAG3/STANDBY1/STANDBY2 is not operating in “AUTO” at the PLC-IPS, that will require Operator action (set pumps in AUTO mode at OIT-IPS or SCADA, before pumps are initiated in the sequence.

d. Pump speeds shall ramp up and down in unison from min. to max. speed, at a speed that is proportional to the wet well level band where the pumps are operating within, unless noted otherwise.

1) As wet well level rises within an active control band, running pump(s) speeds shall increase proportionally.
2) As wet well level falls within an active control band, running pump(s) speeds shall decrease proportionally.

e. Pump speeds shall be limited to prevent the rated motor horsepower from being exceeded under all operating combinations, including one, two, and three-pump operation with either one or two force mains in service.

1) Operator-adjustable setpoints shall be provided to input the max pump speed in each of those six operating scenarios.
2) When required, a lag pump shall be started to reduce the load on the operating pump(s) and maintain individual motor horsepower at or below the motor nameplate rating. Speed limiting parameters shall be calibrated during startup to match flow, speed, and pressure conditions in the field. An additional operator-adjustable warning setpoint shall be provided to establish the maximum allowable pump flow for each operating scenario.

f. During initial configuration of the automatic level control system, Operators shall be able to select one of two password-protected global control options (affecting all pumps). These options shall determine the pump start and stop methodology used by the control system, as described in the associated control procedures specified herein.

g. Pump start procedures: Operators shall always be prompted to initiate a Pump Starting Sequence manually (Operator Prompted Pump Start, requiring the operator intervention and overseeing), as required to maintain level. Starting procedure shall follow the selected global option (see article f):

1) Option 1, Pump Start based on Pump Speed: The pumps shall be started in sequence as they reach maximum speed for a minimum of 60 seconds (operator adjustable), and level in the wetwells continues to rise. At which point, the Operator shall be prompted to start the next Lag pump.
2) Option 2, Pump Start based on Level Bands: The pumps shall be started in sequence as they reach the respective Pump Start level setpoint (operator adjustable) for a minimum of 60 seconds (operator adjustable). At which point, the Operator shall be prompted to start the next Lag pump. See Attachment 1 - Cedar Creek Influent Pumping System Wet Well Level Setpoints at the end of this section.

h. Pump shutdown procedures: Operators shall be prompted to initiate a Pump Stopping Sequence manually (Operator Prompted Pump Stop, requiring the operator intervention and overseeing), as required to maintain level. Stopping procedure shall follow the selected global option (see article f):

1) Option 1, Pump Stop based on Pump Speed: As level in the wetwells decreases, the running pumps will eventually reach a minimum speed at which point, a pump shall be called to stop based on the selected Lead/Lag and Standby Strategy and after the expiration of a user adjustable timer initially set to 60 seconds.
2) Option 2, Pump Stop based on Level Bands: When level in the wetwell reaches a user adjustable minimum pumping wetwell level setpoint (initially set to EL-21.65), a pump shall be called to stop based on the selected Lead/Lag and Standby Strategy and after the expiration of a user adjustable timer initially set to 60 seconds.

i. Pump speed control shall normally be based on wet well level. However, when the operator-adjustable maximum flow setpoint to the plant is reached (initially set to a default of 115 MGD, adjustable from 80MGD up to 150 MGD via OIT-IPS or SCADA), the Operator shall be prompted to acknowledge that the Pumping System operation will be clamped to this maximum flow setpoint. A clear and prominent indication on the HMI shall inform Operators when the pumping system is operating at the clamped flow value. Additionally, Operators shall be provided with a flow measurement selection prompt, where the Operator selects between using the reading of either flowmeter (FIT-0065-1 or FIT-0065-2), or the sum of readings from both flowmeters (FIT-0065-1 and FIT-0065-2), depending on actual valving conditions on the field.

1) In this mode, pump speeds shall be temporarily modulated to prevent flows from surpassing the flow setpoint of the clamp, and until:

a) The operator decides to switch back to Level Control mode (overriding the clamp), or

b) Wet well levels drop such that pumps begin shutting off based on level setpoints and the maximum flow cannot be maintained.

2) At High-High or Emergency wet well level, Operators shall be prompted to continue operation within the flow clamp limit (update the maximum flow setpoint with a larger one), or to switch back to level control. If acknowledgement is not completed before a 15 minute timer, operation shall continue with the flow clamp limit defined informing operators that the timer expired and no acknowledgement was made.

3) If wet well levels rise above the high-level alarms while in high flow clamp mode, the Operator shall be prompted via pop-up that levels are critically high in the wetwell and upstream facilities may be subject to flooding conditions. On the other hand, if level in the wetwell is low and flow falls below a user adjustable minimum setpoint initially set to 12MGD (field determined), the Operator shall be informed that the accuracy of the flow measurements will be marginally reduced until flow increases above this value.

C. Failure Scenarios:

1. East/West Wetwell level mismatch due to level instrumentation failure, or disagreement, or closure of one of the isolation knife gate valves (GV-0071-1 or GV-0071-2). Automatic level control shall be interrupted, running pumps shall continue operating at same speed, and Operators shall be informed via pop-up and alarm that level control is interrupted, and manual control of the pumping system is in place.
2. Lag pump start sequence not initiated by operator within an initially set time of 5 minutes shall inform operators via pop-up and alarm that level conditions in the wetwell will potentially exceed the wetwells capacity and upstream flooding is likely to occur.
3. If a selected the electromagnetic flowmeters fails, flow clamp mode shall be disabled. Operator shall be prompted via pop-up that flow clamp mode is disabled due to flowmeter failure, and downstream facilities may be subject to flooding conditions.
4. Operator switchover of any running pump from Remote to Local at the respective PCP, when the pumps are running in Level Control Mode, or the pump is switched from automatic to manual at the HMI the automatic Level Control Mode shall be cancelled, operating pumps shall remain on at the speed they were running. A clear and prominent indication on the HMI shall inform Operators that Automatic Level Control is cancelled and that running Pump(s) will continue running in manual mode.

LOOP FE-0065-X - SCREENED INFLUENT FLOW

A. General: Continuous monitoring of screened influent flow by means of a flow transmitter to SCADA (FE/FIT-0065-1 and FE/FIT-0065-2).

B. Control: Screened influent flow indication used for compliance and to control the Influent Pumps as described in LOOP LC-0050-X - WET WELL LEVEL CONTROL, article B.4.i, above.

C. Alarms/Monitoring:

1. Provide flow totalization, analog alarming, and monitoring as described in “Accumulators and Totalizers,” “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this section.

2. Generate a NO FLOW alarm if no flow is measured while any of the Influent Pumps are running.

D. Data Collection: Provide historical data collection as described in "Historical Data Collection" Article of this section.

LOOPS KGV-0054-1, KGV-0055-X, GV-0056-1, GV-0071-X, KGV-0073-X - GATE VALVES and KNIFE GATE VALVES

A. General: Gate valves provided with OPEN/STOP/CLOSE (O/S/C) and LOCAL/REMOTE (L/R) hand switches at the respective actuator. The actuator's L/R selector switch shall be left in "Remote" during normal operation. The actuators shall also be provided with accessible Local Control Stations (LCS) at the ground level, with the same hand controls and functionality. Under normal operating conditions, the LCS' L/R selector switch shall also be placed in the "Remote" position.

B. Control:

1. Local (at Actuator Controller):

a. Remote/Local Switch
b. Open/Close Switch

2. Remote, at the respective Remote Control Station (RCS), on the ground level:

a. Remote/Local Switch
b. Open/Close switch

3. PLC-PCPs:

a. Monitoring and control shall be provided at the OIT-PCPs. Operators shall be provided with means to operate the Actuators through soft controls, when both the Actuator and the RCS' Remote/Local switches are in the Remote position.

4. PLC-IPS

a. PLC-IPS shall monitor the open and close limit switch signals of actuators regardless of the position of the L/R selector switches.
b. When the selector switches at both the actuator and its associated LCS, are in "Remote", these actuators are controlled and monitored by PLC-IPS.

C. Alarms/Monitoring:

1. Remote.
2. Overload.
3. Opened.
4. Closed.
5. Data Collection: Provide historical data collection as described in "Historical Data Collection" Article of this section.

LOOP MS-0050-1X - ELECTRICAL EQUIPMENT MONITORING

A. General: Monitors KW usage for each motor starter.

B. Control:

1. Local: None

C. SCADA PLC/OWS:

1. Indications shall be provided at the respective OIT-PCP and SCADA

D. Alarms / Monitoring:

1. SCADA PLC/OWS:

a. KW usage

LOOP UA-0080 – VENTILATION EQUIPMENT MONITORING

A. General: Ventilation failure conditions shall be monitored at the SCADA level. PLC-IPS shall monitor the alarm statuses shown.

B. Alarms/Monitoring:

1. SCADA PLC/OWS:

a. Trouble: Ventilation loss of flow
b. Alarm: Ventilation loss of flow
c. Trouble: Current transducer failure
d. Alarm: Current transducer failure
e. Trouble: Silence button initiated
f. Alarm: Silence button initiated
g. Trouble: VF Panel
h. Alarm: VF Panel.

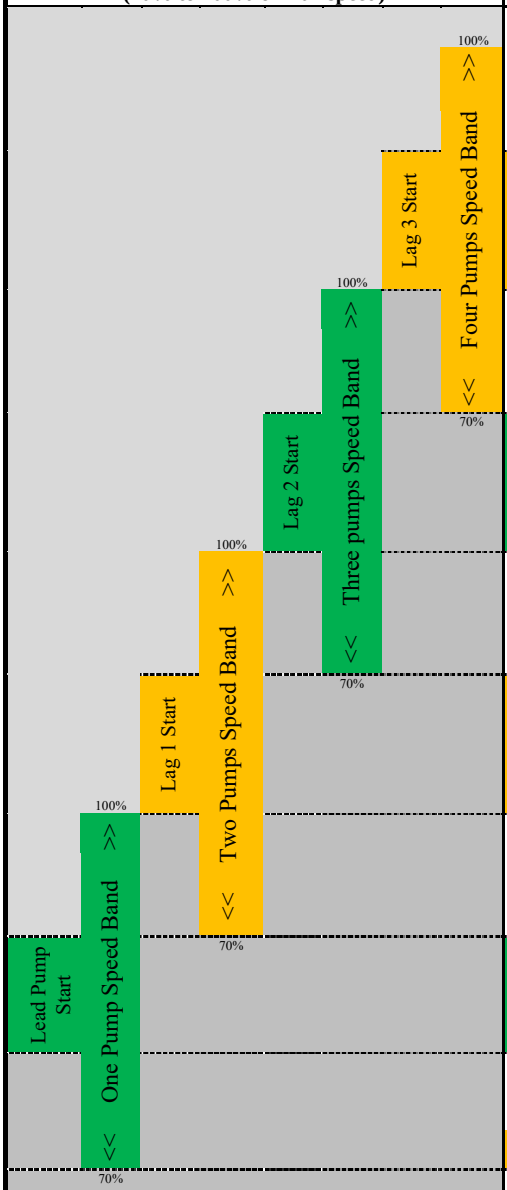
3.8 ATTACHMENTS

A. Attachment 1 - Cedar Creek Influent Pumping System Wet Well Level Setpoints

END OF SECTION 406196

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Attachment 1

CEDAR CREEK INFLUENT PUMPING SYSTEM WET WELL LEVEL SETPOINTS		
Pump Speed Proportional Level Control Bands **(70% to 100% of max speed)**	**EL**	**Pump Start/Stop Control**
	**-8.95**	Top of level range (20mA)
	-15.45	Emergency wetwell Level Alarm (Surge relief @ EL-14.95)
	-17.15	**On increasing level: Start Lag 3 Pump**: Running pumps to ramp down to minimum speed (70%). Start Lag 3 pump and ramp speed up to satisfy Cone Valve Diff. Press setpoint. Once Lag 3 cone valve is open, pumps ramp up and down in sync.
	TBD	On decreasing level: Four pumps running at minimum speed (70%). Stop Lag 3 Pump. Resume level control with remaining pumps.
	-17.65	**On increasing level: Start Lag 2 Pump**: Running pumps to ramp down to minimum speed (70%). Start Lag 2 pump and ramp speed up to satisfy Cone Valve Diff. Press setpoint. Once Lag 2 cone valve is open, pumps ramp up and down in sync.
	TBD	On decreasing level: Three pumps running at minimum speed (70%). Stop Lag 2 Pump. Resume level control with remaining pumps.
	-18.65	**On increasing level: Start Lag 1:** Lead pump to ramp down to minimum speed (70%). Start Lag 1 pump and ramp speed up to satisfy Cone Valve Diff. Press setpoint. Once Lag 1 cone valve is open, pumps ramp up and down in sync.
	TBD	On decreasing level: Two pumps running at minimum speed (70%). Stop Lag 1 Pump. Resume level control with remaining pump.
	-20.65	**On increasing level: Start Lead Pump** once the cone valve is open the pump modulates speed as needed
	-21.65	On decreasing level: **Stop Lead pump**
--- --- --- --- --- --- --- ---	**-23.65**	Pump Volute Centerline
	-34.65	Bottom of Radar Level range (4mA)
Notes: This chart or something similar shall be programmed in the OWS, OIT-PCP and PLC-IPS. Tentative values being provided. Confirm on the field during startup and testing procedures in accordance with LOOP LC-0050-X B.1.		

Attachment 1. Cedar Creek Influent Pumping System Wet Well Level Setpoints

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SECTION 406263 - OPERATOR INTERFACE TERMINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1. Section includes operator interface terminals.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406343 “Programmable Logic Controllers.”
3. Section 406717 “Industrial Enclosures.”
4. Section 406863 “Configuration of HMI Software.”

1.3 DEFINITIONS

A. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Operator Interface Terminals: One spare OIT.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience, and with service facilities within 150 miles of Project.

1.10 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the current version of hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment is as follows:

1. PCSS to submit for approval the required data for the equipment as part of the,,, Hardware and Submittal.
2. Order equipment as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit for approval the required data of the latest available hardware and software equivalent in cost to that which is specified. Do not order equipment more than 3 months prior to when it is needed to be continuously used on the project.

1.11 DELIVERY, STORAGE, AND HANDLING

A. As indicated by the Manufacturer.

1.12 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.13 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 OPERATOR INTERFACE TERMINAL (OIT)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Rockwell Automation Allen-Bradley – PanelView Plus 7 Performance series.
b. Schneider Electric – Harmony series
c. Substitutions: Or equal

B. General

1. OITs are standalone devices with an integrated hardware/software platform to monitor and control a process through an interactive display.

C. Features

1. Software:

a. OITs pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.
b. Integrated OIT software has the following features:

1) Trending
2) Data logging
3) Alarms
4) Graphic symbols
5) Animations

2. Hardware:

a. Minimum one Secure Digital (SD) card slot

D. Communications

1. Ports:

a. Minimum two (2) 10/100MB Ethernet
b. Minimum one (1) USB
c. Minimum one (1) serial RS-232

2. Protocols:

a. EtherNet/IP
b. Modbus TCP/IP

E. Display:

1. Provide OIT screen sizes as shown on the drawings. If not explicitly specified provide a minimum of 15" viewable as measured diagonally across screen.
2. Minimum display resolution

a. 1024 x 768 for 12" to 15” displays
b. 1280 x 1024 for displays larger than 15”

3. Color Active Matrix TFT.
4. Display supports touch screen input.

F. Environmental:

1. Rating: OIT rated to maintain the rating of the control panel it will be mounted on and meet the area classification.
2. Operating Temperature: 32 to 122 degrees F

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where operator interface terminals will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

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3.4 IDENTIFICATION

A. Refer to control system architecture for tagging designations

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 SOFTWARE SERVICE AGREEMENT

A. Not Required.

END OF SECTION 406263

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SECTION 406343 - PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes programmable logic controllers.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Analog Input (AI): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) to be interpreted by a PLC.

B. Analog Output (AO): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) sent from a PLC to a field device.

C. Digital/Discrete Input (DI): A binary signal (0 or 1) to be interpreted by a PLC.

D. Digital/Discrete Output (DO): A binary signal (0 or 1) sent from a PLC to a field device.

E. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

F. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

G. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

H. Peer to Peer: Communication between two or more devices, typically PLC’s, in which each device can control the communication exchange.

I. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

J. Remote I/O (RIO): I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocol and can use standard rack based I/O, or specialized Remote I/O hardware referred to as Distributed I/O.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. The provided system shall be built/simulated in manufacturer’s tools, such as Integrated Architecture Builder by Rockwell Automation. A report demonstrating no errors or warnings in the proposed system shall be provided.

a. An as-built version of the report shall be provided as part of Final System Documentation.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. CPUs: Provide one spare CPU for each unique CPU installed.
2. Power Supplies: Provide two spare power supplies for each unique power supply installed.
3. Chassis: Provide one spare chassis for each unique size installed.
4. I/O Cards: Provide spares for each unique I/O module type installed. Provide two 2 or 10 percent of installed quantity, whichever is greater.
5. Network interface, remote I/O, and communication modules: Provide one 1 spare module for each unique type of module installed.
6. Miscellaneous components (including cables): Provide spares for each unique component installed.

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1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience, and with service facilities within 100 miles of Project.

1.10 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the current version of hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment is as follows:

1. PCSS to submit for approval the required data for the equipment as part of the Hardware and Software Packages Submittal.
2. Order equipment as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit the required data of the latest available hardware and software, equivalent in cost to that which is specified for approval. Do not order equipment more than 3 months prior to when it is needed to be continuously used on the project.

1.11 DELIVERY, STORAGE, AND HANDLING

A. As indicated by the manufacturer.

1.12 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.13 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Configuration:

1. Refer to drawings for PLC configurations and network connections. For systems shown with redundant PLCs on the drawings, hot-standby processors must be provided. The device configuration must allow for instantaneous failover to the secondary PLC.

2.2 SPARE I/O, SLOTS, AND FUTURE EXPANSION

A. Spare PLC I/O:

1. Provide 20 percent points per type AI AO**,** DI, and DO for future use.
2. Provide spare I/O points of same type of I/O modules supplied.

B. Spare PLC Slots (Chassis-Based PLC Systems): Provide at least 2 spare slots for addition of future I/O in each chassis provided.

C. Future PLC Expansion (Non-Chassis-Based PLC Systems):

1. Provide adequate space to the right of the last I/O card per row of I/O cards for 2 future I/O cards.
2. Card width based on the widest I/O card provided in panel.

D. Provide external relays for spare output points that require their use.

E. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules.

2.3 CHASSIS BASED PLC SYSTEM

A. Manufacturers:

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.
2. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

   a. Rockwell Automation Allen-Bradley – 1756 -L 8 ControlLogix
   b. Schneider Electric – M580
   c. Substitutions: Or equal.

B. General:

1. Provide processor, power supply, I/O modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.
2. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.
3. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.
4. Designed for continuous industrial service.
5. Provide products of a single manufacturer.
6. Provide equipment models that are currently in production.

7. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory and resumes normal operation without manual intervention when power is restored.
8. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc. as shown on the Drawings.
9. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

C. Physical:

1. Vibration: 3.5mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 Hz. Vibration tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500 Hz. In accordance with one of the following:

    a. DIN rail mounted PLC, 10 – 57 Hz., amplitude 0.075 mm, acceleration 25-100 Hz.
    b. Panel or plate mounted PLC: 2-25 Hz., amplitude 1.6mm, acceleration 25-200 Hz.
    c. In compliance with IEC 60068 and IEC 61131.

2. Shock: 15G, 11msec. Shock tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing.
3. Operating Temperature: 32 to 140 degrees F.
4. Storage Temperature: -13 to 158 degrees F.
5. Relative Humidity: 10 to 95 percent, non-condensing.
6. Noise Immunity: Tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
7. Altitude (Operating): 0 to 6,500 feet.
8. Altitude (Storage): 0 to 9,800 feet.
9. Degree of protection: NEMA 1 (IP20).
10. All products have corrosion protection.

D. Identification

1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:

    a. Module product type such as analog or digital.
    b. Module catalog number.
    c. Module major revision number.
    d. Module minor revision number.
    e. Module manufacturer vendor.
    f. Module serial number.

E. PLC Central Processing Unit (CPU):

1. General:

    a. Minimum 16-bit microprocessor with system timing and is responsible with scheduling I/O updates with no user programming required to ensure discrete or analog update.

b. Executes user relay ladder logic programs, communicates with intelligent I/O modules, and performs on-line diagnostics.
c. Consists of a single module which solves application logic, stores the application program, stores numeric values related to the application processes and logic, and interfaces to the I/O.
d. Samples all discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU processes the I/O with user programs(s) stored in memory and controls outputs based on the results of the logic operation.
e. Supply the CPU with a battery-backed time of day clock and calendar.
f. CPU family allows for user program transportability from one CPU model to another.

2. Diagnostics:

a. Perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, initiate orderly system shutdown and fail-over. Monitor the following, at a minimum:

1) Memory failure
2) Memory battery low
3) General fault
4) Communications port failure
5) Scan time over run
6) I/O failure
7) Analog or special function I/O module failure

b. Make diagnostic information accessible to the host communications interfaces and to the PLC program.
c. PLC indicators and on-board status area for the following conditions:

1) CPU run.
2) CPU error or fault.
3) I/O failure or configuration fault.
4) Status of Battery or back-up power module.
5) Communications indicator.

3. Memory

a. Provide non-volatile battery backed memory of type CMOS RAM program memory or equivalent.
b. Memory Backup System: Provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.

1) Backup Storage: Provide backup battery or capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
2) SD Memory Card: Provide memory card storage with capacity greater than processor memory capacity. Install memory cards in processors for factory testing.

c. Operating system contained in non-volatile firmware.
d. The memory containing the operating system is field updateable via a separate update tool.

4. Programming Environment

a. Programming port: Use PLC Ethernet port for programming.
b. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
c. Online programming including runtime editing.
d. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structured text.
e. Supply all hardware and software necessary to program the CPU in these languages.

5. Communication Ports:

a. Provide expandable CPU supplied with additional modules to support the required communication interfaces.

6. Remote I/O Communications:

a. Provide CPU capable of communicating with up to 12 remote base locations. Automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
b. Provide communication link between the CPU and any RIO chassis as recommended by the PLC manufacturer.
c. Provide diagnostic and equipment status information from each RIO.
d. Provide remote I/O system with a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU as detailed on the drawings.
e. Communicate with the remote I/O arrangement through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification Section.

7. Controller Redundancy:

a. Provide PLC with all hardware and software required to produce a completely operational redundant system if shown in the Drawings. Redundancy can be implemented using a minimum amount of user programming. Warm backup, which is not a standard offering from the PLC manufacturer, is not acceptable.
b. Provide backup system consisting of redundant controllers located in separate chassis.
c. Provide bumpless switchover for system outputs. All I/O points maintain its last position until either communication is re-established, or the remote I/O watchdog timer expires.
d. Switch-over between the on-line PLC and the back-up PLC occurs within 100 milliseconds if any of the following conditions occurs in the on-line unit:

1) Power failure
2) CPU fault

3) Communications module fault
4) Change in the on-line unit's mode from RUN to PROGRAM

e. Transparent switchover to any devices networked to the redundant controller chassis.
f. Automatically cross-load the primary controller's program to the secondary controller.
~~g.~~ System diagnostics and debugging tools available to troubleshoot all redundancy equipment.

F. Power Supplies:

1. Power Input: 85 to 265VAC, 47 - 63Hz.
2. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.
3. Chassis mounted power supplies to power the chassis backplane and provide power for the processor and applicable modules.
4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.
6. Size power supplies to accommodate the nominal load plus 30%.
7. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10%, and continuous operation through momentary interruptions of AC line voltage of 10ms or less.
8. Automatically shut down the PLC system whenever its output power is detected as exceeding 125% of its rated power.
9. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.
10. Power Supply Redundancy

a. Provide redundant power supplies that comply with all the requirements of non-redundant power supplies in addition to the features stated below.
b. Design redundant power supplies to share the current required by the chassis.
c. In the event of a failure of one redundant power supply, the remaining supply accommodates the entire load of the chassis without disruption to the chassis activity.
d. Provide a failsafe fuse that is not accessible by the customer.
e. Provide a solid-state relay connection to allow for failure annunciation when wired to an input module.
f. Provide diagnostic LED status indicators for Power and redundancy.

G. Chassis:

1. Distribute all system and signal power to the CPU and support modules on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers is acceptable.
2. Provide free air cooling for all system modules, main and expansion chassis. No internal fans or other means of cooling except heat sinks is permitted.
3. Provide means to remove all system modules from the chassis or inserted to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.

4. Modules designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Perform an electronic keying check to ensure that the physical module is consistent with what was configured.

H. Discrete Input & Output Modules:

1. General:

   a. Digital input and output modules provide ON/OFF detection and actuation capability.
   b. Provide cards of I/O type and count as required to implement the functions specified plus an allowance for active spares, as specified herein.
   c. Provide modules capable of being installed or removed while chassis power is applied.
   d. Provide the following status indicators.

      1) On/Off state of the field device.
      2) Module's communication status.
      3) Module health

2. Module Specifications – 120VAC Input Module

   a. Nominal Input Voltage: 120VAC
   b. On-State Current: 15mA at 132VAC, 47 - 63Hz maximum.
   c. Maximum Off-State Voltage: 20V.
   d. Maximum Off-State Current: 2.5mA.
   e. Number of Points per Card: 16.

3. Module Specifications – Individually Isolated Relay Output Module

   a. Output Voltage Range: 10 - 265VAC, 47 - 63 Hz, 5 - 125VDC.
   b. Output Current Rating:

      1) Per Point: 2.5A maximum.
      2) Per Module: 16A maximum.

   c. Power Rating (Steady State): 250VA maximum for 125VAC inductive output.
   d. Maximum Off-State Leakage: 0 mA per point.
   e. Configurable States:

      1) Fault per Point: Hold Last State, ON or OFF.
      2) Program Mode per Point: Hold Last State, ON or OFF.

   f. Number of Points per Card: 16.

I. Analog Input & Output Modules:

1. General:

a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal is transmitted on the backplane.
b. Furnish analog output modules to convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
c. Provide modules designed to be installed or removed while chassis power is applied.
d. Provide the following status indicators:

1) Module's communication status.
2) Module health
3) Input/output devices

e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
g. Following status can be examined in ladder logic:

1) Module Fault Word: Provides fault summary reporting.
2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.
3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing and provide with a readily visible, labeled blown fuse indicator.

2. Differential Analog Input Module:

a. Input Range: 0-20 mA.
b. Resolution: approximately 16 bits across range.
c. Input Impedance: Greater than 249 Ohms.
d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
e. Normal Mode Rejection: 60 dB at 60 Hz.
f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.
g. Isolation Voltage:

1) Channel to Ground/Chassis - 100% tested at 1000 VDC minimum for 1s based on 250 VAC.

h. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 406717 for all signals that enter the panel from outside the building. Substitution of isolated analog input cards to meet this requirement is acceptable.
i. Number of Points per Card: 8.

3. Isolated Analog Output Current Module:

    a. Output Current Range: 4 to 20 mA.
    b. Current Resolution: 12 bits across 20 mA.
    c. Open Circuit Detection: None.
    d. Output Overvoltage Protection: 24V DC/AC maximum.
    e. Output Short Circuit Protection: 20 mA or less (electronically limited).
    f. Calibration Accuracy: Better than 0.1% of range from 4 mA to 20 mA.
    g. Number of Points per Card: 8.

J. Communication Interfaces:

1. Supported protocols:

    a. EtherNet/IP.
    b. Modbus TCP/IP.

2. Ports:

    a. Two 100MB/1G Ethernet.
    b. USB.

3. Utilizing in-chassis communication modules or built-in ports on the PLC is acceptable to meet communication interface requirements.
4. Required Accessories:

    a. Provide protocol converters of the same approved PLC manufacturer as necessary. 3rd party protocol converters are not acceptable unless officially supported by the PLC manufacturer.

K. Required Accessories:

1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

2.4 COMPACT PLC SYSTEM

A. Manufacturers:

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.
2. Manufacturers and their products are subject to compliance with requirements. Provide the following:

    a. Rockwell Automation Allen-Bradley – 5069 CompactLogix
    b. Schneider Electric – Modicon M340
    c. Siemens – S7 300 series

B. General

1. Provide processor, power supply, I/O modules, communication modules, and remote interface modules as required to meet system requirements.
2. PLC is modular based, rather than chassis-based.
3. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.
4. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.
5. Designed for continuous industrial service.
6. Provide products of a single manufacturer.
7. Provide equipment models that are currently in production.
8. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory and resumes normal operation without manual intervention when power is restored.
9. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc. as shown on the Drawings.
10. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

C. Physical:

1. Vibration: 3.5mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 Hz. Vibration tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500 Hz. In accordance with one of the following:

    a. DIN rail mounted PLC, 10 – 57 Hz., amplitude 0.075 mm, acceleration 25-100 Hz.
    b. Panel or plate mounted PLC: 2-25 Hz., amplitude 1.6mm, acceleration 25-200 Hz.
    c. In compliance with IEC 60068 and IEC 61131.

2. Shock: 15G, 11msec. Shock tested in accordance with IEC 68-2-27 and JIS C 0912. The system is to be operational during and after testing.
3. Operating Temperature: 32 to 140 degrees F.
4. Storage Temperature: -13 to 158 degrees F.
5. Relative Humidity: 10 to 95 percent, non-condensing.
6. Noise Immunity: Tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
7. Altitude (Operating): 0 to 6,500 feet.
8. Altitude (Storage): 0 to 9,800 feet.
9. Degree of protection: NEMA 1 (IP20).
10. All products have corrosion protection.

D. Identification

1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:

    a. Module product type such as analog or digital.
    b. Module catalog number.

c. Module major revision number.
d. Module minor revision number.
e. Module manufacturer vendor.
f. Module serial number.

E. PLC Central Processing Unit (CPU):

1. General:

a. Minimum 16-bit microprocessor with system timing and is responsible with scheduling I/O updates with no user programming required to ensure discrete or analog update.
b. Executes user relay ladder logic programs, communicates with intelligent I/O modules, and performs on-line diagnostics.
c. Consists of a single module which solves application logic, stores the application program, stores numeric values related to the application processes and logic, and interfaces to the I/O.
d. Samples all discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU processes the I/O with user programs(s) stored in memory and controls outputs based on the results of the logic operation.
e. Supply the CPU with a battery-backed time of day clock and calendar.
f. CPU family allows for user program transportability from one CPU model to another.

2. Diagnostics:

a. Perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, initiate orderly system shutdown and fail-over. Monitor the following, at a minimum:

1) Memory failure
2) Memory battery low
3) General fault
4) Communications port failure
5) Scan time over run
6) I/O failure
7) Analog or special function I/O module failure

b. Make diagnostic information accessible to the host communications interfaces and to the PLC program.
c. PLC indicators and on-board status area for the following conditions:

1) CPU run.
2) CPU error or fault.
3) I/O failure or configuration fault.
4) Status of Battery or back-up power module.
5) Communications indicator.

3. Memory

a. Provide non-volatile battery backed memory of type CMOS RAM program memory or equivalent.
b. Memory Backup System: Provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.

1) Backup Storage: Provide backup battery or capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
2) Flash SD Memory Card: Provide memory card storage with capacity greater than processor memory capacity. Install memory cards in processors for factory testing.

c. Operating system contained in non-volatile firmware.
d. The memory containing the operating system is field updateable via a separate update tool.

4. Programming Environment

a. Programming port: Use PLC Ethernet port for programming.
b. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
c. Online programming including runtime editing.
d. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structured text.
e. Supply all hardware and software necessary to program the CPU in these languages.

5. Communication Ports:

a. Provide expandable CPU supplied with additional modules to support the required communication interfaces.

6. Remote I/O Communications:

a. Provide CPU capable of communicating with up to 12 remote base locations. Automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
b. Provide communication link between the CPU and any RIO chassis as recommended by the PLC manufacturer.
c. Provide diagnostic and equipment status information from each RIO.
d. Provide remote I/O system with a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU as detailed on the drawings.
e. Communicate with the remote I/O arrangement through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification Section.

F. Power Supplies:

1. Power Input: 85 to 265VAC, 47 - 63Hz.

2. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.
3. Power supply provide power for the processor and applicable modules.
4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.
6. Size power supplies to accommodate the nominal load plus 30%.
7. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10%, and continuous operation through momentary interruptions of AC line voltage of 10ms or less.
8. Automatically shut down the PLC system whenever its output power is detected as exceeding 125% of its rated power.
9. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.

G. Discrete Input & Output Modules:

1. General:

   a. Digital input and output modules provide ON/OFF detection and actuation capability.
   b. Provide cards of I/O type and count as required to implement the functions specified plus an allowance for active spares, as specified herein.
   c. Provide modules capable of being installed or removed while chassis power is applied.
   d. Provide the following status indicators.

      1) On/Off state of the field device.
      2) Module's communication status.
      3) Module health

2. Module Specifications – 120VAC Input Module

   a. Nominal Input Voltage: 120VAC
   b. On-State Current: 15mA at 132VAC, 47 - 63Hz maximum.
   c. Maximum Off-State Voltage: 20V.
   d. Maximum Off-State Current: 2.5mA.
   e. Number of Points per Card: 16.

3. Module Specification – 120 VAC Solid State Output Module

   a. For each triac type discrete output, provide an associated interposing relay located in the same control panel. Provide 120 VAC power for relay outputs from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
   b. Output Voltage Range: 74 - 265 VAC, 47 - 63 Hz.
   c. Output Current Rating:

      1) Per Point: 0.5A maximum at 86 degrees F; 0.25A maximum at 140 degrees F; Linear Derating.
      2) Per Module: 4A maximum at 86 degrees F; 2A maximum at 140 degrees F; Linear Derating.

d. Surge Current per Point: 5A for 43ms each, repeatable every 2s at 140 degrees F.
e. Minimum Load Current: 10mA per point.
f. Maximum On-State Voltage Drop: 1.5V peak at 2.0A and 6V peak at load less than 50mA.
g. Maximum Off-State Leakage: 2.5mA per point.
h. Number of Points per Card: 16.

4. Module Specifications – Individually Isolated Relay Output Module

a. Output Voltage Range: 10 - 265VAC, 47 - 63 Hz, 5 - 125VDC.
b. Output Current Rating:

1) Per Point: 2.5A maximum.
2) Per Module: 16A maximum.

c. Power Rating (Steady State): 250VA maximum for 125VAC inductive output.
d. Maximum Off-State Leakage: 0 mA per point.
e. Configurable States:

1) Fault per Point: Hold Last State, ON or OFF.
2) Program Mode per Point: Hold Last State, ON or OFF.

f. Number of Points per Card: 16.

H. Analog Input & Output Modules:

1. General:

a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value.
b. Furnish analog output modules to convert a digital value that is delivered to the module into an analog signal on the module's screw terminals.
c. Provide modules designed to be installed or removed while power is applied.
d. Provide the following status indicators:

1) Module's communication status.
2) Module health
3) Input/output devices

e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
g. Following status can be examined in ladder logic:

1) Module Fault Word: Provides fault summary reporting.
2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.

3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing and provide with a readily visible, labeled blown fuse indicator.

2. Differential Analog Input Module:

a. Input Range: 0-20 mA.
b. Resolution: approximately 16 bits across range.
c. Input Impedance: Greater than 249 Ohms.
d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
e. Normal Mode Rejection: 60 dB at 60 Hz.
f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.
g. Isolation Voltage:

1) Channel to Ground/Chassis - 100% tested at 1000 VDC minimum for 1s based on 250 VAC.

h. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 406717 for all signals that enter the panel from outside the building. Substitution of isolated analog input cards to meet this requirement is acceptable.
i. Number of Points per Card: 8.

3. Isolated Analog Output Current Module:

a. Output Current Range: 4 to 20 mA.
b. Current Resolution: 12 bits across 20 mA.
c. Open Circuit Detection: None.
d. Output Overvoltage Protection: 24V DC/AC maximum.
e. Output Short Circuit Protection: 20 mA or less (electronically limited).
f. Calibration Accuracy: Better than 0.1% of range from 4 mA to 20 mA.
g. Number of Points per Card: 8.

I. Communication Interfaces:

1. Supported protocols:

a. EtherNet/IP.
b. Modbus TCP/IP.
c. PROFINET.

2. Ports:

a. Two (2) 100MB/1G Ethernet.
b. USB.

3. Required Accessories:

    a. Provide protocol converters of the same approved PLC manufacturer as necessary. 3rd party protocol converters are not acceptable unless officially supported by the PLC manufacturer.

J. Required Accessories:

1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

2.5 PLC SOFTWARE

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

    a. As required to match supplied PLCs.

B. General:

1. Provide PLC configuration and application development software package complete with documentation and installation media.
2. Install the PLC software package and associated licensing and/or activation on the computers shown on the Drawings.
3. Allows for on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.
4. Provide all required hardware (including cables, cable adapters, etc.) for connection to PLCs.
5. Provide all software licenses required to achieve the functionality described in the Specifications.
6. Include a software license agreement allowing the Owner the right to use the software as required for any current or future modification, documentation, or development of the PLCs provide for this project.
7. Provide software capable of the following IEC 61131-3 functions:

    a. Ladder logic.
    b. Function block.
    c. Sequential function chart.
    d. Structured text.

8. Add-on instruction editor allows for the development of custom reusable function blocks. The software permits function block modification while on-line.
9. Software is Microsoft Windows-based and run on the supplied computers.
10. Software includes a security feature to prevent unauthorized personnel from modifying and downloading the programs.
11. Provide an I/O simulator which allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and

debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.

2.6 SOURCE QUALITY CONTROL

A. Testing: Test programmable controller according to NEMA IA 2.2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Programmable Logic Controller will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121 “Process Control System Testing.”

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3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement includes software support for two years.

B. Upgrade Service: At Substantial Completion, update software and firmware to latest compatible version.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406343

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SECTION 406613 - SWITCHES AND ROUTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes switches and routers.

B. PCSS is responsible for performing configuration services for equipment provided under this section.

C. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 406343 “Programmable Logic Controllers.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Control System Security Provider (CSSP): The entity who provides all programming, configuration, and services related to the implementation of cybersecurity countermeasures.

C. Fiber optic Ethernet switch (FOES): An Ethernet based networking device with a combination of fiber optic and copper physical connections.

D. Local Area Network (LAN): A localized group of network devices (e.g. buildings, homes, offices, etc.).

E. Managed Ethernet switch (MES): An Ethernet based networking device that permits the management, configuration, and monitoring of a local area network.

F. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

G. Power over Ethernet (PoE): A method of providing electrical current over an Ethernet connection.

H. Small form-factor pluggable (SFP): A hot-pluggable network interface module connecting a device motherboard (Ethernet switch, router, etc.) to a fiber optic or copper networking cable.

I. Unmanaged Ethernet Switch (UMES): An Ethernet based networking device with a fixed configuration (i.e. “plug-and-play” devices).

J. Virtual Private Network (VPN): An encrypted connection between a private network and a public network (the internet).

K. Wide Area Network (WAN): A network that covers a broad geographic area, typically through use of a public network (e.g. communication across cities, national boundaries, etc.).

L. IEEE: Institute of Electrical and Electronics Engineers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Ethernet Switches: One spare Ethernet switch for each type provided

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

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1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the current version of hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment is as follows:

1. PCSS to submit for approval the required data for the equipment as part of the Hardware Packages Submittal.
2. Coordinate title of this submittal with what is listed in Section 406100 “Process Control and Enterprise Management Systems General Provisions” for the same submittal title.
3. PCSS shall submit for approval the required data for the equipment as part of the Hardware Packages Submittal.
4. Order equipment as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit for approval the required data of the latest available hardware and software equivalent in cost to that which is specified. Do not order equipment more than 3 months prior to when it is needed to be continuously used on the project.

1.10 DELIVERY, STORAGE, AND HANDLING

A. As indicated by the Manufacturer.

1.11 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.12 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 INDUSTRIAL MANAGED ETHERNET SWITCH

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen-Bradley Stratix 5200 series
b. Cisco Catalyst IE3100 series
c. Moxa MDS-G4020 series
d. Or engineer approved equal.

B. General:

1. Provide a DIN rail mountable industrial managed Ethernet switch for connection to the network as shown in the Drawings and specified herein.
2. Provide ethernet switches by the same manufacturer for the project, regardless of type.

C. Physical Features:

1. Switches must include sufficient SFP slots and copper ports to accommodate all connected devices plus 10% spare. The minimum number of ports is included in Table 1 in the switches and routers schedule below. Additional ports may be required based on network connected equipment shown on the drawings.

    a. SFP slots: Refer to Table 1 in the switches and routers schedule.
    b. Copper ports: Refer to Table 1 in the switches and routers schedule.

2. Operating temperature: 0 to 130 degrees F
3. Power: redundant 24VDC power input.
4. Enclosure: Metal case.
5. Rating: UL Class 1, Division 2 Groups A, B, C, and D.

D. Network Features:

1. Layer 2 routing.
2. Spanning Tree Protocol (STP).
3. Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w).
4. 802.1q VLAN tagging protocol
5. Full duplex on all ports.
6. Auto negotiation and manual configurable speed and duplex.
7. Wire speed switching fabric.
8. IGMP snooping.
9. IGMP filtering.
10. Configuration password protected.
11. Configuration backup capability required.
12. SNMP V3.
13. Lock port function for blocking unauthorized access based on MAC address.

E. Additional Features:

1. Provide a dry contact rated for 120 VAC 5A to be used as a programmable common trouble alarm. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.
2. For switches located in control panels shown as connected in a device ring, provide switch capable of being connected with PLC, OIT, and any other equipment shown in the device ring.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where computers will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to control system architecture for tagging designations

3.5 FIELD QUALITY CONTROL

A. Switchers and routers will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. For Managed Ethernet Switches: Refer to Section 408100 “Industrial Control System Cyber Security“ for additional configuration requirements.

a. Enable the lock port function to block unauthorized access based on MAC address for each switch and router. Assign static IP addresses to devices connecting to switch.

3. Lock down all spare switch and router ports.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, ensure service agreement includes software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Ensure upgrading software includes operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days in advance to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 SWITCHES AND ROUTERS SCHEDULE

A. Provide the devices in the following schedules:

Table 1. Ethernet Switch Schedule

Switch Designation	Type	Mount	Fiber Uplinks (1G SFP)	Copper Ports (10/100/1000 Base-T(X), RJ45)
MES-IPS 1 and MES-IPS-2	Managed Ethernet Switch	DIN Rail	2	18
MES-PCP-1 through MES-PCP-6	Managed Ethernet Switch	DIN Rail	2	8

END OF SECTION 406613

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SECTION 406717 – INDUSTRIAL ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes industrial enclosures.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406733 “Panel Wiring.”
3. Section 26053X “Sections for electrical raceways and covers.”
4. The X in the number indicates spec sections starting with the first 5 numbers (indicating a category described in the accompanying text) are included in the reference.

1.3 DEFINITIONS

A. Section 26053X “Sections for electrical raceways and covers”: The X in the number indicates spec sections starting with the first 5 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Touch-up Paint: Provide touch-up paint of each type and color used for cabinets, panels, and consoles supplied.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

C. Provide UL 508 label on complete assembly.

D. Maintain one copy of panel drawings on site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. As indicated by the Manufacturer.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 INDUSTRIAL ENCLOSURES

A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. nVent: Hoffman.
b. Rittal.

c. Saginaw.
d. Substitutions: Or equal

B. Structure and Enclosure

1. Panels in indoor, dry, non-corrosive environments:

a. NEMA 12, painted steel or aluminum construction, as required by the schedule in PART 3.

2. Panels in outdoor, wet, or chemically corrosive environments:

a. NEMA 4X, stainless-steel or FRP construction, as required by the schedule in PART 3.

3. Panels located in hazardous locations:

a. Rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

4. Construction:

a. Freestanding and floor-mounted vertical panels:

1) Panels of 12-gauge sheet steel
2) Front panels or panels containing instruments: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

b. Wall and Unistrut mounted panels:

1) Panels no less than 14-gauge steel,

c. Consoles:

1) Panels of 12-gauge sheet steel
2) Front panels: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

5. Provide angle stiffeners on the back of the panel face to prevent panel deflection under instrument loading or operation, as follows:

a. Structural framework internal to the panel allows for instrument support and panel bracing.
b. Interior structure framework to permit panel lifting without racking or distortion.
c. Removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

6. Full height and fully gasketed access door with full-length, continuous, piano type stainless steel hinges with stainless steel pins.

a. Provide doors with three-point stainless steel latch and heavy-duty stainless-steel locking handle.

b. Provide front access doors of sufficient width to permit instrument or control device mounting without interference from flush mounted instruments.
c. Clamp-type door latches are not permitted.

7. Avoid kinks and sharp bends in wiring.

a. Route wiring for easy access to other components for maintenance and inspection purposes.

8. Panel suitable for top and bottom conduit entry as required by the Electrical Drawings

a. For top mounted conduit entry, provide panel top with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations.
b. Provide conduit and cable penetrations with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

C. General Requirements

1. UL labeled control panels and cabinets.

a. UL listing includes enclosure, specific equipment supplied with enclosure, and equipment installation and wiring within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and other equipment necessary to achieve compliance with UL 508A requirement. The Drawings do not detail UL 508A requirements.

2. Panel door handles with lock, or a hasp and staple for padlocking: key the locks for control panels provided under this Contract alike.
3. Arrange devices for rear of panel mounting within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.

a. Locate heat generating devices, such as power supplies, at or near the top of the panel.

4. Mount components in a manner that permits servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component.

a. Mount interior panel components on removable plates (sub-panels) and not directly on the enclosure.
b. Unless shock mounting is required by the manufacturer to protect equipment from vibration, provide rigid and stable mounting.
c. Mount and orient components in accordance with manufacturer’s recommendations.
d. Identify internal components with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawings and specifications.

5. Mount panel components on a single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions

specified. Side panel mounted components are not permitted without review and approval by Engineer.

6. Type 316 stainless-steel hardware and fasteners:

    a. Provide drilled and tapped mounting screws; self-tapping screws are not permitted.

7. Install suitable gaskets and faceplates, required to maintain NEMA rating of the panel.
8. Intrinsically safe (IS) circuits must comply with the requirements of NEC (NFPA 70 Art. 504):

    a. Provide circuit separation in enclosures using one of the following methods. Indicate which methods are utilized in the submittal drawings required by Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

        1) Secure conductors such that they cannot come loose from a terminal and come into contact with another terminal.
        2) Provide separation by at least 2 inches from conductors of any non-intrinsically safe circuits
        3) Provide separation from conductors of non-intrinsically safe circuits by use of rigid insulating partition 0.0359 inch or thicker that extends to within 0.0625 inch of the enclosure walls.
        4) Use of separate wiring compartments for intrinsically safe and non-intrinsically safe terminals

    b. Provide protection between different intrinsically safe circuit conductors within the same enclosure using one of the following techniques. Indicate which methods are utilized in the submittal drawings required by Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

        1) Provide a minimum of 0.25 inch of clearance between two terminals of field wiring of different intrinsically safe circuits.
        2) Provide conductors of each circuit are within a grounded metal shield.
        3) Provide conductors with insulation with a minimum thickness of 0.01 inch.

    c. Provide a minimum of 0.125 inch clearance between the uninsulated parts of field wiring conductors connected to terminals and grounded metal or other conducting parts.
    d. IS systems must be grounded and bonded as required by NEC (NFPA 70 Art. 504.50 and 504.60).
    e. IS systems must include identification as required by NEC (NFPA 70 Art. 504.80):

        1) Mark terminals in a manner to prevent unintentional interference with the circuits during testing and servicing.
        2) Clearly label wireways and enclosure components containing IS circuits as “Intrinsic Safety Wiring.”
        3) Color cabling and wireways using light blue as required by Section 406733 “Panel Wiring.”

D. Mounting Elevations

1. Refer to ISA Recommended Practice RP60.3 for guidance on layout and arrangement of panels and panel mount components. Account for housekeeping pad dimensions.
2. Locate centerline of indicators and controllers no lower than 48 inches or higher than 66 inches above the floor on a panel face.
3. Locate centerline of lights, selector switches, and pushbuttons no lower than 32 inches or higher than 70 inches above the floor on a panel face.
4. Locate tops of annunciators no higher than 86 inches above the floor on a panel face.
5. Install panel components in accordance with manufacturer's guidelines.

2.2 TEMPERATURE CONTROL

A. Provide force air ventilation or air conditioning units as required to prevent temperature buildup inside of panel.

B. Heat Load Calculations:

1. Submit heat load calculations for control panels located in areas where either venting is not possible due to NEMA rating of panel or control panel is located in an area or building without air conditioning.
2. Utilize manufacturer available thermal calculators to determine heating/cooling requirements (i.e. Saginaw SCE thermal calculator, nVent Hoffman cooling selection tool, or equivalent).
3. Ensure the internal temperature of the panel is regulated between 45 to 104 degrees F under conditions.
4. Account for the following conditions in the heat load calculations:

    a. Loading and dissipation effects on surfaces of the enclosure. Account for surfaces not available for heat transfer (e.g., against a wall).
    b. Internal heat load of components (load and duty cycle).
    c. For outside temperature limits, refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

C. Sun Shields:

1. Provide custom fabricated sun shields for outdoor panels in accordance with the following requirements:

    a. Fabricate sun shields from a material suited for the area classification rating of its environment.
    b. Design, fabricate, install, and support the unit to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.
    c. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure, to preserve rigidity.
    d. Design and mount sun shields with a minimum 3-inch air gap around the enclosure for air circulation and heat dissipation.

e. Drilling holes or welding studs directly to the enclosure for sun shield mounting is not permitted.
f. Slope the top section of the sun shield a minimum angle of 5 degrees from horizontal.

1) Wall mounted enclosures: slope the top section downward away from the wall and towards the front of the enclosure.
2) Free standing, floor mounted, and frame mounted enclosures: slope the top section downward towards the back side of the enclosure.

g. Incorporate a narrow and more steeply sloped drip shield segment on the front edge of the top section to shed water away from the front of the enclosure and prevent dripping or running directly onto the front panel of the enclosure.
h. Fabricate sun shields with continuous seam welds that are ground smooth.
i. Smooth round or chamfer exposed corners, edges, and projections to prevent injury.

D. Louvers

1. If louvers are used, provide louver plate and filter kit.
2. Provide louver plates of stamped sheet metal construction.
3. Provide washable and replaceable filters.
4. Install louvers on the rear, top, or bottom of the panel, as required by the panel installation location.
5. For wall mounted enclosures with their backs directly adjacent to a wall, install louvers on the sides.

E. Forced Air Ventilation:

1. Provide forced air ventilation fans to create positive internal pressure within the panel.
2. Provide washable and replaceable filters.
3. Fan motors operate on 120-volt, 60-Hz power.

F. Air Conditioning:

1. For panels with internal heat that cannot be adequately dissipated with natural convention and heat sinks, or forced air ventilation, provide an air conditioner sized to deliver sufficient cooling.
2. NEMA rating equivalent to the NEMA rating of the panel. Maintain NEMA rating of panel when installed.
3. Provide air conditioner with conformal coating on exposed surfaces.
4. Mount air conditioners on panel side. If provided, cut sun shields to accommodate air conditioner.

G. Heating:

1. Provide an integral heater, fan, and adjustable thermostat for outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture, to reduce condensation and maintain the minimum internal panel temperature.

a. Mount unit near enclosure bottom with discharge away from heat-sensitive equipment.
b. Provide Hoffman DAH series, Stego PTC series, or equal.

2.3 ACCESSORIES

A. Nameplates

1. Identify the panel and individual devices as required, unless otherwise indicated:

a. Include up to three lines:

1) First line containing the device tag number as shown on the Drawings.
2) Second line containing a functional description (e.g., Recirculation Pump No. 1).
3) Third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings:

a. Furnish nameplates as 3/32-inch thick, black against white background unless otherwise noted, Lamicoid with engraved inscriptions. Bevel and smooth edges of nameplate.
b. Nameplates with chipped or rough edges are not acceptable.

3. Mount or fasten cabinet mounted nameplates with epoxy adhesive or stainless steel screws.
4. Provide a panel nameplate with a minimum of 1-inch high letters for every panel.
5. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of door mounted control devices, pilot lights, and meters.
6. Use single Lamicoid nameplates with multiple legends for grouping of devices such as selector switches and pilot lights that relate to one function.

B. Print Storage Pockets

1. Provide print storage pockets of steel construction, welded onto the door of the enclosure.
2. Size storage pockets to accommodate prints required to service the equipment, and to accommodate 8.5-inch by 11-inch documents without folding.

C. Corrosion Control

1. Protect panels from internal corrosion by use of corrosion-inhibiting vapor capsules. Size and quantity as necessary per manufacturer recommendations.
2. Manufacturer:

a. Zerust VC.
b. Hoffman Model AHCI.
c. Or equal.

2.4 GENERAL FINISH REQUIREMENTS

A. Descale, degrease, fill, grind and finish sections.

B. Finish steel-fabricated enclosures with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which are applied by either hot air spray or conventional cold spray methods.

1. Brushed anodized aluminum, stainless steel, and FRP panels do not require a paint finish.

C. Grind smooth, sandblast and then clean with solvent. Fill surface voids and grind smooth.

D. Immediately after cleaning, apply one coat of a rust-inhibiting primer inside and outside, followed by an exterior intermediate and topcoat of a two-component type epoxy enamel.

1. Apply final sanding to the intermediate exterior coat before top coating.

E. Apply a minimum of two coats of manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.

F. Unless otherwise noted, finish exterior colors as ANSI 61 gray with textured finish.

G. Finish products after assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where industrial enclosures will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for Section 26053X "Sections for electrical raceways and covers."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly and lubricate as recommended by manufacturer.

3.4 INDUSTRIAL ENCLOSURE SCHEDULE

A. Provide the following industrial enclosures:

Table 1. Industrial Enclosure Schedule

Panel Designation	Minimum Size	Maximum Size	Enclosure Rating	Construction	General Requirements
PLC-IPS Enclosure	72-inch high by 48-inch wide by 24-inch deep	90-inch high by 72-inch wide by 24-inch deep	NEMA Type 12	Type 12 Painted Carbon Steel	Free-standing, two-door, front-access only. Provide fold-down tray inside the cabinet
PLC-PCP-1 through PLC-PCP-6 Enclosures	72-inch high by 48-inch wide by 24-inch deep	72-inch high by 48-inch wide by 24-inch deep	NEMA Type 12	Type 12 Painted Carbon Steel	Free-standing, two-door, front-access only. Provide fold-down tray inside the cabinet
VTMP Enclosure	72-inch high by 36-inch wide by 24-inch deep	90-inch high by 72-inch wide by 24-inch deep	NEMA Type 12	Type 12 Painted Carbon Steel	Free-standing, singe or two-door, front-access only.

END OF SECTION 406717

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SECTION 406733 - PANEL WIRING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for internal wiring of control panels and consoles.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 406763 “Control Panel Mounted UPS.”
4. Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”

1.3 DEFINITIONS

A. American Wire Gage (AWG): Measurement of the cross-sectional area of a conductor.

B. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

C. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

D. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

1.4 ACTION SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 QUALITY ASSURANCE

A. Perform work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

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C. Provide UL 508 label on complete assembly.

D. Maintain one copy of panel drawings on site.

1.6 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring:

1. Provide stranded, type MTW interconnecting wiring:

a. Use 600-volt insulation rated for not less than 90 degrees Celsius.
b. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring.

1) Locate either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier.

c. Develop panel layout such that technicians have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. For power distribution wiring on the line side of fuses or breakers:

a. Use 12 AWG minimum.

3. For control wiring on the secondary side of fuses:

a. Use 16 AWG minimum.

4. Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits.
5. Cover power distribution blocks with protective guards to meet “finger-safe” requirements of IP20.
6. Route power and low voltage DC wiring systems in separate wireways.

a. Cross different system wires at right angles.
b. Separate different system wires routed parallel to each other by at least 6-inches.
c. Terminate different wiring systems on separate terminal blocks.
d. Do not fill wiring troughs to more than 60 percent visible fill.
e. For wireways with intrinsically safe conductors, utilize light blue wireways.

7. Terminations:

a. Terminate wiring onto single tier terminal blocks:

1) Uniquely and sequentially number each terminal block.
2) Direct wiring between field equipment and panel components is not acceptable.
3) Multi-level terminal blocks or strips are not acceptable.

b. Arrange terminal blocks in vertical rows and separated into groups (power, AC control, DC signal).

1) Provide each group of terminal blocks with a minimum of 25 percent spares.

c. Use compression type, fused, unfused, or switched terminal blocks.

1) Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments.
2) Wire all active and spare PLC and controller points to terminal blocks.

d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point.

1) The third terminal is for shielded ground connection for cable pairs.

a) Ground the shielded signal cable at the PLC cabinet.
b) Wire all active and spare PLC and controller points to terminal blocks.

e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
f. Use only one side of a terminal block row for internal wiring.

1) Field wiring side of the terminal not to be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

g. Isolate circuit power from the SCADA cabinet to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse.

1) Use Allen Bradley Model 1492-H7 or equal.
2) One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.

h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator.

1) Use Allen Bradley 1492-H4 or equal.

8. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
9. Clearly tag and color code wiring.

a. Tag numbers and color coding to correspond to panel wiring diagrams and loop drawings prepared by the PCSS.
b. Power wiring, control wiring, grounding, and DC wiring to utilize different color insulation for each wiring system used.
c. Intrinsically safe wiring to utilize light blue cabling. No other conductors can utilize light blue cabling.
d. Color coding scheme to be in accordance with UL 508a.

10. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
11. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) to have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.

    a. Power instruments requiring 120VAC power as shown on the Drawings.

12. Wiring trough for supporting internal wiring:

    a. Plastic type with snap-on covers.
    b. Side walls to be open top type to permit wire changing without disconnecting.
    c. Trough to be supported to the subpanel by stainless steel screws.
    d. Do not bond trough to the panel with glue or adhesives.

13. Provide each panel with a single tube, LED light fixture, 20 Watt in size (minimum).

    a. Mounted internally to the ceiling of the panel.
    b. Light fixture to be switched and be complete with the lamp.

14. Each panel to have a specification grade duplex convenience receptacle with ground fault interrupter:

    a. Mount internally within a stamped steel device box with appropriate cover.
    b. Convenience receptacle is not to be powered from a UPS.
    c. Protect by a dedicated fuse or circuit breaker.

15. Each panel to be provided with an isolated copper grounding bus for all signal and shield ground connections.

    a. Shield grounding to be in accordance with the instrumentation manufacturer's recommendations.

16. Provide each panel with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
17. Each panel to have control, signal, and communication line surge suppression in accordance with Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
18. Microprocessor-based electronic devices in the panel that are powered by 120VAC to be powered by the UPS.
19. Provide each panel with a circuit breaker to interrupt incoming power.

20. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. to be in compliance with the requirements of Division 26.

B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on the Drawings to be provided under this Section.

C. Orientation of devices including PLC and I/O when installed to be per the manufacturer's recommendations.

1. No vertical orientation of PLC racks are allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

END OF SECTION 406733

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SECTION 406763 - CONTROL PANEL MOUNTED UPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control panel mounted uninterruptible power supplies (UPS).

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”

1.3 DEFINITIONS

A. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the current version of hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment is as follows:

1. PCSS to submit for approval the required data for the equipment as part of the Hardware Packages Submittal.
2. Order equipment as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit for approval the required data of the latest available hardware and software equivalent in cost to that which is specified. Do not order equipment more than 3 months prior to when it is needed to be continuously used on the project.

1.10 DELIVERY, STORAGE, AND HANDLING

A. As indicated by the Manufacturer.

1.11 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.12 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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PART 2 - PRODUCTS

2.1 SINGLE PHASE UPS

A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Eaton-Smart Online, 9PX
b. APC-Smart UPS .
c. Substitutions: Or equal

B. System Description:

1. Provide an industrially rated continuous duty, on-line double conversion, single-phase uninterruptible power system.
2. UPS to provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads as indicated on Drawings.
3. UPS system consists of the following major components:

a. Rectifier and battery charger.
b. Inverter.
c. Batteries.
d. Other features as described in this Section and as indicated on Drawings.

C. General Requirements:

1. Provide battery protection via an internal circuit breaker disconnect.
2. Current limiting circuitry to protect inverter output under any load condition.
3. AC output neutral be electrically isolated from UPS chassis.

a. UPS chassis to have an equipment ground terminal.
b. Provide provisions for installation of a bonding connector.

4. Suitable for installation in a UL508A listed panel or rack or console. Refer to the schedule in PART 3 for form factor and installed enclosure type.
5. Mounting: Refer to the schedule in PART 3 for mounting type.
6. UL recognized components for industrial applications in accordance with UL508 without derating.

D. Performance Requirements:

1. Ratings:

a. Output power: As shown in the schedule in PART 3.
b. Battery runtime: 14 minutes at full-load, 34 minutes at half-load.

2. Environment:

a. Ambient temperature: 0 to 104 degrees F.

b. Elevation: Up to 500-ft above mean sea level.
c. Relative humidity: 1 to 95 percent non-condensing.

3. System Input - Primary source:

a. Nominal Input Voltage: As shown in the schedule in PART 3.
b. Frequency: 45 to 65 Hz.
c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
d. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).

4. System Output:

a. Nominal Output Voltage: As shown in the schedule in PART 3.
b. Frequency: 60 Hertz plus or minus 3 Hertz.
c. 100 percent load with 3:1 Crest Ratio.
d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)

5. AC to AC Efficiency (100 percent load @ rated PF): 88 percent online, 86 percent on battery.
6. Acoustical Noise:

a. Noise generated by UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 77 degrees F and full load.

7. EMI Suppression:

a. UPS to meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

E. Modes of Operation:

1. UPS to operate as a line interactive on-line, fully automatic system in the following modes:

a. Normal:

1) Critical load continuously supplied with filtered and regulated AC power by inverter. Rectifier/battery chargers derive power from preferred AC source and supply DC power to inverter while simultaneously floats charge the batteries.

b. Emergency:

1) Upon failure of preferred AC power source, critical load continues to be supplied by inverter. Inverter power supplied without switching from storage battery. No interruption to critical load upon failure or restoration of preferred AC sources. If AC source cannot be restored before battery discharges to its low voltage dropout value, UPS automatically shuts itself down in an orderly manner.

c. Recharge:

1) Upon restoration of AC source, rectifier/battery charger to power inverter and simultaneously recharge batteries. This to be an automatic function causing no interruption to critical load.

F. Rectifier/Charger:

1. Solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to inverter and for battery charging.
2. Solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

G. Inverter:

1. Include all solid-state equipment and controls to convert DC power from rectifier/charger or battery to a regulated AC power for powering critical load.

a. Use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. Capable of supplying current and voltage for overloads exceeding 100 percent.

a. Provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes.
b. Status indicator and audible alarm indicate overload operation.

3. Maintain output voltage to within plus or minus 5 percent.
4. Output voltage total harmonic distortion (THD) not greater than 5 percent at full load.

H. Batteries:

1. High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements.

a. Require no special ventilation.
b. One or more battery banks with number of cells required to meet requirements of rest of these specifications.

2. Battery Design Life: 2 to 4 years

I. Controls and Monitoring:

1. Microprocessor-controlled circuitry:

a. Provide fully automatic operation of UPS through use of a microprocessor-based controller.
b. Operating and protection parameters firmware controlled.
c. Logic includes system test capability to facilitate maintenance and troubleshooting.
d. Startup, battery charging, and transfers to be automatic.

2. Front Indicators: As a minimum, the following indicators to be provided on UPS control panel:

   a. On-line (UPS is using utility power to power the load).

      1) In bypass mode.
      2) On battery.
      3) Overload.
      4) Replace battery / battery disconnected.
      5) Fault.
      6) Bar graph for utility voltage.
      7) Bar graph for battery.

   b. Front Panel UPS Controls:

      1) Power On/Off.
      2) Self-test.
      3) Alarm silence.
      4) Cold start.
      5) Load off.

   c. Remote alarm and status indication: Isolated SPDT dry contacts provided to indicate UPS status for remote monitoring. Contacts rated for 250VAC @ 5A or 30VDC @ 5A

      1) Individual contacts provide for separate annunciation of the following alarm and status conditions:

         a) Low Battery
         b) On UPS power
         c) Malfunction
         d) In maintenance bypass

J. External Maintenance Bypass Switch:

1. Provide each UPS with a "two-position" external bypass switch system to permit UPS to be removed for repair or maintenance without causing power disruption to connected power loads.

   a. External bypass switch: snap-action type with switching speed approximately 10ms or less independent of operator action.
   b. Label the two positions UPS and UTILITY.

2. For UPS units up to and including 3KVA:

   a. Furnish an Electroswitch series 103 snap action switch or equivalent,
   b. Furnish custom plugs, receptacles, and appropriate wiring to achieve the specified functionality.

3. For UPS units above 3 KVA:

a. Furnish standard manufacturer's maintenance bypass switch unless a dry contact for remote monitoring is specified herein to monitor the switch and it is not offered by the manufacturer.
b. Otherwise, provide an Electroswitch series 103 switch or equivalent, along with:

1) Custom plugs, receptacles, and appropriate wiring to achieve the specified functionality.

4. Provide a dry contact to indicate when bypass switch is in "Maintenance" position.

a. Contact rated for 250VAC @ 5A or 30VDC @ 5A.

PART 3 - EXECUTION

3.1 UNINTERRUPTIBLE POWER SUPPLY SCHEDULE

A. Provide the following uninterruptible power supplies. Exact sizing of the UPS is the responsibility of the PCSS.

Table 1. Uninterruptible Power Supply Schedule

UPS Designation	Minimum VA	Input Voltage	Output Voltage	Location, Type, and Notes
UPS-IPS	1500 VA	120 VAC	120 VAC	PLC-IPS Enclosure. Tower style UPS.
UPS-PCP-1 through UPS-PCP-6	1500 VA	120 VAC	120 VAC	Respective PCP Enclosure. Tower style UPS.

3.2 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where UPS will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.4 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.5 IDENTIFICATION

A. Refer to control system architecture for tagging designations

3.6 FIELD QUALITY CONTROL

A. Uninterruptible power supplies will be considered defective if tests and inspections are not passed satisfactorily.

B. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121. 20 “Process Control System Testing.”

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406763

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SECTION 406863 - CONFIGURATION OF HMI SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.

B. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control of all equipment to be in conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment. Include the following information:

1. Configuration of the HMI System Software, Operator Interface Terminals, and drivers provided for all equipment shown on the drawings, including equipment provided by vendor package systems.

    a. Include configuration updates of the existing PLC-ECR OIT screen displays adding the functionality of the new pumping system.

2. Configuration of any alarm dialer provided.
3. Configuration of the SCADA Historian Software.
4. Configuration of system reports using the Reporting Software provided.
5. Communications and functionality data between all connected devices (such as PLCs) and the HMI software packages, including devices supplied by others, as depicted on the system architecture drawings in order to provide a comprehensive working system of data collection, storage and reporting.

C. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submit to the Engineer and the Owner in the form of a letter.

D. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406126 “Process Control System Training.”
3. Section 406196 “Process Control Descriptions.”
4. Section 406263 “Operator Interface Terminals”

5. Section 406343 “Programmable Logic Controllers.”
6. Section 406866 “Configuration of Controller Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to the meetings specified in that section.

B. Schedule and conduct a Standards and Conventions workshop. The purpose of this workshop is to review the standards, conventions, and methodologies that will be used to program and develop the programs (i.e., HMI and PLC databases, HMI graphics, and PLC programming, etc.) and will solicit Engineer and Owner's input. Submit an agenda with examples for items to be discussed at client workshop.

C. Schedule and conduct a draft graphics review meeting. The purpose of this meeting is to present draft graphics for the Owner's and Engineer's review and feedback prior to creating the full set of graphics for review. For repetitive graphics such as graphics for multiple process trains, include an example of the first graphic only for discussion. Include discussion of process and overview displays, examples of pop-ups, trends, and system navigation tools. Expect major comments and incorporate any changes resulting from those comments.

D. Schedule and conduct a second graphics review meeting. The purpose of this meeting is to finalize the process of building the required HMI system. This meeting will be held after return of the draft graphics submittal and incorporation of comments. At this meeting, present the actual software displays, databases, security system, reports, and the like. The Owner will make comments on the system for incorporation prior to factory test. Bring a working system to allow for live demonstration of graphics.

E. Schedule and conduct a Historical Data Management and Reports workshop. The purpose of this workshop is to discuss and solicit Engineer/Owner input for storage and management of historical data; format of daily, monthly, and yearly reports; development of data entry templates; report formats and layouts; and user interface displays for accessing and generating reports. Bring examples of these documents for review and discussion.

F. Schedule and conduct a factory-testing coordination meeting, two weeks prior to factory testing. The purpose of this meeting is to discuss the specifics of proposed tests and provide a forum for coordinating required factory testing.

G. Schedule and conduct a field-testing coordination meeting, two weeks prior to field testing. The purpose of this meeting is to discuss specifics of proposed tests and provide a forum for coordinating required field-testing.

1.5 ACTION SUBMITTALS

A. Provide the submittals listed below at a minimum:

1. System Standards and Conventions.
2. Operator Interface.
3. Controller Program.
4. Reports.
5. Historical Data Management.

B. System Standards and Conventions Submittal:

1. Following the Standards and Conventions workshop, submit standards and conventions to be used on this project. Define the submittal, at a minimum:

   a. Graphic display standards, including color conventions, equipment symbols, display format, equipment control pop-up displays, trend displays, and display navigation. Include samples of each proposed type of graphic display (i.e., overview, detail, diagnostic, tabular, etc.).
   b. System naming conventions, such as graphic displays naming, database naming, tag names, and computer naming.
   c. System configuration, including network addressing and PLC/RTU addressing.
   d. Alarm configuration standards, including priorities and logging.
   e. Security configuration standards, including user groups and privileges.
   f. PLC/RTU standard programming modules, including analog input scaling, flow totalization, equipment runtime, motor start/stop, valve open/close, and any other standard logic planned to be used.

2. To facilitate the Owner's future operation and maintenance, use the submitted standards and conventions as basis for programming and configuration of the system. Do not begin the system programming and configuration prior to the System Standards and Conventions Submittal.

C. Operator Interface:

1. Following the approval of the standards and conventions submittal, submit a draft of all proposed graphic displays, examples of each type of pop-up (faceplate) displays, and examples of trends. For those graphics, which will be duplicated more than once for similar type of equipment, submit graphics for the first equipment only.
2. Following the draft graphics review meeting and prior to the factory test, submit a ready-for testing version of all graphic displays. These graphics should be completely finished other than the incorporation of comments and changes resulting from testing.
3. Submitted graphic displays and trends are to be no less than 8.5 inches by 11 inches and in full color.

D. Historical Data Management:

1. Following the Historical Data Management and Reports workshop, submit all aspects of the historical data management system and include as a minimum the following:

    a. A complete listing of all signals to be collected and stored, including data sampling rate and duration for which the data will be immediately accessible.
    b. Data reduction methods, rates, and the duration data will be immediately accessible.
    c. Storage space requirements and supporting calculations.
    d. Historical database design description, including data flow diagram, table definitions, procedures and queries used; and description of method of accumulating and displaying run times and flow totals. Define the method of interfacing to the reporting system, methods of handling Data Quality Flags, and methods of storing and displaying trending information.
    e. Description of methodology for restoring data collected locally during times when the historical data management system is not available. Description of database failure and recovery, including data correction.
    f. Description of selecting only the active real-time data source for systems that are utilizing redundant data acquisition nodes.
    g. List of data source interfaces to be used with the system (for example, OPC, file collection, historian-historian collector, HMI applications, etc.)

E. Reports:

1. Following the Historical Data Management and Reports workshop, submit all aspects of the reports generation system and include as a minimum the following:

    a. A complete list of all reports to be developed.
    b. Complete listing of all signals to be reported, including calculated values.
    c. Description of reporting data storage design, including method data is polled and stored.
    d. Description of methodology for entering manual data and interfaced used.
    e. Procedures for recall, generation and printing of reports
    f. Printout of each report to be provided with details of each cell, where data comes from, and calculation of raw data.

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1.6 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. The system specified performs the following generalized functions:

1. Allows the operator to control equipment such as pumps and valves as shown on the Drawings and as defined in Section 406196 “Process Control Descriptions.”
2. Perform real-time process control, including proportional integral derivative control action, sequencing, and process calculations.
3. Collect, calculate, and store accurate, reliable operating information for present and future uses.
4. Assist remote site operating personnel by noting and communicating of normal operating conditions and equipment failures.
5. Accumulate and store equipment running times for use in preventative maintenance.
6. Provide color graphic displays and reports for use by the system operating and supervisory personnel.
7. Provide trending for analog values.
8. Provide control system diagnostics.
9. Perform process control functions including PID, calculations, sequencing, timing, in the process controller. The HMI software performs the real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc.
10. Allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, e.g., on/off, open/close, setpoint value,) when viewing the appropriate graphic screen on the HMI.

3.2 GRAPHIC DISPLAYS - GENERAL

A. Comply with Section 5 of the Nassau County SCADA System Standards unless otherwise noted or specified.

B. Ensure displays contain and continuously update the displayed process variables, date and time of day, with process values showing in engineering units. Incorporate on displays:

1. References to both instrumentation tag numbers and plant equipment numbers.

2. Process variables on their associated display(s) with correct engineering units.
3. Process variables with their associated data quality flags.

C. Operator commands related to controlling field devices or system attributes require multiple keystrokes or mouse actions to protect against inadvertent operations. Confirmation to the operator for the selected point to be controlled is provided, at which time a cancellation of the control can be affected.

D. Process graphic displays are depicted from the P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these Contract Documents. The graphic displays include process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

E. Include on main graphical screens a title bar, main graphic area, navigational buttons, and alarm summary bar.

1. Title bar displayed on the top of each screen and include display name, description and time/date.
2. Main graphical area contains primary screen data in graphical format.
3. Navigational buttons include a minimum of main menu, trends, main alarm summary, and security log in.
4. Alarm summary bar displays the last three valid alarms on the bottom of each screen.

F. Provide animation to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors to change when opened and closed.

G. Adjust from the operator interface timers, setpoints, alarm actuation levels, unless specifically noted.

H. Ensure the system show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri-state must be represented in three conditions.

I. Ensure conditions in the field designated as alarm conditions report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. Display alarms and events on the screen and archived.

J. Identify interlocks that affect equipment operation both by alarm and by HMI indication.

K. Check analog inputs for out of range (via high and low limit checks) and alarmed.

L. Label process flow streams and color-code using the project color schedule in Division 09. Identify structures and equipment by name and appropriate equipment and loop tags.

M. Color coding for equipment status and alarms is as follows:

1. Red for on or open.
2. Green for off or closed.
3. Active, unacknowledged alarms are indicated by flashing amber.
4. Active, acknowledged alarms are indicated solid amber.

N. Automatically record alarm and events should any of the following sequences or events occur:

1. Date/Time entry.
2. Limit changes.
3. Commanded or un-commanded change of any point.
4. Alarm conditions.
5. PLC activation or deactivation.
6. Operator login or logout activity.

O. There may be additional general programming requirements listed in PART 1 of Section 406196 “Process Control Descriptions” that impact the HMI configuration.

3.3 SPECIFIC GRAPHIC SCREENS

A. At a minimum, provide the following types of graphic screen indicated below.

1. Plant Overview screen including a site plan representation, indicating the geographic location of each process and building.
2. Main menu screen linking all screens and process areas; complete and logical listing names and number of all screens.
3. Overall plant process block flow diagram screen showing major processes in block form with flow arrows. Each block includes a text description of key individual treatment processes. Navigational buttons to the individual treatment processes can be performed by pressing on the text description.
4. Individual treatment process screens graphically screening key process variables and equipment. Features:

    a. No operator entries are available from these screens.
    b. Individual process flow screens for each process include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves.
    c. These diagrams are generally depicted from the P&ID's with at least 1 screen per P&ID on average.

5. Individual unit process screens depicted from the P&ID's are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, and drives. Navigational buttons consist of the P&ID's flow arrows to other individual unit processes. The unit process screens provide the ability for the operator to go to individual equipment popup screens. These diagrams are generally depicted from the P&ID's with at least 2 screens per P&ID on average.
6. Provide popup screens for each piece of equipment to start/stop equipment, open / close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.
7. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIT's, power supplies and UPS units.
8. Communications diagnostic screens, showing the details of network status, communications status of all major components including Operator Work Stations, peripheral devices and network components.

9. Maintenance screens display the raw value for each analog and digital I/O point in the system. They allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.
10. Trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.
11. Main alarm summary screen includes the following information for each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button acknowledges all new unacknowledged alarms. Display alarms in the alarm summary screen and in the alarm banner as follows:

    a. Unacknowledged and active alarm: Displayed on screen, blinking
    b. Acknowledged and active alarm: Displayed on screen, not blinking.
    c. Unacknowledged and inactive alarm: Displayed on screen, blinking. Text/background of the alarm displayed in a different color than active alarms.
    d. Acknowledged and inactive alarm: Not displayed in banner.

12. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.

3.4 SECURITY

A. Configure and implement the system with security to prevent unauthorized access. The system allows authorized changes to system operation through defined user accounts and password verification.

B. Coordinate with Owner user account information, including login name and password for each account.

C. Assign security levels of "display only," "operator mode," "supervisor mode," and "engineer mode" through assignable passwords. On system startup, automatically enter the "display only" security level. In the "display only" mode, information is available to be displayed on the screen, but no changes may be made. In the "operator mode," changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode," all operator functions can be modified, and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system are available for modification.

3.5 ALARM/EQUIPMENT STATUS REPORTING

A. Display on the alarm log all alarms as they occur. Include on the alarm message the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal are displayed. Include on all reports the plant equipment number of the associated device.

B. Log the equipment status whenever a change in status occurs (i.e., start, stop). Include on the equipment status log the time, equipment name, tag number, and the particular change in status.

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3.6 HISTORICAL DATA MANAGEMENT

A. Provide the following features for processing and storage of system historical data:

1. Each system point (analog or digital, real or pseudo) has the capability of being historically logged. A point can be deleted from historical log at any time. Points can be added or deleted from the system using minimal keystrokes.
2. Sample and store all process analogs and all flow totals and run time indications of all primary process equipment motors in the historical data management system.
3. Data Processing: Store the real time instantaneous values in a historical log file on the hard disk at defined sampling rates.
4. Data Correction: Manually modify historical data by personnel with appropriate security levels. Differentiate such data from actual monitored values on reports, in the database and in trends.
5. Data Quality: Propagate data Quality flags to the next higher level of the history based on user selectable percentage determining tolerance levels for averages and totals. If the percentage of suspect data exceeds the tolerance level, the suspect data flag propagates to the next higher level. Maximums and minimums are taken from good data.
6. Manual Input Data Handling: This data consists of additional values not obtainable by the system such as laboratory analysis for use in reports. Enter and store all manually entered data in the appropriate engineering units. Display all data entered for confirmation on the display prior to incorporation to the database.

3.7 REPORTS

A. The system generates reports from on-line historical data files or prompt the user for the appropriate archived data files.

B. Initiate reports automatically based upon time of day or manually upon operator’s request.

C. Develop user-interface displays for report generation with easy recall of reports by entering time:day:year target values.

D. User interface displays allows the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when to print (e.g., immediately, on demand, or automatically at a specified time).

E. Print quality tags alongside the value.

F. Identify values for which there are no data with a special character. Thus, print only values which are actually zero.

G. Operational Report Types. Provide the following operational report types with the system:

1. Shift Operation Summary Report:

a. Summarize plant operation from the start and finish time of operation on an operator-adjustable time interval shift operation report.
b. Consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identification, and engineering units.

2. Daily Operation Summary Report

   a. Summarize plant operation for the previous day on the daily operation report. Printed information is stored values (not averages) including scanned, lab, and manually entered data.
   b. The report format consists of the following: correct date, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.
   c. Also calculate the daily minimum, average, maximum, and total where applicable and print and store for each point.

3. Monthly Operation Summary Report:

   a. Summarize plant operation for the previous calendar month on the monthly operation summary report.
   b. Arrange the report format so that the first several pages conform to the requirements of the state regulatory agencies and separate from the rest of the monthly operation report for transmittal to the regulatory agency.
   c. Report format similar to the daily operation summary report, consisting of the following: month and year, plant name, report name, page number, group headings, sub-headings, point identifications, and engineering units.
   d. Print monthly minimum, average, maximum, and totals, where applicable, for each column of points printed.

4. Annual Operation Summary Report:

   a. Summarize plant operation for the previous calendar year on the annual operation summary report. Report consists of scanned data, lab data, and manually entered data.
   b. Format of the report is identical with the monthly operation summary report except for replacing month with year in the heading and replacing date with calendar month.

3.8 TESTING

A. Refer to Section 406121.20 “Process Control System Testing”.

B. Supplement to Field Testing requirements

1. Prior to leaving the site, use the Owner's programming computer to monitor all PLC processors online, make on-line changes, upload and download the processor to ensure programming software version compatibility.
2. Loop Tuning – Tune all PID control loops (single or cascade) following device installation but prior to commencement of the Functional Demonstration Test.

   a. Achieve optimal loop tuning either by auto-tuning software or manually by trial and error, Ziegler-Nichols’ step-response method, or other documented process tuning method.
   b. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control PID. Adjust each

control loop that includes anti-reset windup features to provide optimum response following startup from an integral action saturation condition.

c. Tune all PID control loops to eliminate excessive oscillating final control elements. Adjust loop parameters to achieve a decay ratio of 1/4 or better. In addition, achieve loop steady state at least as fast as the loop response time associated with critical damping.

d. Verify loop performance and stability by step changes to setpoint in the field.

e. Submit loop tuning documentation as specified in Part 1 of this Section.

3.9 TRAINING

A. Refer to Section 406126 “Process Control System Training” for general training requirements.

B. Furnish training as shown in the table below.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	2	12	1	Management
Operator Training (Pre start-up)	8	12	1	Operations
Operator Training (Post start-up)	8	12	1	Operations
Software Maintenance	2	2	1	Maintenance
System Reports and Historian	2	2	1	Maintenance

C. Control System Overview Seminar:

1. Provide Control System Overview seminar for the Owner's personnel at the Owner's facility. The objective of this seminar is to provide personnel with an overview understanding of the Control System. Target the seminar material to the Owner's management, engineering, and other non-operations personnel. The seminar includes, but not limited to, the following:

   a. An overview of the Control system explaining how the hardware and software supplied under this Contract is used for the operation and control of the facilities.

   b. A block diagram presentation of the Control system showing how and what information flow within the system and what each functional unit does.

   c. An explanation of the operator interfaces including a demonstration of how to use an operator's workstation to monitor, control, navigate, display trends, and all other operational features of the system. Address outside of this course a discussion of process control of individual processes.

   d. A walkthrough of the installed system explaining each of the items covered in the functional units' discussion. Discuss the features and functions of operator controls and interfaces.

D. Operator Control System Training (pre- or post-startup):

1. Cover during operator training plant operation with the control system and use of the HMI display screens, including at a minimum all the following items:

    a. Basics of HMI control and navigation.
    b. Alarming and Interlocks.
    c. Auto functionality of automated processes and HMI control.
    d. Failure modes of equipment and operator responses.

2. Hold a minimum of two operator-training sessions (Pre-Startup) for operators one week before system startup. Use the Simulator specified in this project for the pre-startup training. Hold additional one or two operator-training sessions (Post-Startup) for operators one week after system startup.
3. Hold operator training at the convenience of the Owner. Hold this training during the day, late at night, or very early in the morning to accommodate the Owner's shift schedule.
4. Operator training is introductory in nature during pre-startup training and more in-depth and detailed during post-startup training.
5. At a minimum, provide the following teaching aids for distribution during Operator training sessions:

    a. Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup).
    b. P&IDs.
    c. Daily syllabus.

6. Fifty percent of the Operator training is "hands on" utilizing the installed Control System to the fullest extent possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System is not permitted.

E. Software Maintenance:

1. Provide training of how to back-up PLCs, HMIs, OITs, and any other software in this system.
2. Provide training on all aspects covered in the O&M Software Maintenance Manuals.
3. Provide training on PLC program structure, HMI configuration structure, tips in how to edit programming code, and other items which will supplement the maintenance staff's ability to edit and maintain the programs.

F. Historian and System Reports:

1. Provide training of how to run the reports, how to manually enter data, and how to print and reprint the reports.
2. Provide training on how to execute data queries that are outside of those defined in the reports.
3. Provide training on Historian configuration, report configuration, database maintenance and backup, and repair of failed reports.

END OF SECTION 406863

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SECTION 406866 - CONFIGURATION OF CONTROLLER SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.

B. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control all equipment in full conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.

1. Provide configuration of the PLC provided for all equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.

C. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submit to the Engineer and the Owner in the form of a letter.

D. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406196 “Process Control Descriptions.”
3. Section 406263 “Operator Interface Terminals”
4. Section 406343 “Programmable Logic Controllers.”
5. Section 406863 “Configuration of HMI Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to the meetings specified in that section.

B. Refer to Section 406863 “Configuration of HMI Software” for requirements of the standards and conventions workshop.

1.5 ACTION SUBMITTALS

A. Controller Program Submittal:

1. For each controller, submit the following using the controller manufacturer's built-in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.

    a. PLC programs showing ladder logic, function block, high level language or another controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Clearly present each logic segment, describe the function of each timer, label and define the purpose of each subroutine call, etc. Ensure that program documentation is sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal demonstrates that all logic provided under this project follows the same structure and format and reflects a common programming approach.
    b. Submit a memory usage report for the controller. Indicate total memory capacity and unused memory capacity.
    c. Submit cross reference index of I/O allocation and controller memory address. Include every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme.

2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit an HMI tag database showing all signals exchanged between the PLCs and HMI. Define any specific communication block memory addresses.

B. Submit all electronic files associated with the controller such that the Owner and Engineer can open a complete copy of the controller program using the controllers native programming package.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTROLLER PROGRAMS

A. Comply with Section 6 of the Nassau County SCADA System Standards unless otherwise noted or specified.

B. Develop all application programs in a structured manner and follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.

C. Make changes to the application programs and software configuration, based on comments during the submittals, the factory tests, the field tests, and during the commissioning process to meet the design intent, at no additional cost to the Owner.

D. Include configuration updates to the existing PLC-ECR as required and as shown on the drawings.

END OF SECTION 406866

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SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the general requirements to furnishing, installing, and servicing PCSS provided instruments.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 4071XX “Sections for flow measurement.”
3. Section 4072XX “Sections for level measurement.”
4. Section 4073XX “Sections for pressure, strain, and force measurement.”
5. Section 4074XX “Sections for temperature measurement.”
6. Section 4075XX “Sections for liquid analytical measurement.”
7. Section 4076XX “Sections for gas analytical measurement.”
8. Section 4077XX “Sections for position and motion measurement.”

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Section 4071XX “Sections for flow measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Submit complete documentation for all field instruments in one comprehensive submittal. Use ISA-TR20.00.01-2007 data sheet format as a cover sheet for each instrument prior to data sheets. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment, sorted by Loop Number.

B. Submit separate data sheets for each instrument type:

1. Plant Equipment Number and ISA tag number per the Drawings.

2. Product (item) name used herein and on the Drawings.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations in engineering units.

C. Submit the following information for each instrument type:

1. Include construction details, material descriptions, dimensions of individual components and profiles.
2. Sizing calculations where applicable.
3. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.
4. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.
5. Two-wire, three-wire, or four-wire device type as applicable.
6. Indicate which instruments will be provided with manufacturer’s maintenance services if specified.
7. Indicate instruments that are located in hazardous areas based on the Area Classification table and plans (refer to Drawings G-9 through G-15).
8. Where instruments are located in hazardous areas, indicate the classification (e.g., Class I, Division 1) and protection technique utilized for the instrument as required by the NEC (NFPA 70 Art. 500.7) (e.g., explosionproof equipment, intrinsic safety, etc.)

D. Instrument Vendor Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of instrument.
4. Include diagrams for power, signal, and control wiring.

E. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

F. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Submit electronic copies in Microsoft Excel or Word format on DVD disk or USB thumb drive.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Refer to individual instrument specifications for spare parts requirements.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for PCSS requirements regarding submission of maintenance materials.

1.8 QUALITY ASSURANCE

A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer’s start-up and training services.

B. Provide components compatible with functions required to form complete working system.

C. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for overall quality assurance requirements for PCSS scope of work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. As indicated by the Manufacturer.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 INSTRUMENT TAGS

A. Permanent stainless steel or other non-corrosive material tag firmly attached and indelibly marked with the instrument tag number, as indicated in the Drawings. Tag equipment before shipping to the site.

B. Provide 1/8-in by 3/8-in, Type 316 stainless-steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements require a stainless-steel identification tag. Attach tag via stainless steel chain or stainless-steel wire (24-gauge min) to a non-removable part of the device. Stamp the ISA alphanumeric instrument number as indicated on the P&ID, loop, or detail drawings into the tag. Minimum tag size is 1” H x 3” W with 3/16” high alphanumeric characters.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. See installation requirements in individual specification sections.

B. Mount instrumentation on instrumentation racks or stands, unless otherwise indicated. Provide shutoff and drain valves on all instrumentation connections.

C. Provide all necessary accessories and safety equipment required to meet the area classification requirements.

D. Existing instruments that are scheduled to remain in service (I.E. Ultrasonic level transducers, LE/LIT-0011-1 and -2). Coordinate with contractor to avoid installation of piping or equipment directly below the existing ultrasonic transducer. Where required, recalibrate the existing ultrasonic transducer to account for potential interference from new hardware installed in the wet well. Where software masking is deemed insufficient, Contractor shall relocate the ultrasonic spool piece and transducer.

3.2 FIELD INSTRUMENT SCHEDULE

A. The field instrument schedule Section 407000 APPENDIX A itemizes field instruments being provided by the PCSS (Division 40) or manufacturers of vendor provided equipment.

B. Each column of the field instrument schedule is defined as follows:

1. DRAWING NUMBER: The P&ID or drawing where the I/O point appears on.
2. ISA TAG AND LOOP: The identifier assigned to the field instrument.
3. TYPE: The type of instrument to be provided. For example, if the instrument is a pressure, this will specify whether it is a differential pressure transmitter, gauge pressure transmitter, etc.
4. RANGE/SETPOINT: Required measurement span/trip points of the instrument.
5. POWER: Details how the instrument will be powered.
6. SPECIFICATION NUMBER: The specification section number where the instrument details can be found.
7. INSTALLATION DETAIL: Detail on the drawings showing specific installation requirements.

END OF SECTION 407000

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SECTION 407000 ATTACHMENT-A: FIELD INSTRUMENT SCHEDULE

Drawing Number	ISA Tag and Loop	Type	Range/Setpoint	Power	Specification Number	Installation Detail
I-005	PDS-0050-1	Differential Pressure Switch	0 – 50 PSI	N/A	407336	D
I-005	PDS-0050-2	Differential Pressure Switch	0 – 50 PSI	N/A	407336	D
I-005	PDS-0050-3	Differential Pressure Switch	0 – 50 PSI	N/A	407336	D
I-006	PDS-0050-4	Differential Pressure Switch	0 – 50 PSI	N/A	407336	D
I-006	PDS-0050-5	Differential Pressure Switch	0 – 50 PSI	N/A	407336	D
I-006	PDS-0050-6	Differential Pressure Switch	0 – 50 PSI	N/A	407336	D
I-005	FE-0065-1	Magnetic Flow Meter W/ Remote Transmitter	0 – 150 MGD	Powered From Transmitter	407113	A
I-006	FE-0065-2	Magnetic Flow Meter W/ Remote Transmitter	0 – 150 MGD	Powered From Transmitter	407113	A
I-005	FIT-0065-1	Magnetic Flow Transmitter	0 – 150 MGD	UPS	407113	A
I-006	FIT-0065-2	Magnetic Flow Transmitter	0 – 150 MGD	UPS	407113	A
I-005	PG-0050-1A	Pressure Gauge	0 – 100 PSI	N/A	407313	D
I-005	PG-0050-1B	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-005	PG-0050-1C	Pressure Gauge	-30 inHG – 30 PSI	N/A	407313	E
I-005	PG-0050-2A	Pressure Gauge	0 – 100 PSI	N/A	407313	D

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Drawing Number	ISA Tag and Loop	Type	Range/Setpoint	Power	Specification Number	Installation Detail
I-005	PG-0050-2B	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-005	PG-0050-2C	Pressure Gauge	-30 inHG – 30 PSI	N/A	407313	E
I-005	PG-0050-3A	Pressure Gauge	0 – 100 PSI	N/A	407313	D
I-005	PG-0050-3B	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-005	PG-0050-3C	Pressure Gauge	-30 inHG – 30 PSI	N/A	407313	E
I-005	PG-0060-1	Pressure Gauge	0 – 100 PSI	N/A	407313	D
I-005	PG-0076-1	Pressure Gauge	0 – 30 FT	N/A	407313	D
I-005	PG-0076-2	Pressure Gauge	0 – 30 FT	N/A	407313	D
I-006	PG-0050-4A	Pressure Gauge	0 – 100 PSI	N/A	407313	D
I-006	PG-0050-4B	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-006	PG-0050-4C	Pressure Gauge	-30 inHG – 30 PSI	N/A	407313	E
I-006	PG-0050-5A	Pressure Gauge	0 – 100 PSI	N/A	407313	D
I-006	PG-0050-5B	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-006	PG-0050-5C	Pressure Gauge	-30 inHG – 30 PSI	N/A	407313	E
I-006	PG-0050-6A	Pressure Gauge	0 – 100 PSI	N/A	407313	D
I-006	PG-0050-6B	Pressure Gauge	0 – 160 PSI	N/A	407313	E

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Drawing Number	ISA Tag and Loop	Type	Range/Setpoint	Power	Specification Number	Installation Detail
I-006	PG-0050-6C	Pressure Gauge	-30 inHG – 30 PSI	N/A	407313	E
I-006	PG-0060-2	Pressure Gauge	0 – 100 PSI	N/A	407313	D
I-005	PSL-0076-1	Pressure Switch Low	0 – 30 FT	N/A	407336	D
I-005	PSL-0076-2	Pressure Switch Low	0 – 30 FT	N/A	407336	D
I-005	PIT-0050-1	Pressure Transmitter	0 – 100 PSI	Loop Powered	407326	D
I-005	PIT-0050-2	Pressure Transmitter	0 – 100 PSI	Loop Powered	407326	D
I-005	PIT-0050-3	Pressure Transmitter	0 – 100 PSI	Loop Powered	407326	D
I-005	PIT-0060-1	Pressure Transmitter	0 – 100 PSI	Loop Powered	407326	D
I-006	PIT-0050-4	Pressure Transmitter	0 – 100 PSI	Loop Powered	407326	D
I-006	PIT-0050-5	Pressure Transmitter	0 – 100 PSI	Loop Powered	407326	D
I-006	PIT-0050-6	Pressure Transmitter	0 – 100 PSI	Loop Powered	407326	D
I-006	PIT-0060-2	Pressure Transmitter	0 – 100 PSI	Loop Powered	407326	D
I-005	LE/LT-0020-1	Radar Level Sensor/Transmitter	0 – 30 FT	Loop Powered	407223	G
I-006	LE/LT-0020-2	Radar Level Sensor/Transmitter	0 – 30 FT	Loop Powered	407223	G
I-005	LI-0020-1	Radar Level Indicator	0 – 30 FT	Loop Powered	407223	G
I-006	LI-0020-2	Radar Level Indicator	0 – 30 FT	Loop Powered	407223	G

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Drawing Number	ISA Tag and Loop	Type	Range/Setpoint	Power	Specification Number	Installation Detail
I-005	FG-0050-1	Rotameter / Variable Area Flow Meter	0 – 5 GPM	N/A	407143	Sheet MG-004 Detail F
I-005	FG-0050-2	Rotameter / Variable Area Flow Meter	0 – 5 GPM	N/A	407143	Sheet MG-004 Detail F
I-005	FG-0050-3	Rotameter / Variable Area Flow Meter	0 – 5 GPM	N/A	407143	Sheet MG-004 Detail F
I-006	FG-0050-4	Rotameter / Variable Area Flow Meter	0 – 5 GPM	N/A	407143	Sheet MG-004 Detail F
I-006	FG-0050-5	Rotameter / Variable Area Flow Meter	0 – 5 GPM	N/A	407143	Sheet MG-004 Detail F
I-006	FG-0050-6	Rotameter / Variable Area Flow Meter	0 – 5 GPM	N/A	407143	Sheet MG-004 Detail F
I-005	FSL-0050-1	Thermal Dispersion Flow Switch	0.5 GPM	120VAC	407179	B
I-005	FSL-0050-2	Thermal Dispersion Flow Switch	0.5 GPM	120VAC	407179	B
I-005	FSL-0050-3	Thermal Dispersion Flow Switch	0.5 GPM	120VAC	407179	B
I-006	FSL-0050-4	Thermal Dispersion Flow Switch	0.5 GPM	120VAC	407179	B
I-006	FSL-0050-5	Thermal Dispersion Flow Switch	0.5 GPM	120VAC	407179	B
I-006	FSL-0050-6	Thermal Dispersion Flow Switch	0.5 GPM	120VAC	407179	B
I-007	FE-0095-1	Ultrasonic Flow Meter (Transit Time)	0 – 80 MGD	Powered From Transmitter	407163	F
I-007	FIT-0095-1	Ultrasonic Flow Transmitter (Transit Time)	0 – 80 MGD	UPS	407163	F
I-007	PDG-0045-1	Differential Pressure Gauge	0 – 100 PSI	N/A	407313	Sheet MG-004 Detail D
I-007	PDG-0045-2	Differential Pressure Gauge	0 – 100 PSI	N/A	407313	Sheet MG-004 Detail D

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Drawing Number	ISA Tag and Loop	Type	Range/Setpoint	Power	Specification Number	Installation Detail
I-007	PG-0045-1A	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-007	PG-0045-2A	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-007	PG-0045-1B	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-007	PG-0045-2B	Pressure Gauge	0 – 160 PSI	N/A	407313	E
I-007	PSL-0045-1	Pressure Switch Low	0 – 100 PSI	N/A	407336	E
I-007	PSL-0045-2	Pressure Switch Low	0 – 100 PSI	N/A	407336	E

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SECTION 407113 - MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes magnetic flow meters.

B. Related Requirements:

1. Section 260503 “Equipment Wiring Connections.”
2. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each magnetic flow meter, for tests or calibrations performed by manufacturer and witnessed by a qualified testing agency. Provide accuracy information for flow meters for each installation location.

C. Evaluation Reports: For Magnetic Flow Meters.

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1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

1.9 DELIVERY, STORAGE, AND HANDLING

A. As indicated by the Manufacturer.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of magnetic flow meter that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Furnish sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, transmitters, control devices, interconnecting cables, and unit conversions and algorithms as required for application.

B. Flowmeters FE-0065-1 and FE-0065-2, shown on drawings, shall be the same make and model.

2.2 MAGNETIC FLOW METERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following :
   a. ABB Instrumentation
   b. Endress+Hauser
   c. Foxboro
   d. Krohne
   e. Rosemount
   f. Siemens
   g. Or equal.

B. General:

1. Low-frequency, electromagnetic induction-type flow meter, producing a linear signal directly proportional to flow rate, consisting of flow tube, signal cable, and transmitter.

C. Type:

1. Between-flange mounting.
2. Comply with AWWA M33.

D. Performance and Design Criteria:

1. Process Fluid: Screened Sewage Influent.
2. Flow Rate Range: 0 to 112.5 MGD.
3. Accuracy: Plus or minus 0.5 percent of actual flow rate over a 30:1 range, within velocity limits of 3 to 20 ft/sec when installed in a straight run of pipe with 2 DN upstream and 5 DN downstream lengths.
4. Size: As shown on Drawings and instrument schedule in Section 407000.
5. Flow Tubes:

   a. Body Material: Carbon Steel or Type 304 stainless steel

6. Liner: Polyurethane
7. Flanges: ANSI 150lb
8. Flange Material: Carbon steel.
9. Environment: For meters with remote mounted transmitters, meters below the design flood elevation are to be suitable for submergence for up to 48 hours to a depth of 30 feet.

E. Electrodes:

1. Hastelloy C.

F. Accessories:

1. Provide nonmechanical electrode cleaning system without taking meter out of service.
2. Provide manufacturer cable between transmitter and receiver.
3. Furnish stainless-steel grounding rings, wires, and gaskets as recommended by the manufacturer. All materials must be suitable for the process and surrounding pipe.

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2.3 TRANSMITTERS

A. Manufacturer: Same manufacturer as meter.

B. Transmitter Output:

1. 4- to 20-mA DC analog signal.

C. Housing: NEMA 4X (IP65), suitable for surface or pipe stand mounting.

D. Display:

1. Touch-screen programming, functioning through enclosure window without opening enclosure.
2. Size: Four lines by 16 characters.
3. Type: Backlit digital display.
4. User-selectable engineering units.
5. Readout of diagnostic error messages.

E. Control Power:

1. 120VAC, single phase, 60 Hz.
2. Wire in accordance with Section 260503 “Equipment Wiring Connections.”
3. Provide local transformers as required.

F. Mounting:

1. Mounting: Remote, as shown on the contract drawings, up to 100 feet from flow meter.
2. Remote Mounting Locations Less Than 4 feet above Grade: Provide stainless-steel mounting posts.

G. Required Accessories:

1. A fully configurable and locally viewable totalizer integral to the transmitter.
2. Current signal output simulation.
3. Empty pipe detection.
4. Self-diagnostics.
5. Signal Cable: Provided by flow meter manufacturer.
6. Automatic zero adjust.

2.4 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of meters according to AWWA M6.

B. Owner Inspection:

1. Make completed flow meter available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing by Owner’s Representative of factory inspections and tests at manufacturer's test facility.
2. Notify Owner at least 14 days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where magnetic flow meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Magnetic flow meters will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:

1. How to install, troubleshoot, read the diagnostics, verify calibration, and maintain the sensor and transmitter.
2. Provided 2 times and last up to 8 hours in the field.

END OF SECTION 407113

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SECTION 407143 - VARIABLE AREA FLOW METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes variable area flow meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
2. Section 407000 “Instrumentation for Process Systems”.

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

D. Refer to Section 014000 "Quality Requirements" for quality requirements.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 ROTAMETERS – TUBE TYPE

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. ABB FAM540
b. Brooks MT3809
c. King Instrument Company.
d. Omega Engineering, Inc.
e. Or equal

B. Performance and Design Criteria:

1. Design: According to AWWA M33.
2. Measuring Range: As shown in the instrument schedule in Section 407000.
3. Scale: Zero to 10 markings.
4. Accuracy: Plus or minus 5 percent of full scale.
5. Maximum Operating Temperature: 150 degrees F.
6. Maximum Operating Pressure: 100 PSIG.

C. Materials:

1. Indicator Housing: Stainless Steel.
2. Flow Tubes: Stainless Steel**.**
3. Floats: Stainless steel**.**
4. Wetted Parts: Stainless Steel**.**
5. End Fittings: Stainless steel**.**

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where variable area flow meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of rotameters.

3.3 IDENTIFICATION

A. Refer to drawings tagging designations

3.4 FIELD QUALITY CONTROL

A. Variable area flow meters will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

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3.6 MAINTENANCE SERVICE

A. Not Required

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407143

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SECTION 407166 - TRANSIT TIME FLOW METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes transit time flow meters as temporary devices in maintenance of plant operations.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Furnish sensors, offset and span adjustments, transmitters, interconnecting cables, and unit conversions and algorithms as required for application.

2.2 TRANSIT TIME FLOW METERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. Emerson Flexim 736 series.
b. Dynasonics DXN.
c. Substitutions: Or equal.

B. Type:

1. Separate and nonintrusive transmitting and receiving transit time transducers, clamped to outside of process pipe.
2. Provide meter with the following:

a. The ability to employ an alternate Doppler measurement technique for liquids with high air or solid content.

b. "Auto Toggle" from Transit Time measurement to Doppler measurement if the signal decays due to high air or solid content, and toggle back automatically when the Transit Time signal recovers.

1) The time delay of this "Auto Toggle" feature must be programmable.
2) Perform the Transit Time/Doppler measurement with a single set of transducers.

3. The transducers shall have built in RTDs for measuring the transducer block temperature and automatically compensating for the effect that temperature change has on the transducer refraction angle and calibration, and shall be in full compliance with ASME MFC 5M.
4. The flow transducers shall be coupled to the pipe using permanent coupling pads for maintenance free operation. The use of coupling gel or grease shall not be acceptable.

C. Performance and Design Criteria:

1. Process Fluid: Screened sewage with < 10 % gaseous or solid content in volume.
2. Meets AWWA C-750 standard and ASME MFC-5.1-2011.
3. Measuring Range: As shown in the instrument schedule in Section 407000.
4. Nominal Size: As shown on Drawings and instrument schedule in Section 407000.
5. Rated for hazardous area, Class I, Division 2.

D. Required Accessories:

1. Stainless-steel mounting straps and hardware.
2. Provide manufacturer cable between transmitter and receiver.
3. When used in hazardous area:

a. Instrument sensor to be intrinsically safe or rated for the NEMA certification of the ambient conditions.
b. Where possible, mount the transmitter unit outside hazardous area.

2.3 TRANSMITTER

A. Manufacturers: Same manufacturer as flow sensor.

B. Type:

1. Microprocessor based, compatible with sensor provided.

C. Function/Performance:

1. The meter shall be capable of outputting four 4-20ma, Voltage 0-1v or 0-10v, high precision frequency 0-1kHz or 0-10kHz galvanically isolated, RS-232, RS-485, Modbus, BACnet, Foundation Fieldbus, HART, Profibus PA, Ethernet, binary output pulse or alarm for relay total and meter statusLinear with flow rate.
2. Linearity: Plus or minus 0.5 percent.
3. Repeatability: Plus, or minus ±1.0 % of reading ±0.03 ft/s.
4. Operating Ambient Temperature: -4 to 131 degrees F

5. Suitable for surface, pipe stand, or wall mounting.
6. Enclosure: NEMA 4X (IP65)

D. Display:

1. Resolution: 128 x 64 pixels
2. Type: Backlit digital display.
3. User-selectable engineering units.
4. Readout of diagnostic error messages.

E. Power Requirements:

1. 120VAC, 60 Hz or as indicated on the drawings.

F. Mounting:

1. Remote mounting, as indicated on the drawings.
2. Mounting Locations as indicated on the drawings. Provide stainless-steel mounting posts.

G. Required Accessories:

1. Provide signal cable for installation between the flow sensor and the transmitter. Length as required by installation indicated on the Drawings.

2.4 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of meters according to AWWA M6.

B. Owner Inspection:

1. Make completed flow meter available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and tests at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where transit time flow meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install as per manufacturer instruction supplied with unit.

B. Comply with NECA 1.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Transit time flow meters will be considered defective if tests and inspections are not passed.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on

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the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.6 MAINTENANCE SERVICE

A. Not Required.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.
2. Provided 2 times and last up to 4 hours each in the field.

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SECTION 407179 - FLOW SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes flow switches.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Double Pole Double Throw (DPDT): A switch with 2 inputs and 4 outputs. Each input has 2 corresponding outputs to control.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flow switches: 1 flow switch for each unique switch installed

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 THERMAL DISPERSION FLOW SWITCHES

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. ABB - TX units.
b. Dwyer Instruments, Inc.
c. Fluid Components International.
d. Magnetrol - Thermatel units.
e. Substitutions: Or equal.

B. Type:

1. Thermal dispersion flow switch with integral electronics enclosure.
2. Inline with flow body or insertion type as indicated on the Drawings or in the Instrument Device Schedule:

C. Function/Performance:

1. Provide a positive indication of seal water flow at ranges indicated in the instrument schedule in Section 407000.

    a. Immune to air entrainment, minor debris, and vibration.

2. Process Operating Temperature: 32 to 160 degrees F
3. Operating Temperature for Electronics: 0 to 140 degrees F.
4. Flow switch: Stable and repeatable setpoint performance suitable for low-flow seal water protection service.
5. Repeatability: ±5 percent of setpoint or better.
6. Output: One or more dry contact outputs suitable for alarm or permissive service.

    a. Minimum contact rating: 1A at 120 VAC or equivalent.
    b. Configurable for normally open or normally closed operation.

D. Physical:

1. Wetted parts to be Type 316 stainless-steel.
2. Electronics head to be NEMA 4X (IP65). Where installed in a classified hazardous location, provide a flow switch suitable for the area classification indicated on the Drawings.

E. Power Requirements:

1. 120 VAC unless otherwise indicated or approved.

F. Accessories Required:

1. For insertion type flow elements provide a hot tap assembly including a ball valve and packing gland that will allow removal of the sensor without shutdown of the process. Provide welded fitting on the pipe for the hot tap assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where flow switches will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260626 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Flow switches will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407179

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SECTION 407223 - RADAR LEVEL METERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes radar level meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.2 DEFINITIONS

A. Not used.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Radar level meters: One radar level sensor and transmitter for each unique meter installed.

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1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 NON-CONTACT RADAR-LEVEL MEASUREMENT DEVICE

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following manufacturers:

a. Endress+Hauser.
b. Rosemount.
c. Siemens Automation Technology; Siemens AG Industry Sector
d. VEGA Americas, Inc.

B. Type:

1. Non-contact, microwave type level meter.
2. 80 GHz Frequency Modulated Continuous Wave (FMCW) radar frequency for continuous level measurement of liquid, slurry and sludge processes in storage vessels that may be turbulent, have heavy vapors, foaming, and nominal pressure and temperature conditions.
3. Antenna: Encapsulated.

C. Function/Performance:

1. Measuring Range: As shown in the instrument schedule in Section 407000.
2. Accuracy: Plus or minus 0.08 inches or better.
3. Operating Temperature: -40 to 176 degrees F.
4. Output: Isolated 4-20 mA output; Bluetooth configuration capability.
5. Display: Integrated or remote digital indicator capable of displaying level, volume, or percent in engineering units, as indicated on the Drawings or in the Instrument Device Schedule.

6. Remote digital indicator device for level, volume, or percent in engineering units.

D. Physical:

1. Antenna: PVDF with FKM seal, Type 316 stainless-steel, Hastelloy C or other material depending upon its compatibility to the process in which it is measuring.
2. Capable of being completely submerged without damage.
3. Both Enclosure and antenna must meet IP68 (Type 6P), suitable for submersion or equivalent ingress protection standards.
4. Provide integral antenna with transmitter.
5. Mounting:

    a. Flange:

        1) Provide with a minimum Class 150 pound (DN 80, PN16) mounting flange to match vessel flange size, material and class when mounted on pressurized vessel. Alternatively, provide suitable adapter flange for vessel operating pressures up to 43.5 psig.
        2) Provide flange material compatible with process and environmental conditions.

    b. Threaded Connection:

        1) Thread size: 1-in NPT
        2) Use appropriate gaskets or thread sealant compatible with process media.

6. Approved for Class I, Division 1, Groups C and D installation and certified for installation of the antenna in a Class I, Division 1, Groups C and D.
7. Power Requirements:

    a. 24VDC loop power.
    b. Include integrated surge protection or provision for external surge suppressors.
    c. Comply with IEC 61010-1 for equipment safety and NFPA 70 (NEC) for installation practices.
    d. Provide intrinsically safe barrier as required by the manufacturer to meet area classification requirements.

8. Remote Display: Digital indicator displaying level or volume in engineering units or percent, as indicated on the Drawings or in the instrument schedule. Display unit used to remotely program the transmitter.

    a. NEMA 4X (IP66) housing. Where the indicating transmitter is installed in a hazardous area, provide explosion-proof housing, approved for Class I, Division 1, Groups C and D installation.
    b. Must support remote programming of the transmitter via HART, Bluetooth, or manufacturer supported protocols.

E. Required Accessories:

1. Provide 316 stainless steel mounting brackets and hardware for mounting equipment, and as shown.

2. Provide hand-held programmer or manufacturer-supported configuration software compatible with the transmitter for setup, calibration, and diagnostics.

F. Manufacturer Start-up and Training services:

1. Provide manufacturer's start-up and training services as specified in the start-up and training services paragraph.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where radar level meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Radar level meter will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not Required

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units as follows:

1. Instruction about how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION 407223

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SECTION 407276 - LEVEL SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes level switches.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.2 DEFINITIONS

A. Single Pole Double Throw (SPDT): A switch with one input and two output contacts.

B. Double Pole Double Throw (DPDT): A switch with two inputs and two output contacts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Level Switches: One level switch for each unique switch installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 FLOAT SWITCHES

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

   a. Contegra FS90.
   b. Siemens Water Technologies Model 9G-EF
   c. Substitutions: Or equal.

B. Type:

1. Mercury free ball float switch.

C. Function/Performance:

1. Differential: Less than 8-inch.
2. Type of Switch: SPDT snap switch
3. Switch Rating: 1A at 120 VAC or 100 VA @ 120 VAC.

D. Physical:

1. Type 316 stainless steel, Teflon or non-stick coating, minimum 5 in diameter.
2. Totally encapsulated switch.
3. Heavy-duty cable, PVC or equivalent jacketed integral to float.

E. Required Accessories:

1. Provide stainless steel hardware.
2. Lead wire to be a waterproof cable of sufficient length so that no splice or junction box is required in the vault.
3. Provide cast-aluminum weatherproof junction box outside the sump pit with terminals for all floats and tapped as required for conduit connections. Provide NEMA 7 box where required by area classification.
4. Provide mounting equipment as shown on the drawings.
5. Provide Intrinsically Safe Relays for all floats installed in Class I, Div 1 or Div 2 areas.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where level switch will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Level switch will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

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3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407276

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SECTION 407313 - PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pressure and differential pressure gauges.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”
3. Section 407363 “Diaphragm Seals.”

1.2 DEFINITIONS

A. Not used.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Pressure and Differential Pressure Gauges: Full-size units equal to ten percent of quantity installed for each size indicated, but no fewer than one units of each kind.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

    a. Ametek US Gauge.
    b. Ashcroft.
    c. Omega Engineering, Inc.
    d. Weksler.
    e. Or equal.

B. Type:

1. Bourdon tube actuated dial face differential pressure gauge.

C. Function/Performance:

1. Accuracy: Plus or minus 1.0 percent of full-scale range.
2. Provide for zero-reading adjustment.
3. Adjusting Screws: Accessible from rear of case without need for disassembly.
4. Comply with ASME B40.100.

D. Physical:

1. Dial:

    a. Nominal Diameter: 4-1/2 inches.
    b. Face: White, laminated plastic dials with black graduations.
    c. Scale: Extend over arc not less than 200 and not more than 270 degrees.
    d. Ranges and Graduation Units: As indicated on instrument schedule.

2. Cases:

    a. Liquid filled.
    b. Material: Phenolic
    c. Provide removable rear plate.
    d. For gauge pressure, vented case for temperature/atmospheric compensation
    e. Windows:

        1) Material: Clear acrylic or shatterproof glass.
        2) Thickness: 1/8 inch.
        3) Provide gasket.

3. Bourdon Tubes:

    a. Material: Stainless steel, to brass socket.
    b. Provide welded, stress-relieved joints.

4. Connection:

    a. Location: Bottom.
    b. Socket:

        1) 1/2-inch NPT male thread.
        2) Material: Brass forging.
        3) Extend minimum 1-1/4 inches below gage cases.
        4) Provide wrench flats.

    c. Mounting: Stem or surface.

E. Required Accessories:

1. Pressure Snubber:

    a. Material: Type 316 stainless steel.
    b. Provide isolation valve.

2. Shutoff Cocks: Furnished by gauge manufacturer.
3. Provide diaphragm seals as shown on the drawings.
4. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.
5. Liquid fill gauges at the factory.
6. For each differential pressure switch, provide a three-valve manifold. Manifold to be Type 316 stainless steel. Manifolds to be D/A Manufacturing or Anderson Greenwood.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where pressure gauges will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 IDENTIFICATION

A. Refer to drawings for tagging designations

3.3 FIELD QUALITY CONTROL

A. Pressure and differential pressure gauges will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 MAINTENANCE SERVICE

A. Not Required.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407313

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SECTION 407326 - GAUGE-PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gauge-pressure transmitters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”
3. Section 407363 “Diaphragm Seals.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Gauge Pressure Transmitters: Full-size units factory filled and calibrated equal to 10 percent of quantity installed for each size indicated, but no fewer than one unit.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 GAUGE PRESSURE TRANSMITTERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. ABB 266HRH.
b. Foxboro IGP20.
c. Rosemount 3051CG.
d. Siemens Sitrans P DS III.
e. Smar LD301M.
f. Substitutions: Or equal.

A. Type:

1. Microprocessor based, intelligent type.

B. Function/Performance:

1. Measuring Range: As shown in the instrument schedule in Section 407000.

2. Accuracy: 0.075 percent of span.
3. Operating Temperature: -4 to 176 degrees F.
4. Temperature Effect: Combined temperature effects less than 0.2 percent of maximum span per 82 degrees F temperature change.
5. Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
6. Output: Zero adjustable over the range of the instrument calibrated span is greater than the minimum calibrated span.
7. Stability: 0.05 percent of upper range limit for 1 year.
8. Response Time: Less than 1 ms.
9. Display: Digital indicator displaying pressure in the engineering units indicated on the Drawings or in the instrument device schedule.
10. Diagnostics:

    a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
    b. Simulation capability for inputs and loop outputs.
    c. Test terminals available to ease connection for test equipment without opening the loop.
    d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to be available.

11. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored.

C. Physical:

1. Power Supply: 24 VDC loop power.
2. Enclosure:

    a. NEMA 4X (IP66), explosion proof
    b. Approved for Class I, Division 1, Groups C and D.
    c. Instruments for hazardous locations have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the instrument device schedule.

3. Process Wetted Parts (except for ozone/oxygen service):

    a. Isolating diaphragm and other wetted metal parts: Type 316L stainless-steel.
    b. Gaskets and O-rings: Teflon.

4. Sensor Fill Fluid (except for ozone/oxygen service): Silicone.

D. Required Accessories:

1. Shutoff Cocks: Furnished by gauge manufacturer.
2. Provide diaphragm seals as shown on the drawings.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where gauge pressure transmitter will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Gauge-pressure transmitter will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

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3.7 MAINTENANCE SERVICE

A. Not Required

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

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SECTION 407336 - PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pressure and differential pressure switches.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”
3. Section 407363 “Diaphragm Seals.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Pressure and Differential Pressure Gauges: 10 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Ashcroft.
b. Mercoid.
c. Static-O-Ring (SOR).
d. Substitutions: Or equal.

B. Type:

1. Pressure: Diaphragm actuated.
2. Differential Pressure: Mechanical differential pressure switch, diaphragm-actuated, with field-adjustable setpoint.

C. Function/Performance:

1. Accuracy:

a. Pressure: Plus or minus 5 percent of operating range.
b. Differential Pressure: Plus or minus 2.0 percent of full-scale range.

2. Range:

a. Pressure: Refer to instrument schedule in Section 407000.
b. Differential Pressure: Refer to instrument schedule in Section 407000.

3. Type of Switch: SPDT snap action.
4. Switch Rating: 10A at 230VAC.
5. Repeatability: Better than 1 percent of full scale.
6. Dead band: Adjustable to 60 percent of full scale.
7. Set Points: Adjustable between 20 and 80 percent of adjustable range.
8. Automatic reset type.
9. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored.

D. Physical:

1. Hermetically sealed switches.
2. Enclosures shall meet the area classification of the location where the device is being installed.
3. Materials:

a. Diaphragm: Stainless steel.
b. Wetted parts: 316L Stainless Steel.
c. Seals: Viton.
d. Connection port: 316 Stainless Steel.

4. Connection:

a. Location: Bottom.
b. Size: 1/4 inch.
c. Furnish taps for sensing lines.

E. Required Accessories:

1. Pressure: Provide Type 316 stainless-steel shutoff valve. Provide manifold by D/A Manufacturing, Anderson Greenwood, or equal.
2. Differential Pressure: Provide Type 316 stainless-steel three-valve manifold. Mount manifold directly to the instrument or separately mounted, as shown on the Drawings. Provide manifold by D/A Manufacturing, Anderson Greenwood, or equal.
3. Provide diaphragm seals as shown on the Drawings.
4. Where indicated on the drawings, provide Type 316 stainless-steel pressure snubber for pulsation dampening.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where pressure and differential pressure switches will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Pressure and differential pressure switches will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

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3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

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SECTION 407363 - DIAPHRAGM SEALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes diaphragm seals.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”
3. Section 407313 “Pressure and Differential Pressure Gauges.”
4. Section 407326 “Gauge Pressure Transmitters.”
5. Section 407336 “Pressure and Differential Pressure Switches.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Threaded Diaphragm Seals: 10 percent of quantity installed.
2. Annular seals: 10 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 DIAPHRAGM SEALS – THREADED

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Rosemount
b. Ashcroft
c. Ronnigen-Petter Company
d. Siemens
e. Marquest Scientific.
f. Winters Instruments - U.S.

B. Type:

1. Threaded, mounted directly to pressure gauge socket.

C. Physical:

1. Wetted Parts and Bolt Materials: Corrosion resistant to process fluid.
2. Provide fill/bleed screw for filling of diaphragm seal.
3. Instrument Connection: NPT, 1/4 inch.
4. Process Connection: NPT, 1/2 inch.
5. Flushing Connection: NPT, 1/4 inch.
6. Working Pressure Rating: Refer to instrument list for pressure range.
7. Calibration: Provide cleanout ring to be removed for recalibration or cleaning, without loss of filling liquid or change in calibration.

2.2 DIAPHRAGM SEALS – ANNULAR FLANGE MOUNTED

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

    a. Reotemp
    b. Siemens
    c. Wika
    d. Substitutions: Or equal

B. Type:

1. In-line mounted, between two flanges.

C. Function/Performance:

1. Pressure Limit: Correspond to flange ratings.
2. Inside diameter conforms to the dimensions of the pipe where the seal is installed.
3. ANSI or DIN Flange Class: Equivalent to the flange class of the piping where the seal is installed. Bolting dimensions conform to ANSI or DIN drilling specifications as required by the installation.

D. Physical:

1. Body material and Flange: Type 316 stainless-steel and compatible with process connection.
2. Process connection: 1/4-inch NPT.
3. Wetted Parts and Bolt Materials: Corrosion resistant to process fluid.
4. Sensing Liquid: Silicone Oil.

E. Diaphragm Seals:

1. Factory-assemble, fill, and calibrate entire assembly, including gauge switch and transmitter, prior to shipment.

    a. Accessories: Instrument quick disconnect.

2. Field filling is not acceptable.

F. Provide shop inspection and testing of completed assembly.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where diaphragm seal will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD QUALITY CONTROL

A. Diaphragm seal will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 MAINTENANCE SERVICE

A. Not Required.

3.5 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain units.

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SECTION 407413 - RESISTANCE TEMPERATURE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes resistance temperature devices.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”
3. Section 432341 “End Suction Solids Handling Pumps.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resistance Temperature Devices: Provide full set of spare units equivalent to the amount installed in each pump motor and pump bearing.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 RESISTANCE TEMPERATURE DEVICES (RTD)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. ABB, Process Automation Business.
b. Digi-key Electronics.
c. Dwyer Instruments, Inc.
d. Foxboro
e. Rosemount.
f. Siemens.
g. Smar
h. TE Connectivity
i. Substitutions: Or equal

B. Type:

1. Wire-wound RTD

C. Function/Performance:

1. Accuracy: Plus or minus 0.1 percent at 32 degrees F.
2. Base Resistance at 32 degrees F: 100 ohms.
3. Thermal Coefficient of Resistance: 0.00391 Ω/Ω degrees C.
4. Stability: Tested to meet IEC 60751.
5. Tolerance: Class B, according to IEC 60751.
6. Vibration Resistance: 3g over frequency range 5 Hz to 500 Hz. Tested to meet IEC 60751.
7. Self-Heating: Tested to meet IEC 60751.

D. Physical:

1. Material: Platinum
2. Comply with ASTM E1137/E1137M.
3. Encapsulation: Series 300 stainless-steel.
4. Configuration: Three-wire.
5. Connector: Four-pin; male.
6. Housing:

a. Welded housing
b. Material: Type 316L stainless steel**.**
c. Connection: Adequate for installation in motor stator and motor bearings where required.

7. Probe:

a. Diameter: 1/4 inch.
b. Length: suitable for installation location shown on Drawings.
c. Sheath Style: Stainless-steel
d. Operating Temperature: -58 to 482 degrees F
e. Maximum Response Time: 9 seconds.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where resistance temperature devices will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Resistance temperature devices will be considered defective if it does not pass tests and inspections.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407413

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SECTION 407719 - VIBRATION VELOCITY MEASUREMENT DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes vibration velocity measurement devices.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”
3. Section 407723 “Vibration Monitoring Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

C. Services of Manufacturer’s Representative

1. Provide services of a manufacturer service representative specifically trained on type of equipment supplied. Submit qualifications of service representative for approval. The number of required days listed below are exclusive of travel time, and do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation

a. Operation and Maintenance instruction: One 8-hour day.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 VIBRATION SENSORS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following**:**

a. Bently Nevada 330400 Accelerometer.

b. Metrix Instrument Company ST5491E Series sensor.
c. Substitutions: Or equal

B. Type:

1. Loop-powered seismic transmitter providing a 4-20 mA signal proportional to velocity, or acceleration/velocity/frequency data to module.

C. Function/Performance:

1. Range: 0 to 2 inch/sec or as recommended by the pump manufacturer.
2. Accuracy: 2 percent.
3. Sensitivity: 10.2 mV/m/s^2 (100 mV/g), plus or minus 5 percent.
4. Frequency Response: 10 to 1500 Hz.
5. Supply Voltage: 11 to 30 VDC.
6. Isolation: 500 Vrms, circuit to case.
7. Enclosure: Type 303 stainless steel.
8. Mounting: 1/4-inch NPT.
9. Hazard Rating: Class 1, Division 2, Groups C and D.
10. Environmental Rating: NEMA 4X (IP67).

D. Required Accessories:

1. Vibration sensors to be monitored by monitoring panel specified in Section 407723 "Vibration Monitoring Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where vibration velocity measuring devices will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

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3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Vibration velocity measurement devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. The factory-authorized service representative or manufacturer to work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.
2. How to scale signals, set alarms, set shutdowns, set delay timers, display alarm events, get data and trend it in the display in the monitoring control system.

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SECTION 407723 - VIBRATION MONITORING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes vibration monitoring systems for use with vibration velocity sensors, resistance temperature devices, thermocouples, velometers and/or accelerometers.

B. The influent pumps shall be provided with a dedicated vibration and temperature monitoring system as shown.

C. Sensors:

1. The system shall include velometers to accommodate vibration measurements for the horizontal, vertical, and axial directions of each pump motor.

    a. Monitors and sensors: Appropriate to monitor the vibration range for each 700-horsepower pump.
    b. Sensors: Compatible with the monitor and have adequate output for the cable lengths required.
    c. Sensor Output: Not affected by stray magnetic fields.

2. Vibration and Temperature Sensors: Securely mounted to permanently affixed studs or brackets on the pump bearing frame.

    a. Mounting Locations: In accordance with the instructions of the pump manufacturer.
    b. Each sensor cable: Provided with stainless steel armor jacket
    c. Cable Lengths: Field verify.

D. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”
3. Section 407719 “Vibration Velocity Measurement Devices.”
4. Section 407413 “Resistance Temperature Devices.”
5. Section 432341 “End Suction Solids Handling Pumps.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Provide an Input/Output or memory map for signals communicated over the plant Ethernet network to the plant SCADA/PLC system. The documentation must include all settings needed to connect the device to the plant SCADA system as required in Division 40 and shown on the P&IDs. The system must communicate with the native communication protocol of the PLC system as required by Section 406343 “Programmable Logic Controllers.” The reference sheet shall be created for each networked device and at a minimum include device IP address, protocol specific configuration parameters, a description of the data for each address/register, range, units, scaling factors, and data type (Int, Float, Boolean, etc.).

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

C. Services of Manufacturer’s Representative

1. Provide services of a manufacturer service representative specifically trained on type of equipment supplied. Submit qualifications of service representative for approval. The number of required days listed below are exclusive of travel time, and do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation

    a. Operation and Maintenance instruction: One 8-hour day.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 VIBRATION AND TEMPERATURE MONITORING PANEL

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

    a. Bently Nevada Orbit 60 Asset Condition Monitoring Panel.
    b. Metrix Instrument Company Datawatch IX Monitoring Panel.

B. Or equal.Type:

1. Operator interface station for monitoring pump and motor vibration and temperatures via direct sensor inputs.

C. Function/Performance:

1. One monitoring panel rack provided for each pump.
2. Modules: Monitor shall include enough modules to connect the vibration and RTD sensors required by the drawings Capable of monitoring velometer/accelerometer inputs, thermocouple, DC voltage, and resistance temperature device (RTD) signals.
3. Channels Per Module: As required by the Drawings.
4. Update Rate: 8 times per second.
5. Maximum Operating Temperature: 131 degrees F
6. Outputs: Four or more SPDT relay outputs for alarming and shutdown purpose. Provide adequate quantity of relay cards to enable pump shutdown in response to any temperature or vibration condition.

a. Any sensor exceeds a high vibration/temperature (warning) or high-high vibration/temperature (shutdown), the contact will close. The vibration Alarm shall trigger at 1.5x the allowable limit and shutdown shall trigger at 2x the allowable limit. Coordinate with the pump/motor supplier for temperature setpoints. Refer to Section 432341 "End Suction Solids Handling Pumps" for additional requirements.
b. Relay Contacts: Fully configurable to alarm on any available signal based on user defined setpoints.

7. Inputs: All temperature and vibration monitoring points shall be wired to their own isolated input channel.
   a. Independently programmable time delays for both warning and alarm signals for each relay output.

8. Communications: Ethernet based communications for monitoring by the plant's PLC system.

   a. An RJ45 Ethernet port that communicates all data. The system must communicate with the native communication protocol of the PLC system as required by Section 406343 "Programmable Logic Controllers." Provide any protocol converters/gateways needed to communicate with the PLC system.
   b. The IP address assigned to each of the monitors, gateways, or other networked components shall correspond with the addressing scheme developed by the PCSS.
   c. At minimum, the following signals shall be available for continuous monitoring by the PLC:

      1) Real Time Vibration
      2) Peak Vibration
      3) Real Time Temperature
      4) Peak Temperature

9. Additional Equipment: Signal conditioners must be provided as necessary to ensure accurate measurement of vibration data throughout the RPM range of each pump.

D. Physical:

1. Panel Rating: NEMA 12 (IP54).
2. Power: 120VAC. Provide 24VDC power supplies if the vibration monitoring device does not support 120VAC. Refer to Section 407859 "Power Supplies" for additional requirements.
3. Display: A graphical touchscreen display shall be provided to show the status/feedback of each sensor. Must be panel-mountable or rack-mountable.

   a. Visual warning and alarm indications for each sensor shall be displayed on the graphical interface.
   b. Visual indication for proper operation for each sensor shall be displayed on the graphical interface.
   c. Manual reset button to acknowledge alarm conditions and reset the pump operation if the alarm conditions no longer exist.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where vibration monitoring system will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Vibration monitoring systems will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the

instrument. The factory-authorized service representative or manufacturer to work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and monitoring device.
2. How to scale signals, set alarms, set shutdowns, set delay timers, display alarm events, get data and trend it in the display in the monitoring control system.
3. Provided 2 times and last up to 4 hours in the field.

END OF SECTION 407723

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SECTION 407816 - INDICATING LIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes indicating lights.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Indicating Lights: Full-size units equal to 20 percent of quantity installed, but no fewer than 3 units.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PILOT TYPE INDICATING LIGHTS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following**:**

a. Allen Bradley.
b. Eaton Cutler-Hammer
c. Eaton Crouse-Hinds (NEMA 7)
d. General Electric.
e. Square D.
f. Substitutions: Or equal.

B. Type:

1. Energy efficient, Solid-State LED Lamps.

C. Function/Performance:

1. Low voltage LED lamps suitable for the voltage supplied.
2. Integral reduced voltage transformers for 120VAC powered lights.
3. Replaceable lamps from the front of the unit.

4. Push-to-test operator type.

D. Physical:

1. Hazardous Area Rating: Refer to drawings for control panel locations to determine necessary rating. Provide type NEMA 4X for non-hazardous locations.

2. Lens caps: 1.18-inch (30 mm) diameter.
3. Lens color:

a. Running, On, Open - Red.
b. Stopped, Off, Closed - Green.
c. Alarm - Amber.
d. White - Power on.
e. Blue - All other status indications not covered by the above.

4. Provide legend faceplates engraved to indicate the required function of each device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where indicating lights will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations

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3.5 FIELD QUALITY CONTROL

A. Indicating lights will be considered defective if they do not pass tests and inspections. Replace defective lights and re-test.

B. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407816

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SECTION 407819 - SWITCHES AND PUSH BUTTONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes switches and push buttons.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Switches and Push Buttons: Full-size units equal to 20 percent of quantity installed, but no fewer than 2 units.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SELECTOR SWITCHES AND PUSHBUTTONS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen Bradley.
b. Crouse Hinds (NEMA 7).
c. Cutler-Hammer.
d. General Electric.
e. Square D.
f. Substitutions: Or equal.

B. Type:

1. Heavy-duty oil tight type with stackable contact blocks.

C. Function/Performance:

1. Contact arrangement and switching action as required for the control system specified.

2. For 120VAC service, provide contacts rated 10A at 120VAC. For 24VDC service, provide silver sliding contacts rated 5A at 125VDC. For electronic (millivolt/milliamp) switching, provide contacts rated 1A at 28VDC.

D. Physical:

1. Hazardous Area Rating: Refer to Drawings for control panel locations to determine necessary rating of switches and push buttons. Provide type NEMA 4X for non-hazardous areas.
2. Size: 1.18-inch (30 mm) diameter.
3. Pushbuttons: Flush type operators.
4. Selector switches: Knob or wing lever operators.
5. Provide legend plates denoting switch/pushbutton position and/or function.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where switches and push buttons will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407819

B. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

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3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 MAINTENANCE SERVICE

A. Not Required.

END OF SECTION 407819

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SECTION 407833 - ANNUNCIATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes annunciators.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 EMERGENCY ALARM BEACON

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Benjamin.
b. Federal Signal.
c. Edwards.
d. Wheelock.
e. Substitutions: Or equal.

B. Beacon alarm light:

1. Type:

a. Beacon alarm light.

2. Physical:

a. Beacon alarm light for control panel mounting
b. Power Requirements: 120VAC
c. Flush mounted
d. NEMA 4, weatherproof construction.
e. 750,000-candle power xenon strobe tube and red polycarbonate lens.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where annunciators will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Annunciators will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not Required.

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3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:

END OF SECTION 407833

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SECTION 407853 - RELAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes relays.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Relays: Full-size units for SPDT, DPDT, 3PDT, or 4PDT equal to 20 percent of quantity installed for each size indicated, but no fewer than 2 units of each type.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen Bradley.
b. IDEC
c. Omron
d. Schneider Electric.
e. Substitutions: Or equal

B. Type:

1. General purpose plug-in type.

C. Function/Performance:

1. Provide all relays with number of poles required to meet the design intent.
2. Mechanical life expectancy to be in excess of 10 million.
3. Provide solid state time delays with polarity protection (DC units) and transient protection.
4. Time delay units in ranges from .1 second to 4.5 hours.

D. Physical:

1. Mounting: DIN rail.
2. Integral indicating light to indicate if relay is energized.
3. For 120 VAC service, provide contacts rated 10A at 120VAC. For 24 VDC service, provide contacts rated 5A at 28VDC. For electronic (milliamp/millivolt) switching applicator, provide gold plated contacts rated for electronic service.
4. Dust and moisture resistant covers.

E. Required Accessories:

1. Provide DIN rail mounted relay socket for each relay, rated 10A at 300VAC.

2.2 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Acromag.
b. Action Instruments Slim Pak.
c. Substitutions: Or equal

B. Type:

1. Solid state, ASIC technology, electronic type.

C. Functional:

1. Input: 4-20 mA.
2. Output: Isolated contact output, double pole double throw, rated 5A at 120VAC.
3. Accuracy: 0.1 percent.
4. Protection: Provide RFI protection.
5. Deadband: Adjustable between 0.1 and 5.0 percent of span.
6. Set point Adjustment: Single Point alarms adjustable to trip on rising or falling input signal, dual point alarms adjustable to trip on rising and falling input signals.
7. Repeatability: Trip point repeatability at least 0.1 percent of span.

D. Physical:

1. Mounting: DIN rail.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where relays will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 MAINTENANCE SERVICE

A. Not Required.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407853

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SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes isolators, intrinsically safe barriers, and surge suppressors.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”
4. Section 4072XX “Sections for level measurement.”
5. Section 407336 “Pressure and Differential Pressure Switches.”

1.3 DEFINITIONS

A. Section 4072XX “Sections for level measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”
2. Clearly indicate which instruments will have surge protection and either separate enclosures or conduit mounts. Provide listings and/or tables indicating location for both building and field devices.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Isolators, Intrinsically Safe Barriers, and Surge Suppressors: Full-size units equal to 20 percent of quantity installed, but no fewer than 3 units per type.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Acromag.
b. Action Instruments Slim Pak.
c. Substitutions: Or equal.

B. Type:

1. Solid state, ASIC technology; electronic type.

C. Function/Performance:

1. Accuracy: 0.15 percent.
2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
3. Output: Current or voltage as required.
4. Isolation: Complete isolation between input circuitry, output circuitry, and power supply.
5. Adjustments: Zero and span adjustment.
6. Protection: Provide RFI protection.

D. Physical:

1. Mounting: DIN Rail.

2.2 INTRINSIC SAFETY BARRIERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Gems – 54800 (4-20mA) and 65800 (dry contacts).
b. R. Stahl – Intrinspak.
c. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts).
d. Substitutions: Or equal.

B. Type:

1. Solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

C. Function/Performance:

1. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.
2. Locate in non-hazardous areas.
3. Match power supply provided.

D. Physical:

1. Mounting: DIN Rail.

2.3 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Gems.
b. P&F.
c. Unitech.
d. Substitutions: Or equal

B. Type:

1. Passive devices requiring no external voltage supply.

C. Function/Performance:

1. Supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.
2. Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

D. Physical:

1. Mounting: DIN Rail.

2.4 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Citel
b. MTL Surge Technologies
c. Phoenix Contact
d. Transtector
e. Substitutions: Or equal

B. Function/Performance:

1. Provides surge protection of electronic instrumentation from induced surges propagated along the signal and power supply lines from lightning, utility, or the plan electrical systems.
2. Protection system lower than the instrument withstand level, while not interfering with normal operation.
3. Maintenance free and self-restoring.
4. Response time: Within nanoseconds.

C. Required Surge Protection:

1. Control Panel Power Feed (120VAC).

a. Provide protection of 120VAC power feed into control panels, server racks, network racks, and communication enclosures.

b. Nominal Discharge surge current: 20kA (at an 8x20µs impulse waveform) when nominal Current is 20A and accepts 12-24 AWG wire connection
c. Provide surge protector from one of the following:

1) Citel DS40 series
2) MCG Surge Protection PT Series (for Control Panels)/ 400 series (For Equipment)
3) Phoenix Contact "PLT/PT" or VAL-US series
4) Transtector AC SPD I2R Series
5) Substitutions: Or equal.

2. 4-Wire Field Instrument Power:

a. Provide surge protection at the field device to protect 120 VAC power and 24 VDC power to analog instrument.
b. Mount transmitter surge protectors in separate NEMA 4X enclosure for field installations.
c. Nominal Discharge surge current: 2.5kA (at an 8x20µs impulse waveform).
d. Provide Field Mounted (at instrument) surge protector from one of the following:

1) Phoenix Contact BoxTrab BXT-N4X Series
2) MTL Surge Technologies SDyyX series
3) Substitutions: Or equal.

3. Analog Signal (4-20mA) Circuits:

a. Provide surge protection where any part of the circuit is outside of the building envelope.
b. Mount transmitter surge protectors in separate NEMA 4X enclosure or conduit mount for field installations.
c. Protect circuits at both the transmitter side and the PLC panel side of the circuit.
d. Nominal Discharge surge current: 10kA (at an 8x20µs impulse waveform). Provide Field Mounted (at instrument) surge protector from one of the following:

1) Phoenix Contact SurgeTrab S-PT Series
2) MTL Surge TechnologiesTP48
3) Citel TSP M series.
4) Substitutions: Or equal.

e. Provide panel mounted surge protector for Field Mounted Instruments from one of the following:

1) Phoenix Contact TermiTrab TTC Series
2) MTL Surge Technologies SD series
3) Citel DLA series. DLC series
4) Substitutions: Or equal.

4. Inductive Loads:

a. Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120VAC or less that drive solenoid, coil, or motor loads.
b. Nominal Discharge surge current: 20kA (at an 8x20µs impulse waveform)
c. Provide surge protector from one of the following:

1) Citel DS240S series
2) Phoenix Contact PT series
3) Substitutions: Or equal

5. Non-Fiber Based Data Highway or Communications Circuits:

a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
b. Provide circuit protection at both ends of the line.
c. Nominal Discharge surge current: 2kA (at an 8x20µs impulse waveform)
d. Provide surge protector from one of the following based on specific application:

1) Phoenix Contact DATA Trab or PlugTrab PT Series,
2) Transtector FSP Series, CPX series
3) MTL Surge Technologies ZoneBarrier NC Series,
4) Citel DLA series, MSP Series
5) Substitutions: Or equal.

6. Ethernet Connection:

a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
b. Mount surge protectors in enclosures for field installations.
c. Provide circuit protection at both ends of the line.
d. Nominal Discharge surge current: 2kA (at an 8x20µs impulse waveform)
e. Provide surge protector from one of the following based on specific application:

1) Phoenix Contact DATA Trab Series,
2) Transtector FSP Series, CPX series
3) MTL Surge Technologies ZoneBarrier NC Series,
4) Citel DLA series, MJ8 Series
5) Substitutions: Or equal

7. Serial Connection (RS-485/RS-232):

a. Provide surge protection on RS-485 connection. Connection method to device by 9-position D-SUB connector
b. Mount surge protectors in separate NEMA 4X enclosure for field installations.
c. Provide circuit protection at both ends of the line.
d. Nominal Discharge surge current: 5kA (at an 8x20µs impulse waveform)
e. Provide surge protector from one of the following based on specific application:

1) Phoenix Contact DATA Trab Series, DT-UFB-485/BS
2) Transtector FSP Series,
3) MTL Surge Technologies Zone Barrier Series,

4) Citel Data Line, DD series
5) Substitutions: Or equal

8. RF Coaxial Cable:

a. Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure.
b. Protected in accordance with NEMA and UL 497E standards.
c. Nominal Discharge surge current: 5kA (at an 8x20µs impulse waveform)
d. Provide surge protector from one of the following:

1) Citel P8AX series
2) Polyphaser GT Series
3) Phoenix Contact Coax Trab series
4) Substitutions: Or equal.

9. Telephone Circuits:

a. Provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.
b. Nominal Discharge surge current: 10kA (at an 8x20µs impulse waveform)
c. Provide surge protector from one of the following:

1) Citel MJ8-Telecom or DLA series
2) Phoenix Contact Data Trab Series or PT-IQ Series
3) Substitutions: Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where products will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Isolators, intrinsically safe barriers and surge suppressors will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407856

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SECTION 407859 - POWER SUPPLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes power supplies

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Supplies: Equal to 10 percent or two units for each size used, whichever is greater.
2. Redundancy Modules: Equal to 10 percent or two units for each size used, whichever is greater.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 POWER SUPPLIES (24VDC)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen-Bradley.
b. Phoenix Contact.
c. SOLA HD.
d. Substitutions: Or equal.

B. Type:

1. Redundant power supplies that operate in parallel with an independent redundancy module to power field instruments and panel devices as shown on the Drawings.

C. Function/Performance:

1. Input power: 115VAC, plus or minus 10 percent, 60 Hz.
2. Output voltage: 24VDC.

3. Output voltage adjustment: 5 percent.
4. Line regulation: 0.05 percent for 10V line change.
5. Load regulation: 0.15 percent no load to full load.
6. Ripple: 3 mV RMS.
7. Operating temperature: 32 to 140 degrees F.
8. Sized to accommodate the design load plus a minimum 25 percent spare capacity.

D. Physical:

1. Mounting: DIN rail. Mounted such that heat dissipation does not adversely affect other panel components.
2. Equipped with power on/off circuit breaker.
3. Provide relay contact (internal to the redundancy module or external if the power supply is not so equipped) to indicate on/off status of the power supply.
4. Provide relay contact to indicate power supply fault.
5. Output overvoltage and overcurrent protective devices to protect from damage due to power supply failure and external failure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where power supplies will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings and control system architecture for tagging designations

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3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 MAINTENANCE SERVICE

A. Not required.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407859

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SECTION 408100 – INDUSTRIAL CONTROL SYSTEM CYBERSECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. Section includes all programming, configuration, and related services to implement security controls or countermeasures for the industrial control system to be performed by the PCSS. Control system, including vendor package systems and existing equipment, must function in full conformity with the Contract Drawings and specifications with security controls applied.

B. Provide configuration of equipment to maintain existing control system functionality and diagnostics with implemented countermeasures.

C. Coordinate work with plant operating personnel to minimize impacts on daily operation. Formally note and submit details on any delays caused during startup to the Engineer and Owner in the form of a letter.

D. Related Requirements:

1. Section 4061XX “Sections for Process Control System Supplier Requirements.”
2. Section 4063XX “Sections for Control System Equipment.”
3. Section 4066XX “Sections for Network and Communication Equipment.”

1.3 ACRONYMS AND DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system, including the cybersecurity requirements included in this Section.

B. “Section 4062XX - Sections for Computer System Hardware” – The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

C. HMI - Human Machine Interface.

D. MAC – Media Access Control.

1.4 COORDINATION MEETINGS AND WORKSHOPS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 ACTION SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For any named CSSP, submit a statement on company letterhead indicating that the requirements in the “Quality Assurance” paragraph below are met by the firm.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 IDENTIFICATION AND AUTHENTICATION CONTROL

A. User Identification and Authentication

1. Users accessing the Operator Interface Terminals provided under this contract are required to provide a unique identifier and password to access the control system graphic interface.

B. Identity Management

1. Accounts for the Control System’s Windows based computers are centrally managed using the existing Windows Active Directory System. Any modifications to the existing HMI system must utilize the existing user groups utilized by the Active Directory and HMI integration to the Active Directory.

C. Authenticator Management

1. Change default passwords associated with control system equipment that supports user accounts or accounts supplied as part of this Project, including but not limited to routers, switches, PLCs, servers, and workstations.

3.2 USE CONTROL

A. Authorization Enforcement

1. User accounts must be assigned a security group, and system permissions are defined by the associated group. Security groups and permissible actions must be approved by the

Owner and Engineer. User group assignment is determined by the least functionality required to complete job assignments. Coordinate with requirements of the HMI system in Section 406863.

B. Session Lock

1. Systems where the HMI system is required to be always active must log the user into a view only account after 15 minutes of inactivity. When in the view only account, operations will have access to view alarms and process control.

3.3 DATA CONFIDENTIALITY

A. Use of Secure Protocols

1. Configure the system to reject the use of communication of the following insecure protocols.

a. FTP
b. Telnet
c. SNMP v1, SNMP, v2
d. TLS 1.0. TLS 1.1
e. HTTP

3.4 RESTRICTED DATA FLOW

A. Network Segmentation

1. Configure the control system network to logically segment non-control system networks from the control system network and to logically segment critical control system networks from other control system networks as shown on the drawings.
2. Establish network segments dedicated to specific types of network traffic, with clearly defined boundaries between each segment.

a. Segments must be physical or logical (i.e., VLAN configurations) as shown on the drawings.
b. Coordinate with the Owner for information on the VLANs used for equipment provided for this project.

3.5 RESOURCE AVAILABILITY

A. Network and Security Configuration Settings

1. Fully document and backup network device configurations and settings. Once network devices are configured, perform a backup of the configuration settings. Take additional backups for individual devices if any changes are made following the initial backup.

B. System Component Inventory

1. Provide an inventory of IP-based control system hardware. The inventory list includes device name, device description, model and manufacturer, physical location, IP addressing information, MAC address, interface connection information (*i.e.,* what interface is used on the device itself), and where the device is connected (*i.e.,* switch or switch interface information).
2. Provide the Operating System software version/patch level and firmware revision for the control system, including all servers and workstations, PLCs, intrusion detection systems (IDS), data diodes, and network components.

3.6 SYSTEM AUDITING

A. System Logs

1. Enable logs for devices in the control system with the capability to generate logs, including but not limited to routers, modems, switches, firewalls, servers, workstations, and controllers.

    a. Log types include but are not limited to system logs, application logs, and security logs.

B. Timestamps

1. Coordinate with the Owner such that equipment provided under this contract is synchronized using an existing central Network Time Protocol (NTP).

3.7 GENERAL SYSTEM HARDENING

A. Network Hardening

1. Disable unused network interfaces on managed switches and physically restrict or ‘lock’ access to any unused port on unmanaged switches with physical port locks.
2. Ensure network devices are operating using the most up to date stable operating system or firmware ensuring compatibility with all application software.
3. Disable features for re-directing traffic that are not required (*e.g.,* ICMP redirects, IP source routing).
4. Disable features for probes and scans in reconnaissance attacks (*e.g.,* Finger, ICMP unreachable, ICMP mask reply).
5. Ensure security of terminal connections (*e.g.,* IP ID service, TCP keepalives).
6. Disable gratuitous ARP and proxy ARP.
7. Disable IP-directed broadcasts.
8. Ensure no overlapping or duplicate router or firewall rules.
9. Ensure no unused rules are present in routers or firewalls.
10. Wherever possible, do not use clear text protocols on the internal (trusted) network. Use encryption where possible (*e.g.,* SSH, SNMP (version 3), HTTPS instead of Telnet, HTTP).

B. Industrial Control Device Hardening:

1. Configure devices installed within the control system network designed to monitor and control processes and equipment based on the following practices:

    a. Install vendor recommended firmware updates.
    b. Disable unused network interfaces, where possible.
    c. Disable remote program changes and password protect the application.
    d. Remove default accounts where possible.
    e. Enable logging on each device.
    f. Disable unneeded services, such as webserver and file transfer.
    g. Disable protocols not used by current system configurations or as requested by the Owner such as HTTP, FTP, SNMP, ICMP, etc.

END OF SECTION 408100

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SECTION 432341 – END SUCTION SOLIDS HANDLING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vertical end suction solids handling pumping system at the Cedar Creek Water Pollution Control Plant Influent Pump Station, including, but not limited to, pumps, motors, shaft couplings, line shafting, eddy current drives, and vibration and temperature monitoring.
2. Supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.
3. Pump manufacturer/supplier shall have unit responsibility for the pumping system.
4. Delegated Design.
5. Eddy Current Drives.

B. Application

1. Pumping units pump raw wastewater from influent wet well to headworks facility.

C. Related Requirements:

1. Section 036000 “Grouting” for grouting associated with pumping unit base installation.
2. Section 055000 “Metal Fabrications”: Fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
3. Section 260505 “Medium Voltage Cables” for conductor requirements.
4. Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for connections and terminations.
5. Section 260523 “Control-Voltage Electrical Power Cables” for connections and terminations.
6. Section 260573 “Power System Studies” for harmonic study requirements.
7. Section 400593.13 “Medium Voltage Motor Requirements for Process Equipment”: Electric motors and accessories normally supplied as part of equipment assemblies.
8. Section 406100 “Process Control and Enterprise Management Systems”.
9. Section 406121 “Process Control System Testing”.
10. Section 406126 “Process Control Descriptions”.
11. Section 407000 “Instrumentation for Process Systems”.

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1.3 ACTION SUBMITTALS

A. If manufacturing techniques differ, completely describe all aspects that do not conform to specifications.

B. Shop Drawings and Product Data:

1. Manufacturer's literature, bulletins, and/or catalogs describing equipment in sufficient detail to indicate conformance with this Section.
2. Equipment total weight, including weight of single largest item.
3. Certified shop and erection drawings showing dimensions and details of construction and dimensions.
4. Drawings showing installation of equipment in designated locations including dimensions and piping connections, based upon field measured dimensions.
5. Complete Bill of Materials.
6. Parts arrangement drawing including materials of construction of each part.
7. Details of accessory components: Shaft couplings, extended shaft.
8. Equipment nameplate data.
9. Data on the characteristics and performance of each pump:

    a. Catalog sheets showing a family of curves covering full range selection of impeller diameter.
    b. Guaranteed Performance Curves:

        1) Based on actual shop tests on similar units.
        2) Show the specified requirements for head, capacity, efficiency, guaranteed maximum net positive suction head required (NPSHR), and brake horsepower.
        3) Clearly identify Preferred Operating Region (POR) and Allowable Operating Region (AOR) (refer to ANSI/HI 9.6.3).
        4) Demonstrate compliance with ANSI/HI 14.6 acceptance grade 1U for specified design point and acceptance grade 1E for the other specified points.
        5) Plot Curves on 8 1/2-inch by 11-inch sheets at as large a scale as practical specifically for the pump proposed. Show no-flow condition at shut-off head to pump capacity at minimum specified Total Head (TH).
        6) Variable Speed Pumps: Include variable speed curves with five evenly spaced speeds plotted from maximum to minimum recommended speeds.

10. Equipment Base Drawing:

    a. Indicate size and location of bolt holes for anchorage plus details of anchorage of equipment to foundation including anchor bolt type, size, materials, embedment depth, and minimum edge distance.
    b. Summary of external weight and thrust loads applied to the supporting structure.
    c. Summary of maximum vertical and horizontal reactions at each anchor bolt considering all applicable loads and load combinations.
    d. Submit manufacturer's specification and data including recommended design values and physical characteristics for the selected anchors to the concrete foundation.

11. Description of painting and protective coatings.
12. Complete master wiring diagrams, elementary or control schematics, including coordination with electrical equipment and control devices, and suitable outline drawings showing such details as are necessary to locate conduit stub-ups and field wiring.
13. Data for electric motors in accordance with Section 400593.13 “Medium Voltage Motor Requirements for Process Equipment”.

1.4 DELEGATED DESIGN SUBMITTALS

A. Delegated Design Submittals: Submit New York State registered signed and sealed Shop Drawings with design calculations and assumptions for equipment base anchorage**.**

B. Vaned-Flow Conditioning Spool:

1. Submit shop drawings.

    a. Include weight, materials, dimensions, and calculations for flow conditioner.

C. Equipment Base Drawing:

1. Using manufacturer’s provided size and location of bolt holes for anchorage, provide details of anchorage of equipment to foundation including anchor bolt type, size, materials, embedment depth, and minimum edge distance.

    a. Summary of external weight and thrust loads applied to the supporting structure.
    b. Summary of maximum vertical and horizontal reactions at each anchor bolt considering all applicable loads and load combinations.
    c. Manufacturer to submit signed and sealed seismic certification if required by authority having jurisdiction.

2. Submit specification and data including recommended design values and physical characteristics for the selected anchors to the concrete foundation.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificates:

1. Certify that products meet or exceed specified requirements.
2. Certification from the motor manufacturer that the motors are capable of continuous operation without affecting the design life of bearings or windings.
3. Certify pump and motor bearing life meets or exceeds specified value. Motor bearing life is stated in Section 400593.13 “Medium Voltage Motor Requirements for Process Equipment.” Include supporting data.
4. Certify setting plan, with tolerances, for anchor bolts.
5. Manufacturer's certification of installation meeting Manufacturer’s installation, operation and maintenance manuals and as specified in PART 3.
6. Welder certifications.

B. Test and Evaluation Reports:

1. Dynamic Vibration Analysis Report:

a. Submit prior to manufacturing equipment.
b. Include backup information and sufficient detail to confirm that the specified requirements have been met.
c. Include a statement of guarantee that the required analyses were completed and the specified limitations met.

C. Manufacturer Instructions:

1. Delivery, storage and handling instructions. Include storage power requirements for space heater and terminal board.
2. Installation instructions, including anchoring layout and details.

D. Source Quality-Control Submittals:

1. Schedule including factory testing and anticipated delivery dates of equipment to job site.
2. Shop testing procedures, pump and piping set up, equipment to be used and testing tolerances.
3. Certified results of hydrostatic testing.
4. Certified shop hydraulic performance testing results.
5. Certified motor test data as described in Section 400593.13 “Medium Voltage Motor Requirements for Process Equipment”.
6. Inspection report of pump condition prior to shipment.

E. Field Quality-Control Submittals:

1. Identify the entity and experienced individual who will inspect the installation.
2. Documentation from Manufacturer’s representative attesting that equipment has been properly installed and is ready for startup and testing.
3. Field testing procedures, equipment to be used, and testing tolerances.
4. Field testing results.

F. Qualifications Statements: Manufacturer Qualifications, as required by Article Quality Assurance.

G. The pump manufacturer/supplier shall coordinate with the motor manufacturer and Eddy Current Drive manufacturer and submit, as part of the shop drawings, a written statement signed by the pump manufacturer/supplier and eddy current drive manufacturer. This written statement shall certify that the eddy current drive manufacturer has received the required information from the pump manufacturer/supplier and motor manufacturer; that all parties have reviewed the system and coordinated the equipment selection; and that the pumps, motors, drives and controls are designed to operate continuously at any and all points within the required range of operation, without overheating, without cavitation and without excessive vibration or strain. Include with this written statement all motor data and information that has been used for the coordination.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manual:

1. Provide an Operating and Maintenance Manual for the equipment specified herein, specifically prepared for this installation and including all required drawings, equipment and materials information, descriptions, complete bill of materials, etc., as required to instruct operating and maintenance personnel unfamiliar with such equipment.

B. Warranty Documentation:

1. Submit warranty complying with requirements herein and Section 017700 “Closeout Procedures”.

C. Project Record Documents:

1. Submit Project Record Documents recording actual locations and final orientation of all equipment and accessories.
2. Include field measured dimensions for actual equipment locations and all piping connections.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Manufacturer's Recommended Spare Parts List:

1. Include gaskets and related materials.
2. List all bearings by the bearing manufacturer's numbers only.
3. Include Manufacturer's current price for each item; pricing to remain in effect for not less than one year after Substantial Completion.

B. Prepare spare parts for long term of storage and pack in containers that clearly identify contents with indelible markings.

C. Provide the following spare parts – one set:

1. One mechanical seal.
2. One complete set of gaskets, “O”-rings, etc.
3. One shaft sleeve (if utilized).
4. One full rotating assembly for single pump (bearings, impeller, etc.)

D. Provide any special tools required to maintain the equipment.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Company specializing in manufacturing products specified in this Section with minimum five years of documented experience.
2. Minimum of five operating installations with pumps of the same size or larger and in the same service as specified.

3. Certified to ISO 9001 standard for design and manufacture of this type of pump.
4. Manufacturer or its representative shall have an authorized warranty center within a 300 mile radius of the Project site, fully staffed with factory trained mechanics, confirm service facility and strategic spare parts.

B. Provide pumping units by a single Pump Manufacturer.

C. Pump Manufacturer has unit responsibility for providing and coordinating the pumping system, including, but not limited to, the pumps, motors, eddy current drives, vibration and temperature monitoring, and supporting base.

D. Manufacture pumps in accordance with Hydraulic Institute Standards, except where otherwise specified.

E. Provide new and unused equipment from Manufacturer's standard product line having a successful record of manufacturing and servicing similar equipment and systems for a minimum of five years.

F. Welders of Pressure-Containing Fabrications: Qualified to ASME Code Section 9 or AWS D1.1 Structural Welding Code – Steel.

G. Eddy current drives shall be designed, built and tested in accordance with the latest applicable editions of ANSI/IEEE, NEMA, and UL.

H. The eddy current drive manufacturer shall have 10 years' experience in the design and be regularly engaged in manufacturing and servicing equipment for installations of the type and size specified under this Section.

I. Each eddy current drive shall be totally compatible with the driven equipment and motors. The eddy current drive shall be matched to the driven equipment specific load requirements for each system specified in this Section or as shown on the Contract Drawings.

J. In order to ensure that all equipment is properly coordinated, the eddy current drive manufacturer shall coordinate application date with the driven equipment suppliers.

K. All eddy current drives that comprise a given system shall be similarly equipped. Similar components of each system shall be the product of a single manufacturer.

L. All materials, equipment and parts comprising each eddy current drive shall be new, of current manufacture and of the highest grade. All components shall be covered by the manufacturer's standard warranty on new eddy current drives.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Specific written approval from Engineer is required prior to shipment of pumps.

B. Do not disassemble factory assembled parts and components for shipment unless written permission received from Engineer.

C. Ship pumping units with motor space heaters connected to a terminal board ready to be energized. Promptly energize motor space heaters during storage. House pumping units in weatherproof enclosures at all times during storage.

D. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage. As necessary, provide inspection report to Manufacturer identifying any damage and rework necessary prior to installation.

E. Store pumps and all appurtenances according to Manufacturer's instructions.

F. Rotate pumps once a week at a minimum to ensure proper maintenance.

G. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to Manufacturer's instructions.
3. Protect unpainted finished iron and steel surfaces to prevent rust and corrosion.
4. Protect finished surfaces of exposed flanges with wood or equivalent blank flanges.
5. Protect bearings against formation of rust in accordance with bearing manufacturer's recommendations. Apply lubricant or corrosion inhibiting treatment during transportation, storage, handling, installation, and lapse of time prior to start-up. Intermittently manually rotate equipment prior to start-up to ensure distribution of lubricant/protection.

H. Eddy current drives shall be delivered, stored and handled in accordance with the manufacturer's instructions and the following:

1. Eddy current drive equipment shall be inspected for shipping damage or loose parts when received.
2. Evidence of water which may have entered equipment during transit shall be checked for.
3. Eddy current drive equipment shall be stored in a clean, dry location in which a uniform temperature is maintained. Equipment shall be protected with coverings and air circulation shall be maintained.
4. Eddy current drive shall be maintained and regularly inspected by Contractor, in accordance with manufacturer's instructions, prior to installation.

1.10 FIELD CONDITIONS

A. Ambient Temperature Range: 60 to 104 degrees F.

1.11 WARRANTY

A. Provide Manufacturer's warranty for all equipment provided under this Section.

B. Warranty Period: Five year extended warranty from date of Substantial Completion as determined by engineer.

C. Manufacturer's warranty period runs concurrently with the Contractor's warranty period. No exception to this provision is allowed.

D. Warrant equipment free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, replace and restore unit(s) to service.

E. The sequence of construction relies upon operation of new influent pumps in various interim configurations. The manufacturer shall provide written confirmation that operation in all interim configurations will not void warranties.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. The Cedar Creek Water Pollution Control Plant Influent Pump Station is a six-pump station, three per wet well. The pump are dry-pit solids handling pumps with extended shafts to an eddy current drive and motor.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide pumps by one of these manufacturers:

1.	Patterson:	F30B
2.	KSB:	Sewatec 700-902
3.	Flygt AC, a Xylem brand:	30 x 24 SSE

B. Subject to compliance with requirements, provide Eddy Current Drives by the following manufacturer:

1. Dynamatic Model SPMV-8240 Vertical Eddy Current Drive
2. Magnadrive 2500 series
3. Or Engineer Approved Equal per Division 00/01 requirements.

C. Subject to compliance with requirements, provide Eddy Current Controller by the following manufacturer:

1. Dynamatic Model EC-2000 HPP digital Controller
2. Magnadrive 2500 series
3. Or Engineer Approved Equal per Division 00/01 requirements.

D. The contract documents are based upon the specific dimensions and operating characteristics of the Patterson pump and Dynamatic eddy current drive specified above. Provision for substitute equipment, therefore, may require partial re-design and modification of associated facilities i.e.: piping arrangements, structural dimensions, etc., which shall be at contractor's own expense and must receive approval by the engineer.

E. A physical model of the system shown on the contract drawings and the Patterson equipment specified herein has been performed

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2.3 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 013300 ”Submittal Procedures” and Section 014000 “Quality Requirements” to design equipment base anchorage.

B. Performance:

1. Standards:

a. ANSI/HI 9.6.1 Rotodynamic Pumps – Guideline for NPSH Margin.
b. ANSI/HI 9.6.3 Rotodynamic Pumps – Guideline for Operating Regions.
c. ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values.
d. ANSI/HI 9.6.8 Rotodynamic Pumps – Guidelines for Dynamics of Pumping Machines.
e. ANSI/HI 14.1-14.2 Rotodynamic Pumps for Nomenclature and Definitions.
f. ANSI/HI 14.3 Rotodynamic Pumps for Design and Application.
g. ANSI/HI 14.6 Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

2. Pumps of Same Service Type: Identical in every respect with all parts interchangeable.
3. Design each pump for design conditions listed herein and for operation within the system head curve envelope as appended.
4. Head – Capacity Performance Curve: Continuously rising from runout to shutoff with no points of inflection at any operational speed for stable operation within the AOR.
5. Operate throughout the specified range within the vibration limitations specified herein.
6. Capable of temporary operation at and near shut off head for 30 seconds maximum, against a closed pump check valve as pump starts and stops under the power of the eddy current drive ramping up and down.
7. Capable of handling temporary backflow during cone valve closure.
8. Design and build pumps, motors, eddy current drives, and vibration and temperature monitoring equipment for 24-hour continuous service at all points within the required range of operation, without overheating, excessive vibration or strain.

C. Anchor Bolts:

1. Pump and motor base(s) to be rigidly and accurately anchored into position, precisely leveled and aligned, so that completed installation is free from stress or distortion.
2. Furnish and install Type 316 stainless steel cast-in anchor bolts installed in sleeves**,** plates, nuts and washers under Section 055000 “Metal Fabrications”.
3. Bolt size, arrangement, embedment, and edge distance conforming to recommendations and instructions of Delegated Design Engineer.

a. Anchor bolt configuration and installation in accordance with API RP 686 and ACI 318-08.
b. Stainless Steel Anchor Bolt Nuts: Monel.
c. Anchor Bolt Threads: Apply anti-seize compound of molybdenum disulfide base such as Molycoat G or approved equal.

4. Foundation rails are an acceptable alternate to anchor bolts. A full design shall be submitted during bid to evaluate.

D. The maximum sound pressure level from one pump/motor when operating on utility power measured 3 feet from the equipment and 5 feet above the floor shall be 93 dBA.

E. When operating at any point on performance curve at any point on the performance curve between shutoff and runout at maximum speed, motor shall not exceed nameplate ratings, nor shall design service factor be reduced.

F. Pumping Unit Design Requirements:

1. Pumped Fluid:

   a. Service: Raw Wastewater.
   b. Specific Gravity: 1.0.
   c. Solids Concentration: 0.5 percent maximum.
   d. Temperature Range: 50 to 90 degrees F.

2. Number of Pumps (total (operating/standby)): 6 (4/2).
3. Location: Cedar Creek Water Pollution Control Plant Influent Pump Station.
4. Service: Raw Wastewater (RWW)
5. Pump Equipment Tag Numbers:

   a. P-1.
   b. P-2.
   c. P-3.
   d. P-4.
   e. P-5.
   f. P-6.

6. Configuration: Vertical long coupled (motor separately supported connected to pump with vertical shafting
7. Maximum Design Pump and Motor Full Load Speed (FLS): 600 rpm.
8. Minimum Motor Speed (rpm as percent of FLS): 60 percent.
9. Maximum Motor Rated Power: 700 HP

   a. Non-overloading at any point on pump characteristic curve.

10. Motor Design Voltage/Phase/Frequency: 4160/3/60.
11. Minimum Suction Connection Size: 30 inches.
12. Minimum Discharge Connection Size: 24 inches.
13. Shutoff Head at Motor FLS Acceptable Range: 95 to 110 feet.
14. Factory Test Acceptance Grade for Secondary Operating Point: 1E.
15. Flow Rate at Secondary Operation Point[1]: 18,000 gpm (26 mgd).
16. Minimum Total Head (TH) at Secondary Flow Rate: 35 feet.
17. Minimum Efficiency at Secondary Flow Rate: 60 percent.
18. Maximum NPSHR at Secondary Flow Rate: 26.8 feet.
19. Design Point Flow Rate: 26,000 gpm (37.5 mgd).
20. Design Point TH: 75 feet.
21. Minimum Efficiency at Design Point Flow Rate: 84 percent.
22. Maximum NPSHR at Design Point: 27.7 feet.
23. Factory Test Acceptance Grade for Design Point: 1U.
24. Best Efficiency Point (BEP) Flow Rate Acceptable Range: 35 to 42 MGD.

25.	Minimum Pump Efficiency at BEP:	84 percent.
26.	Factory Test Acceptance Grade for Tertiary Operating Point:	1E.
27.	Flow Rate at Tertiary Operation Point[2]:	31,000 gpm (44.6 mgd).
28.	Minimum Total Head (TH) at Tertiary Flow Rate:	60 feet.
29.	Minimum Efficiency at Tertiary Flow Rate:	76 percent.
30.	Maximum NPSHR at Tertiary Flow Rate:	27.9 feet.
31.	NPSHA[3]:	32.3 feet.
32.	Minimum Diameter Solid Sphere Passing through Pump:	4.5 inches.

Notes:
[1] The secondary operating point is located on the left side of the pump curve to denote the minimum TH, toward pump shut off. The point is specified at FLS with a required flow rate at the minimum specified TH. The point must be in the pump's AOR.
[2] The tertiary operating point is located on the right side of the pump curve to denote the maximum flow rate per pump. The point is specified at FLS with a required TH at the specified minimum flow rate, limited by speed to not exceed 700HP inclusive of drive losses. The point must be in the pump's AOR.
[3] The NPSHR must not exceed the NPSHA at any point on pump characteristic curve.

G. Eddy Current Drives

1. The eddy current drive (clutch) shall be an adjustable speed general purpose magnetic coupling placed between a motor and a load requiring speed control.
2. The eddy current clutch shall be comprised of a rigid frame, constant speed input drum member and an adjustable speed output member for coupling to the pump shafting. The design of the eddy current clutch shall be such that the drive can be easily disassembled for service with a minimum amount of down time. Removal of the motor from the clutch flange adapter plate shall allow the motor and drum to be lifted from the clutch frame for easy access to the internal pilot bearing and other internal components. Removal of other internal drive components shall be further facilitated by not having to remove the clutch frame. The clutch frame shall be open drip proof design and shall support the vertical motor. It shall provide mounting space for the output support bearing housing, terminal box, lifting lugs, and motor flange adapter. Machine guards/bird screens shall be provided for the clutch enclosure.
3. The adjustable speed output rotor shall be of the salient pole design and shall be mounted within and concentric to the smooth inner surface of the drum. The rotor shall be cast of high permeability steel and shall be machined to insure a uniform precision air gap. The pole windings shall be spool wound for ease of replacement of Class H insulated glass magnet wire and wrapped in a protective tape to ensure protection against moisture. The outer rotor shall be supported and held within accurate clearances by means of grease lubricated internal anti-friction bearings. The internal pilot bearing shall separate the input drum and the rotor. The output bearing support housing shall support the weight of the rotating members and shall be suitable for external thrust loading due to intermediate shafting, pump rotating parts, or hydraulic loading. External thrust loading data shall be verified by the pump manufacturer. All bearings should be capable of being lubricated while the drive is in location, from fittings easily accessible on the clutch frame. The output bearing support housing shall also provide for the mounting of the enclosed slip ring and brush assembly. The brushes and slip rings shall be easily accessible through a removable cover plate on the assembly. Each brush of the dual brush assembly for each slip ring shall be capable of handling the current required by the coils. An internal alnico

type AC generator shall be used to provide the speed feedback signal for the controller and tachometer readout.

4. Output end flange shall be NEMA P base design manufactured to fit on the extended shaft connected to the vertical pump. The motor/drive shall be supported by a sub base furnished by the vendor.
5. The vertical adjustable speed drive and motor shall be fully assembled, balanced, and tested at the factory to ensure satisfactory performance. The motor and clutch shall be shipped, handled and installed as a unit.
6. The Eddy Current drive shall include a factory installed NRR, non-reversing ratchet mechanical device capable of preventing reverse rotation of the pump. The NRR and shall have a rotational resistance capacity capable of resisting the reverse rotation forces equal to both the static and dynamic forces of maximum head pressures.

H. Eddy Current Clutch Controller

1. Input rating of the controller shall be 480 VAC +/- 10%, 60 HZ. Output rating of the controller shall be 200VDC, 48A.
2. The controller hardware shall consist of the logic board, the driver board, the output stage and the keypad display. Circuit boards shall be provided with a conformal coating for protection against moisture/humidity, dust, chemicals and temperature extremes.
3. A door mounted, gasketed, keypad display shall be provided. Pulse signals, tachometers, analog voltages and currents shall all be accommodated by use of the programming keypad display. The keypad display shall have a dual role, as a programmer and process variable display. Up to three process variables shall be able to be displayed simultaneously. The keypad shall be common to all controls to simplify programming and maintenance.
4. SCR Paks shall be mounted separately to simplify testing and maintenance.
5. The control shall use surface mount technology and microprocessor control to provide reliability and accuracy. The programming interface shall be intuitive and allow rapid startup for any application. On board programmable PID control shall allow virtually any process to be quickly stabilized.
6. Configurable inputs and outputs shall allow easy interface with computers and other controls.
7. The Eddy Current Clutch Controller shall be installed in a NEMA 12 ventilated steel enclosure with cooling fan and filtered air intake. Enclosure and cooling capacity shall be designed for continuous operation in 40°C ambient air.
8. Control enclosure shall be provided with the following door mounted features:

    a. LOCAL/REMOTE selector switch;

        1) In LOCAL, the pumps can be started and stopped and the speed can be adjusted from the clutch control panel.
        2) In REMOTE, the pumps can be started and stopped and the speed can be adjusted from an external source

    b. START and STOP pushbuttons for motor start and stop.
    c. Potentiometer for speed adjustment. Potentiometer shall have a grooved circular scale from 0 to 100% speed.
    d. Keypad display
    e. Status indicators shall include separate pilot lights for indication of:

1) Motor On – Red.
2) Motor Off – Green.
3) Clutch On – Red.

f. Speed output shall include two (2) 4-20mA signals for local indication and remote indication of motor speed. Panel meter shall be provided on the MSP LCP enclosure for speed indication.

9. Alternately, the controller can be a self contained actuator unit.

2.4 PUMP CONSTRUCTION

A. General:

1. Provide lifting lugs or safety hoist rings on all major equipment/components.
2. All pump components to be interchangeable in pumps of same size.
3. Provide access for maintenance of all pump components.
4. Criteria:

a. Clog free rotodynamic impeller to handle rags, fibrous material, and high solids concentration.
b. High efficiency, low NPSH, large solids passage.

5. Furnish and install mechanical equipment, including electric motors in accordance with applicable OSHA regulations. Provide guards on all rotating assemblies.

B. Casing:

1. Design:

a. Volute type - Single
b. One piece.
c. End suction.
d. Back pullout.
e. Registered fit to mating components.

2. Material: Cast iron, ASTM A48/A48M or Ductile iron, ASTM A536.
3. End Connections:

a. Flanged.
b. Comply with ASME B16.1, Class 125.
c. Configuration: Tangential side discharge or Centerline discharge.

4. Connections: Gauge, cleanout port, prime, air vent, and drain/flush.

a. Face cleanout port in accessible location as shown on the Drawings.

5. Provide hand-hole in casing for access to casing interior and impeller. Inner contours of hand-hole cover to match contours of casing.

C. Back Head:

1. Same material as casing.
2. Cast separate from casing.
3. Shouldered registered fit to casing.
4. Braced and reinforced to provide support for bearing frame.
5. Connection to casing to provide for back pull-out of rotating assembly without disturbing pipe connections.
6. Stuffing box cast integrally with back head and arranged for mechanical seal, with 3/4-inch drilled/tapped connections for seal water and drain.

D. Suction Head (if required):

1. Same material as casing.
2. Cast separate from casing or integral to casing.
3. Shouldered registered fit to casing (for cast separate casing only).
4. Suction wear ring mounted in suction head.
5. The pump suction nozzle size at impeller eye not less than 24”.
6. Provide minimum 6-inch hand-hole in suction head for access to impeller eye. Inner contours of hand-hole cover to match contours of suction head.

E. Impeller:

1. Design:

   a. Enclosed.

2. Material: CA6NM
3. Keyed to shaft with Type 316 stainless steel locknut.
4. Statically and dynamically balanced after assembly.
5. The design of impeller and the shape of vanes for maximum efficiency and to minimize clogging by rags or similar materials.
6. The impeller will have a maximum of four vanes and pass a minimum 4.5-inch solid.

F. Wear Rings:

1. Replaceable hardened 410 or 440 series stainless steel wear rings on impeller and suction inlet.
2. Oriented normal to axis of rotation.
3. Securely fastened with stainless steel set screws
4. Impeller ring hardened to 300 to 375 Brinell
5. Casing ring hardened to 435 to 500 Brinell

G. Pump Shaft:

1. AISI 4340 alloy steel, 4140, or 420 SS dimensioned for full driver power with safety factor, accurately machined over its entire length.
2. Shaft diameter and bearing span selected to avoid lateral and torsional resonances corresponding to run speed and blade pass frequencies.
3. Keyed at impeller end.
4. Provide renewable stainless steel shaft sleeve extending from the impeller hub through stuffing box.

a. Sleeve of Type 316 stainless steel with 32 micro-mesh inch surface finish.
b. Shaft sleeve internally ground for accurate fit to shaft.
c. Positively secure to shaft to prevent relative rotation using "O" rings, packing, Loctite adhesive sealant, or other means. Shrink fit shaft sleeves not acceptable.

H. Sealing:

1. Mechanical Seals:

a. Split mechanical seal.

1) Manufacturers:

a) Chesterton Model 442C.
b) John Crane Model 3740.
c) No substitutions allowed.

2) Self-aligning, split type, single outside mounted mechanical seal equipped with Silicon Carbide stationary and rotating seal faces with SpiralTrac bushing.
3) Four bolt gland design.

b. Seal/Lubrication Water Control and Monitoring System:

1) Provide seal and bearing lubrication water control and monitoring system for each pump as shown on contract drawings.

a) Configure system in accordance with API Plan 32.

2) System designed to provide a flow range of 0.5 through 5 gpm and pressure of 100 psi per pump, with a 3/4-inch water connection.
3) Pressure and flow to be confirmed by the pump manufacturer.

I. Bearing Frame:

1. Cast iron, ASTM A48 of strength and stiffness to support pump operating loads and external load of motor with rigidity to maintain vibration within specified limits.
2. Designed to allow complete rotating element to be removed from casing without disconnecting piping.
3. Rigidly attached to back-head accurately centered with registered shoulder fit.

J. Bearings:

1. Anti-friction ball or tapered-spherical roller type.
2. Inboard radial-load bearing and outboard radial-thrust bearing.
3. Size to carry all loads imposed under continuous operation without overheating.
4. Minimum L-10 Life at Continuous Maximum Load and Speed: 100,000 hours.
5. Lubrication: Grease.
6. Furnish inboard and outboard bearing retainers, water deflectors, and fittings.

K. Pump Base and Sole Plate:

1. Support vertical pump at required height on fabricated steel base plate or base supports cast integrally with volute for support on sole plate that is anchored to concrete foundation.

    a. Support of size, strength, and rigidity to support the weight and operating force of pump and motor and meet specified pump vibration criteria.

L. Suction Elbow with Spool Piece:

1. Suction elbow of cast iron, (ASTM A48, Class 30 or 35) with epoxy coating; 316 stainless steel; or carbon steel with epoxy coating.
2. Spool piece between suction elbow and pump if necessary per process drawings
3. 150 lb standard ANSI flange of specified size to receive suction pipe, reducing to size pump casing suction flange.
4. Handhole with inside face flush with inside contour of suction elbow.
5. Design suction elbow such that headloss through the elbow does not exceed a K-factor of 0.25. Provide the estimated K-factor for the suction elbow.

M. Ancillary Components:

1. Vaned Flow-Conditioning Spool:

    a. Provide vaned flow-conditioning spool piece meeting the requirements shown in the Physical Modeling Report on the suction of all six pumps and project drawings.
    b. Design and manufacture by company specializing in optimization of flow in pumping systems.
    c. Submit certification of qualifications.
    d. Materials: Type 316L A778 welded stainless steel pipe, Schedule 40S.
    e. Number of Vanes: 6.
    f. Length of Each Vane: 48 inches.
    g. Vane Thickness: 0.375 inches.
    h. Vane Height: 12 inches.
    i. Vane Spacing: 60 degrees.
    j. Vane Profile: 45-deg. upstream profile.
    k. Length of Spool: 66 inches.
    l. Diameter of Spool: 48-inch.
    m. Van Stone flat face rings and back up flanges: ANSI 150-lb, type 316L stainless steel.
    n. Hardware: Type 316 stainless steel.
    o. Finish:

        1) Preparation: Bead Blast.
        2) Picked and passivated.
        3) Completely immerse for a minimum of 15 minutes in 10% nitric acid and 3% hydrofluoric acid at 125 degrees Fahrenheit, followed by a neutralizing rinse.

p. Vaned flow-conditioning spool piece to incorporate a 4-inch drain connection with 4-inch 316 stainless steel ball valve and 4-inch 316 stainless steel quick connect.
q. Vaned flow-conditioning spool piece to incorporate 12-inch diameter handhole clean-out with ANSI bolt circle flange, blind flange, and gasket.
r. Vaned flow-conditioning spool piece to incorporate 2-inch diameter threadolet with 6” stainless nipple and ball valve.
s. Provide a signed and sealed drawing including dimensions, weight, welding requirements, material designations, material thicknesses and flange details for review with pump submittal.
t. Manufacturers: Flow Optimizers or equal.

N. Factory Coatings:

1. All surfaces of all pump components (pump, motor, base, couplings, guards) to receive surface preparation, primer, and finish paint in accordance with pump manufacturer’s standard practice.
2. All exterior and wetted surfaces of the pump to be painted with the manufacturer’s standard epoxy.
3. Color: To be selected by Owner.
4. Pump and motors are not to be field painted.
5. Mating flange surfaces and surfaces to be in contact with the concrete grout do not receive paint.
6. Protect nameplates during painting.

2.5 DRIVER

A. Motor:

1. Comply with Section 400593.13 “Medium Voltage Motor Requirements for Process Equipment”.
2. Power Data:

a. Horsepower as specified herein.
b. 4160 Volt, three phase, 60 Hz.
c. Constant Speed (with eddy current drive).
d. Service Factor: 1.15 (constant speed)
e. Pump power not exceeding motor nameplate rating at 1.0 service factor at any point on pump characteristic curve.
f. Motor nameplate stamped Inverter Duty Rated.
g. Starting Method: Reduced voltage auto transformer.
h. Coordinate with Pumps and pump driving motors.
i. Coordinate power factor correction capacitor in accordance with Section 400593.13.

3. Environmental Data:

a. Load Type: Variable torque.
b. Continuous duty, 40 degrees C ambient, 3300 feet maximum elevation.
c. Space Classification: Unclassified

4. Physical Data:

a. Construction and nameplate: comply with Section 400593.13 “Medium Voltage Motor Requirements for Process Equipment”.
b. Orientation/Mounting: Vertical/P-Base.
c. Speed as specified.
d. Enclosure: WPI.

5. Features and Accessories:

a. Winding Temperature Protection: Resistance Temperature Detectors.
b. Space heaters.
c. Cooling fan.
d. Bearing Temperature Monitors: 3 wire RTDs.
e. Bearing Housing Vibration Sensors: Three sensors mounted to a rigid motor component. One measures X, one measures Y, one measures Z.

6. Lubrication Fittings:

a. Bring fittings to the outside of all equipment so that they are readily accessible without removing covers, plates, housings, or guards, and without creating falling hazards.
b. Buttonhead Type.
c. Mounted together wherever possible.
Pressure grease-lubricated fittings: "Zerk Hydraulic" type or the "Alemite" type. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.

B. Motor Mount:

1. Mount vertical P-Base motor on Eddy Current Drive.

C. Mount vertical motor and eddy current drive on ring base supported by independent foundation above pump.

D. Shafting

1. Manufacturer:

a. Johnson Power Products
b. Watson Spicer
c. Rexnord
d. KTR

2. Solid or hollow shafting of medium carbon steel, supported by independent shaft support bearings.
3. Shafting straight to within 0.001 inch per foot length
4. Each shafting section dynamically balanced including flanges, keys, and bolts.
5. First critical (natural) frequency of shafting to be a minimum of 150 percent above maximum operating speed of driver and pump.
6. U-joint couplings or disc couplings
7. Bottom coupling to pump to provide axial flexibility of shafting.

8. Driver output coupling to shafting fitted with shear-pin hub to allow driver to spin while retaining shaft in place.
9. Provide OSHA compliant galvanized fabricated steel guards for shafting.
10. Shafting joint locations shall be as per Process drawings. No deviation is permitted.

E. Eddy Current Drives:

1. Speed control for variable speed pumps will be Eddy Current Drives
2. Coordinate with pumps and pump driving motors.
3. Include all internal auxiliaries required to meet the functional specifications.
4. Design for a speed range of 60 percent to 100 percent of full load motor speed.

2.6 CONTROLS

A. Refer to control logic in Section 406196 “Process Control Descriptions” for coordination with plant control system.

B. Refer to the P&IDs for I/O signals to plant control system.

2.7 VIBRATION AND TEMPERATURE MONITORING

A. Provide temperature and vibration monitoring accessories with each pump and motor. All detectors, sensors, accelerometers, etc. shall be capable of continuous monitoring, and be completely compatible with the associated temperature and vibration monitoring equipment.

B. Motor stator temperature detectors: six, 100-ohm platinum resistance-type temperature detectors (RTDs) embedded in the stator windings, two per phase, symmetrically installed between stator coils where highest temperature will occur, with leads brought out to a separate terminal box on the motor frame. One set in each phase to be operational and one set spare.

C. Pump and Motor bearing temperature sensors: one per bearing, replaceable, three wire RTDs, having the same resistance as motor stator RTDs, with spring loaded tip, mounted as closely as possible to the outer surface of each bearing with conduit connection head, terminal block, and cabling brought out to a common terminal box.

D. Vibration sensors: Provide integrated electronic piezoelectric accelerometers with 4-20mA communication. Sensors to measure velocity with seismic type transducers that provide output in 0-2 inches/second RMS. Install three sensors for X, Y, and Z axis at motor outboard bearing and two sensors for the X and Y axis at top of pump bearing housing. Sensors shall be Metrix or approved equal. The accelerometers shall be completely compatible with the monitoring equipment specified under Section 407723 “Vibration Monitoring Systems”.

2.8 ACCESSORIES

A. Nameplates:

1. Each major piece of equipment shall be furnished with a stainless-steel nameplate (with embossed data or equivalent) securely mounted to the body of the equipment.

2. Pump Nameplate: At a minimum, include manufacturer's name and model number, serial number, rated flow rate, head, and speed.
3. Motor Nameplate: At a minimum, include manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors.
4. Eddy Current Drive Nameplate: Include manufacturer's name and serial number, input speed, voltage, current and frequency and horsepower at full load.

2.9 FACTORY TESTING:

A. Perform non-witnessed factory hydrostatic test on the pressure-containing components of each pump in accordance with ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests, Appendix B – Hydrostatic Pressure Testing prior to shipment.

1. Test pressure not less than 1.5 times pump shut-off head.

B. Perform witnessed factory performance test for each pump as described in ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests prior to shipment.

1. Pump hydraulic performance acceptance will be based on factory tests.
2. Perform test for flow rate, total head, overall efficiency and input KW to demonstrate each pump meets ANSI/HI 14.6, acceptance grade 1U for specified design point.
3. Perform testing at pump design point speed. Conform to ANSI/HI 14.6 if alternate test speed is required.
4. If pump fails to meet specification requirements, modify pump and retest.
5. Replace pump that cannot be modified to meet specification requirements.
6. Submit raw and adjusted test data and certified pump performance curves, including total head, flow rate, overall efficiency and total brake horsepower for each pump supplied for approval prior to shipment.
7. Submit NPSHR performance data for pump operating at design speed.

    a. NPSHR performance may be based upon historical testing of similar pump. Submit documentation of historical tests.
    b. If historical NPSHR performance data does not exist, test one pump of each size/rating at design point and maximum flow point speed, head, and flow rate to demonstrate NPSHR performance. Submit complete documentation of test results. If witnessed factory test is determined to be required (and noted above), include the following, otherwise delete. Update the number of test days, trips, etc. for project specific requirements.

8. Performance tests to be witnessed by up to five persons designated by Engineer or Owner.

    a. Notify Engineer in writing at least 21 days in advance of scheduled factory testing of each pump.
    b. Include all witness travel and out-of-pocket expenses in Contractor’s bid to be reimbursed by Contractor to Engineer and/or Owner.

c. Expenses include airfare, automobile, lodging, meals, parking, tolls, taxi and car rental costs.

1) Air travel based upon travel from airport closest to Owner's facility to airport closest to test facility.

9. Schedule witness testing to be accomplished in as short time as possible, and in as few trips as possible.

a. During any trip, time gaps between testing sessions not to exceed 24 hours.
b. If more time than 24 hours is required between testing sessions, provide return trip with at least one week gap for travel time, unless other arrangements can be negotiated.
c. Testing may extend through the weekend if testing sessions will run continuously, but not continue through more than one weekend.

10. Should the hydraulic performance of any component require re-testing, reimburse all witness travel and out-of-pocket expenses as defined above.

C. Provide shop inspection and testing of completed assembly.

D. Owner/Engineer Inspection:

1. Owner/Engineer may inspect any equipment to be furnished under this Section prior to shipment from place of manufacture.
2. Owner/Engineer will notify of equipment components to receive inspection.
3. Make completed pump available for inspection at manufacturer's factory prior to packaging for shipment.
4. Notify Owner/Engineer at least seven days before equipment component available for inspection.
5. Make provisions for both in-person and remote attendance of factory inspections. Remote attendance will be via video conferencing.

2.10 DYNAMIC ANALYSIS

A. Design and arrange all connected rotating components of assembled pumping unit mounted on structural foundation to ensure that neither harmful nor damaging structural vibration resonances or internal lateral or torsional vibration resonances occur at frequencies that may become excited by operation within specified range of speeds.

B. Prior to manufacture, submit certification that dynamic vibration analyses outlined herein have been performed and that the specified vibration limitations will be met.

1. Base dynamic vibration analysis on minimum and maximum operating speeds to satisfy the conditions of operation specified above.
2. Dynamic vibration analyses to be performed by one of the following:

a. Mechanical Solutions Inc. (MSI) of Whippany, NJ.
b. Engineering Dynamics Inc. (EDI) of San Antonio, TX.

3. Perform structural dynamic analysis of combined pump/motor/eddy current drive/extended shaft system including pump foundation and piping out to first pipe restraint or expansion joint.

    a. Base analysis on foundation design shown on Drawings. Do not assume foundation is rigid.
    b. Structural dynamic analysis to predict no first or second bending mode frequencies will exist within a pump speed range from 20 percent below minimum operating speed of 75 to 20 percent above maximum operating speed.

4. Perform lateral rotordynamic analysis of the pump rotating system (i.e., motor rotor, motor shaft, shaft couplings, pump shaft, and impeller) to identify and predict that first lateral critical speed will have a separation margin of at least 20 percent above maximum pump speed or 20 percent below minimum pump speed.

    a. If a design modification (i.e., such as changing shaft diameter) cannot resolve a separation margin deficiency or is not practical, perform a forced damped response analysis to demonstrate that pump will function properly over the speed range.

5. Perform torsional rotordynamic analysis of the complete rotating system (motor rotor, motor shaft, shaft couplings, shafting, pump shaft, and impeller) to identify and predict that no torsional natural frequencies occur within a separation margin extending from 25 percent below to 25 percent above specified pump operating speed range, and no natural frequencies occur within +/- 10 percent of 2x times running speed, line frequency, 2x line frequency, vane pass frequency, and VFD control frequencies (if applicable).

    a. If a design modification (i.e., such as a shaft diameter change or different coupling arrangement) cannot resolve a separation margin deficiency or is not practical, perform a forced damped response analysis to show that infinite life will be achieved with a safety factor of at least two.

6. Prepare and submit Campbell diagrams documenting the structural lateral, rotating component lateral, and torsional analysis results, graphically demonstrating separation margins specified above.

C. Pumps to operate throughout AOR with field measured maximum vibration velocity in inches per second RMS for operating speeds greater than 600 rpm and displacement in mils peak-to-peak for operating speeds 600 rpm or less, in conformance with ANSI/HI 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values. In addition, for operation in the POR, at the top of the motor the maximum allowable vibration velocity shall be 0.32 ips RMS and maximum allowable displacement shall be 13.5 mils peak-to-peak. For operation in the AOR, at the top of the motor the maximum allowable vibration velocity shall be 0.42 ips RMS and maximum allowable displacement shall be 15 mils peak-to-peak.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Field verify all pertinent data and dimensions to determine exact location and arrangement for equipment to be installed.

B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

C. Verify layout, orientation and connections.

D. Coordinate with other trades, equipment and systems to the fullest extent possible.

3.2 FIELD QUALITY CONTROL

A. Prior to system startup, submit installation documentation from equipment Manufacturer’s representative attesting that equipment has been properly installed and is ready for startup and testing.

B. Manufacturer Services:

1. In accordance with Sections 014000 “Quality Requirements” and 017900 “Demonstration and Training”.
2. Provide on-site services of manufacturer's representative experienced in installation of equipment provided under this Section.
3. Services include equipment installation, inspection, start-up, field testing and instructing Owner's personnel in operation and maintenance of equipment.
4. Services on-site to meet minimum time requirements listed below. Time requirements do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation. If there are difficulties in start-up or operation of the equipment due to manufacturer's design or fabrication, provide additional service at no additional cost to the Owner.
5. Installation/Inspection:

    a. 2 days per pump.
    b. Inspect grouting, location of anchor bolts, setting, leveling, grouting, alignment of pump with driver, field erection, connection of piping, electrical and miscellaneous utility connections.

6. Startup/Testing:

    a. 1 day per pump.
    b. Place equipment into operation and make necessary adjustments.
    c. Complete functional and performance testing.

7. Operation and Maintenance Instruction:

    a. 2 days.
    b. Instruct representatives of the Owner on proper operation and maintenance. Provide training agenda and utilize approved O&M manuals.

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3.3 INSTALLATION

A. Install pumping units as shown and according to Manufacturer's instructions.

B. Install pumping units in accordance with Manufacturer's setting plans on concrete foundation at elevation to align with piping as shown.

1. Set pump and motor base(s) into final position supported on temporary supports and jack bolts. The use of leveling nuts and shims is prohibited.
2. Grout pump and motor base(s) utilizing expansive, non-shrink, low exothermic epoxy grout system applied according to grout manufacturer's directions to thickness recommended by pump Manufacturer.

    a. Prior to grouting, chip concrete surface to be in contact with grout to present a slightly rough surface and remove laitance. Clean surface of all dust, moisture and oil.
    b. Place a 1 inch minimum diameter by 0.25 inch thick stainless-steel disk, with full radiused edges at each jack bolt contact point bearing on a thin layer of leveling grout.
    c. Grouting to be performed under supervision of Manufacturer's representative

3. Upon completion of grouting, back off jack bolts, and repair edges to present a smooth finish.

    a. Remove and clean jack bolts, coat with grease, and reinsert in jack bolt holes with lock nut to loose fit to bottom of hole.

4. Tighten anchor bolts to torque levels as recommended by Manufacturer.

C. Accurately align piping with pump flanges, without bending and/or twisting, imposing no external loading on the pump. Perform connection piping to pumps in presence of Engineer.

D. Provide and connect power and control conduit and wiring to make system operational and ready for startup.

E. Provide lubricants in accordance with Manufacturer's recommendations.

F. Flush piping with clean water.

G. Make system operational and ready for startup.

3.4 INSPECTION AND TESTING

A. Prior to operating system or components, perform the following:

1. Check pump and motor alignment.
2. Check for proper motor rotation.
3. Check pump and drive units for proper lubrication.
4. Confirm receipt and initial review of first draft copies of all Operation and Maintenance manuals for the pumps and associated system components.

B. Startup and Performance Testing: Upon completion of installation, perform a sequence of inspection, check-out and testing of each pump to assure that all components and systems operate as required. Testing to culminate in a final acceptance test to show full compliance with this Section. Manufacturer's representatives to assist, confirm procedures, participate in inspections, and advise as to interpretation of testing requirements. Testing phases shall consist of the following in sequence:

1. Physical Checkout to include physically inspecting each product or system component individually following installation in the Work to determine that components have been installed as specified and are ready for field and functional testing. Checkout to be in accordance with manufacturer's recommendations and include at a minimum as follows:

    a. Apply electric power to individual components to determine continuity of power supply and signal systems.
    b. Perform pressure and leakage testing of all pressure connections.
    c. Perform dry running tests where possible to confirm rotation and function. Perform a bump test of the motor to verify rotation.
    d. Rotate pump and motor components manually to assure free rotation without evidence of binding.
    e. Verify all bearings are correctly lubricated.
    f. Verify construction is in accordance with approved manufacturer's drawings, and that equipment and all auxiliaries are ready for operation.
    g. Verify that all monitoring, alarm, and shut-down devices function at correct set point and sequence.
    h. Perform preliminary tests of the bearing monitoring system furnished under this Section.
    i. Perform all inspections specified in Section 400593.13 "Medium Voltage Motor Requirements for Process Equipment".

2. Field Testing: Once flow can be allowed through the pumps, perform field tests by operating each pump individually to make all corrections and adjustments required for initial operation. Operate each pump in manual control and simulated remote automatic control, utilizing local control panel.

    a. Submit written test procedures 30 days prior to testing, including a sample test data log sheet.
    b. Upon completion of testing, submit a written report tabulating equipment tested, test results, problems encountered and corrective action to be taken within two weeks after test completion.
    c. Following start-up operation, conduct performance test of each pump including motors, couplings, shafting, and eddy current drives to demonstrate equipment generally conforms to specified operating conditions. Factory testing specified above will be the basis of performance acceptance. If pump performance does not generally agree with factory test results, perform corrective measures or remove and replace with a pump that satisfies specified conditions.

        1) Obtain pressure readings (or wet well level readings) from installed or Contractor furnished pressure gauges and level monitors. Install tapped holes in pipes for pressure gauges if no usable taps available.
        2) Obtain flow readings from installed flow meter, timed fill and draw, or Contractor provided temporary flow meter.

3) Utilize metering equipment located in motor controls or hand-held to obtain motor power draw.
4) Provide a portable tachometer to obtain pump speed.

d. Continuously monitor pump operation to verify pump operates without vibration, jamming, leakage or overheating and to perform specified functions.
e. Simulate operation as close as possible to design point and other specified operating points.

1) For variable speed application, confirm pump performance at three reduced speeds corresponding to: 75 percent**,** 50 percent, and 25 percent of design point flow, unless otherwise defined herein. Period of operation at Engineer's discretion.

f. Record data on approved log sheets at 15 minute intervals. Include at least suction and discharge gauge readings, flow, pump speed, wet well level, power supply voltage and amperage, power, power factor, and all other information necessary to calculate pump performance characteristics.
g. Verify that primary monitoring devices (vibration and temperature) are transmitting information to their receivers. Simulate alarm conditions as possible to verify that alarms will function. Make final adjustments necessary to place equipment in satisfactory working order.
h. Perform a preliminary vibration test on each pump utilizing a hand-held vibration detector, to verify that overall vibration velocity and displacement is within the acceptance criteria of ANSI/HI 9.6.4. Measure horizontal, vertical, and axial vibration at upper portion of pump bearing housing and at both motor bearing housings. Record preliminary vibration readings.

i. Vibration Signature Test:

1) Upon completion of startup and performance testing, retain an independent mechanical testing and analysis firm staff member with a minimum level III qualified vibration technician as defined by Vibration Institute or equivalent to perform a detailed vibration signature analysis of each pump and motor in accordance with ANSI/HI 9.6.4:

a) Mechanical Solutions Inc. (MSI) Whippany, NJ.
b) Engineering Dynamics Inc. (EDI), San Antonio, TX.
c) Pre-Approved Equal.

2) Perform a detailed X-Y-Z vibration signature analysis of each pump and motor.
3) Perform experimental modal analysis to identify potential resonant frequencies.
4) Operate each pump at full speed, lowest speed, and at a maximum 5 percent increments between minimum and full speed. Select speed(s) corresponding to potential vibration conditions if any exist.
5) Measure horizontal, vertical, and axial vibration at upper portion of pump bearing housing and both motor bearing housings.

6) Prepare and submit a written report including a sketch of the pump, indicating thereon where and the direction in which the vibration signatures were taken and recorded.
7) Report vibration profiles as plots of vibration spectra showing displacement and velocity versus frequency.
8) Demonstrate compliance with specified overall vibration velocity and displacement allowable values for pump in accordance with ANSI/HI 9.6.4 and for motor in accordance with allowable values listed above.
9) Demonstrate there are no field installed resonant conditions caused by misalignment, foundation or connecting piping and pipe supports when operating at any speed within the specified operating range including a 10 percent separation margin above the maximum pump speed and 10 percent separation margin below the minimum pump speed.
10) Prepare and submit a written report including the following:

    a) Sketch of pumps and motors indicating location and direction of vibration measurements.
    b) For each test point: (a) peak to peak displacement, in mils, (b) frequency, (c) peak filtered velocity level in inches per second, (d) overall velocity level in inches per second RMS.
    c) A complete analysis of findings, any issues encountered, probable causes, and specific recommendations for corrective actions.

11) If pump system is furnished with vibration and temperature monitoring system, use measurements obtained from temporary surface mounted vibration sensors mounted in vicinity of installed sensors to confirm accuracy of permanently installed system.

3. Functional Test: Perform in conjunction with testing of control systems.

    a. Operate each pump under remote automatic control based upon level monitoring system and control, operating each pump as lead pump.
    b. Obtain plant data recorder records throughout duration of test of wet well level and flow rate, and any additional information pertinent to operating protocol of pumping system.
    c. Submit final test results demonstrating proper control of pumps to maintain level. Test duration to be 24 hours.

4. Acceptance Test: Final stage of testing to demonstrate pumping system functions fully automatically as specified.

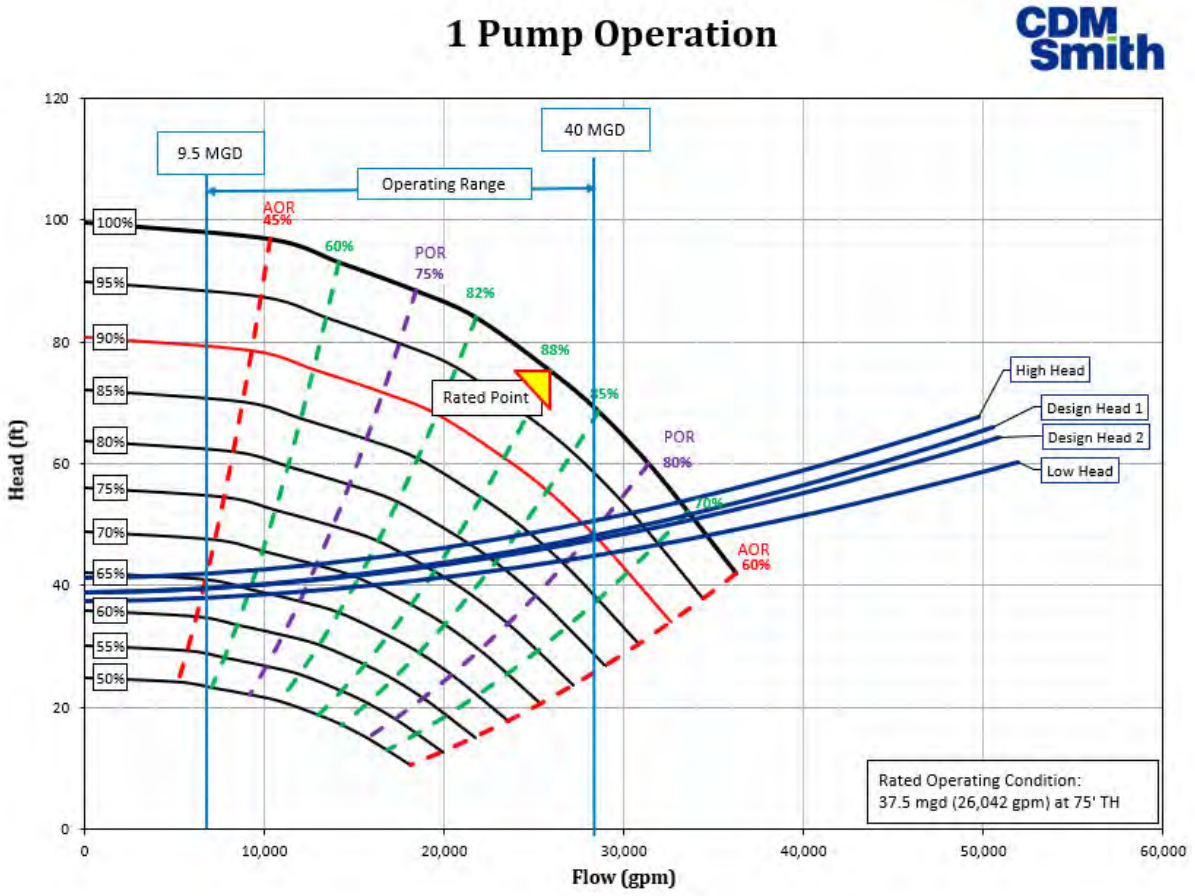
    a. Demonstrate equipment is properly installed, connected, and aligned, is free of damage and mechanical defects, and operates without overheating, vibration, noise, or overloading.
    b. Duration of test an elapsed time of fourteen days, operating as continuously as possible, switching the lead pump daily.
    c. Should any pump fail during the acceptance test, perform repairs/adjustments and initiate a new acceptance period.

C. Equipment Acceptance:

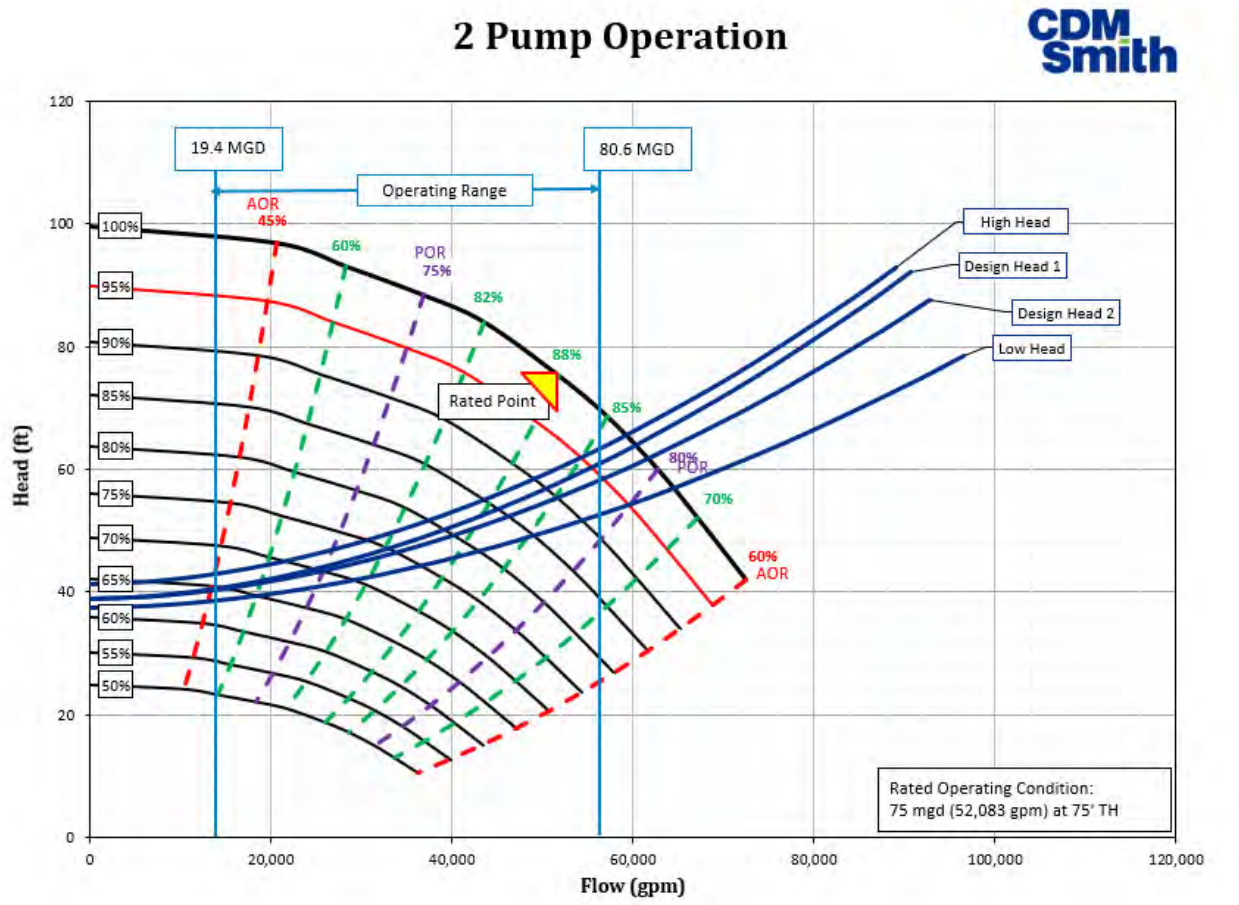
1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.
3. If any equipment fails to fulfill the specified performance, perform corrective measures and retest or replace to assure full compliance with Specifications.
4. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 ATTACHMENTS

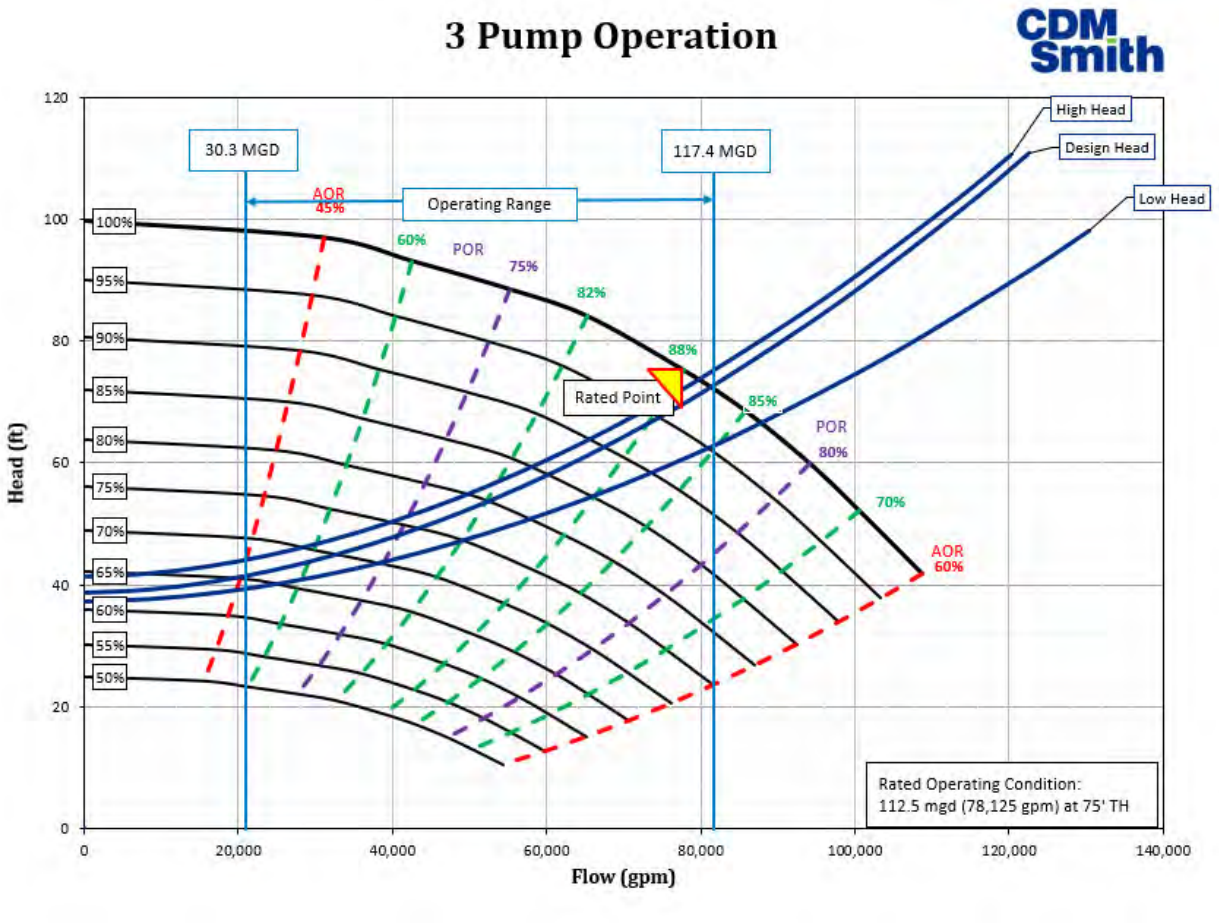
A. Single Pump Operation through one force main



B. Two Pump Operation through one force main



C. Three Pump Operation through one force main



END OF SECTION 432341

Appendix A Valve Pre-Purchase Contract/Proposal

DRAFT

Request for Proposal (RFP)

Valve Procurement for the Cedar Creek Water Pollution Control Plant (WPCP)

Influent Pumping System Project

Introduction

Nassau County, New York (County) is currently seeking proposals from qualified manufacturers and entities authorized to do business in the State of New York, to provide twenty-three (23) valves to the County's Department of Public Works. The services include but are not limited to, development of fabrication shop drawings, O&M manuals, fabrication, testing, extended warranty, delivery, and commissioning coordination with the installing contractor as described herein, to the Cedar Creek WPCP.

The purpose of this proposal is to pre-purchase the valves that are critical to the functionality of the Influent Pump Station and that have the potential for long delivery times. The pre-purchase will reduce contractor risk and potential for delay of the Cedar Creek WPCP Influent Pump Station Improvements project.

Anticipated Proposal Schedule

RFP Issue Date: ……TBD
Proposal Conference: …… TBD
Deadline for Questions: ……TBD
Proposal Due Date: …… TBD

Dates indicated above are subject to change at the sole discretion of the County.

THE PROPOSER SHOULD PROVIDE A PROPOSAL THAT MEETS THE SCOPE REQUIREMENTS SET FORWARD HEREIN. THE COUNTY WILL REVIEW SINGLE OR MULTIPLE PROPOSALS FROM AN ENTITY.

Scope of Services

The Scope of Services (Scope) outlined herein has been established for the purpose of procurement of twenty-three (23) valves for installation by others under the Influent Pump Station Improvement Contract. During design development of the Influent Pump Stations Improvements Contract, it was determined that several pieces of equipment have long procurement timelines. These long timelines may have the potential to interfere with the estimated construction sequence and schedule, and thus have been recommended for purchase directly by Nassau County DPW.

The proposer shall present the cost for the shop drawing development, fabrication, factory testing, O&M manuals, delivery, commissioning coordination with the installing contractor, and extended warranty for fifteen (15) knife gate valves with electric actuators, and eight (8) resilient wedge gate valves with electric actuators, stem extensions, and supports for installation under a separate contract. The schedule of valves is included in the Construction Contract Documents. The proposer shall submit fabrication shop drawings and O&M manuals for review and approval by the County and its Engineer. The proposer shall assume up to three rounds of comments on the fabrication shop drawings and O&M manuals.

DRAFT

The valves shall be delivered to the Cedar Creek WPCP located at 3340 Merrick Road, Wantagh, NY 11793.

The valves will be offloaded for long term storage by the Owner or its designee. The Owner and installing Contractor will be responsible for storage prior to installation. The proposer shall identify the long term storage requirements for the valves, including but not limited to, temperature control requirements, power, or frequency of exercising the valves. The valves may be in storage for up to four (4) years depending on the approved construction sequence from the installation Contractor.

The included specifications and plans are to be used to pre-qualify and purchase a total of twenty-three (23) electrically actuated valves of various sizes for installation by others in order to meet project construction deadlines. For purposes of this pre-purchase agreement, language that states (Contractor" shall be determined to mean "Proposer".

Contract Term

It is the intent to award the contract for a 55-month period. The shop drawing review and procurement phase is anticipated to be twelve (12) months, including four (4) months for fabrication shop drawing development through approval from the Engine (with up to three review cycles), followed by a fabrication duration anticipated to be eight (8) months.

Compensation for the scope of services shall be on the basis of lump sum.

At any time during the term of this Agreement, the County may, in its sole discretion, require the Proposer to perform Extra Services. The Proposer shall not perform, nor be compensated for, Extra Services without the prior written approval of the Commissioner or his or her duly designated deputy.

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Appendix B Verdantas Flow Labs Physical Hydraulic Model Study

NASSAU COUNTY, NEW YORK

CEDAR CREEK WATER POLLUTION CONTROL PLANT

PHYSICAL HYDRAULIC MODEL STUDY

Final Report

Conducted For

CDM Smith

Verdantas Flow Labs Report No. 1268-26

verdantas | Flow Labs

NASSAU COUNTY, NEW YORK

CEDAR CREEK WATER POLLUTION CONTROL PLANT

PHYSICAL HYDRAULIC MODEL STUDY

Final Report

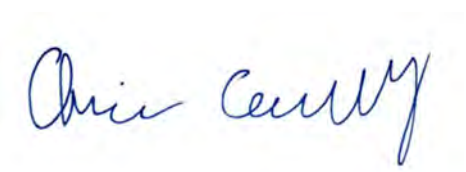
Conducted For

CDM Smith

Verdantas Flow Labs Report No. 1268-26

June 2026

Prepared by:



Chris Carley
Project Engineer

Approved by:



Matthew Havice., P.E.
Principal Engineer

EXECUTIVE SUMMARY

A physical model study of the Cedar Creek WWTP Influent Pump System was conducted. A 1:6.85 scale model was constructed, and tests were conducted to determine the nature and severity of any adverse hydraulic conditions that may affect pump or cleaning performance.

Baseline testing indicated that the trough baffles installed in each wet well were effective at eliminating air entrainment into the pumps across all operating conditions. Given the orientation of the trough baffle openings, however, concentrated influent flow did not re-distribute vertically downwards. This resulted in overall vertical circulation within the wet well and unstable conditions entering the pumps. This instability was more pronounced with more pumps in operation but as pumps were taken offline conditions improved. The more stable conditions within the wet well allowed for organized surface vortices to form. These vortices were infrequent but intermittently organized into a well-organized, air entraining vortex that entered into each pump. Conditions entering the suction piping remained unstable. Frequent flow oscillations and wrapping were observed in the horizontal suction piping approaching the reducing elbows. Once through the elbows, conditions remained unstable passed the pump suction flange. Overall, pre-swirl was elevated and unstable with frequent stalling and burst swirl observed in each operating conditions.

A series of six (6) flow straightening vanes were installed in the suction piping supplying each pump and were effective at stabilizing flow at the pump suction flange. With vanes installed, strong surface vortex activity was still observed. A series of four (4) horizontal beams were installed in the wet well and were effective at eliminating all surface vortex activity and stabilized overall conditions within the wet well. With modifications installed, pre-swirl was low and stable. Velocity and turbulence variations were within criteria across the full range of expected operating conditions. Additional testing was conducted with the plant drain extended to El. (-) 21.30 ft in the wet well and was in operation at 14.16 MGD. Flow entered the wet well under the water surface, which prevented air entrainment and surface oscillations from occurring. Additionally, there was no change to approach conditions with the plant drain in operation, and stable conditions were observed at the pump suction flange. Given the orientation of the horizontal beam installed above Pump 3, extending the plant drain down resulted in interference between the beam and the piping. Removing this beam allowed for surface vortices to organize while operating Pump 3 at a runout flow. The horizontal beam was re-installed in a revised location which eliminated the surface vortex. The revised beam locations remained effective at eliminating surface vortex formation for all remaining conditions. Additional testing was conducted with a 48-in x 36-in reducing elbow and a 36-in x 30-in reducer positioned after the elbow for Pump 1. The additional testing showed similar results to previous testing, with pre-swirl low and stable and velocity and turbulence variations within HI criteria.

It is recommended that flow straightening vanes be installed in the suction piping supplying the pumps. A series of four (4) horizontal beams should be installed in each wet well. The plant drain should be extended to El. (-) 21.30 ft. The recommended modifications can be seen in Figures 5-1 through 5-2.

1.0 INTRODUCTION 1-1
1.1 Draft Final Report (Rev. 1) Comments..... **Error! Bookmark not defined.**
1.2 Additional Testing and Draft Report Comments..... **Error! Bookmark not defined.**
1.3 Background 1-1
1.4 Objectives 1-1
1.5 Sump Hydraulics & Pump Problems 1-1
2.0 MODEL SCALING AND ACCEPTANCE CRITERIA 2-1
2.1 Model Scaling 2-1
2.2 Acceptance Criteria 2-3
3.0 THE MODEL 3-1
3.1 Model Boundaries 3-1
3.2 Model Construction 3-1
4.0 INSTRUMENTATION AND TESTING PROCEDURES 4-10
4.1 Instrumentation and Data Collection 4-10
4.2 Test Program 4-10
5.0 TEST RESULTS 5-1
5.1 Baseline Testing 5-1
5.2 Modification Testing 5-10
5.3 Witness Testing 5-21
5.4 Final Documentation Testing 5-21
6.0 INITIAL CONCLUSIONS & RECOMMENDATIONS 6-1
6.1 Conclusions 6-1
6.2 Recommendations 6-1
7.0 REFERENCES 7-1

Figure 2-1 Vortex Classification 2-4
Figure 3-1 Model Details – Overview 3-2
Figure 3-2 Model Details – Model Layout 3-3
Figure 3-3 Model Section Details – Section A 3-4
Figure 3-4 Model Section Details – Section B 3-5
Figure 5-1 Modification Details – Overview Figure 5-2 Modification Details – Vanes with Original Reduction 5-18
Figure 5-3 Modification Details – Vanes with New Reduction 5-20

Photo 3-1 Model Overview 3-6
Photo 3-2 Model Trough Openings 3-6
Photo 3-3 Model Wet Well 3-7
Photo 3-4 Model Plant Drain 3-7
Photo 3-5 Model Suction Piping 3-8
Photo 3-6 Model Pumps 3-8
Photo 3-7 Model Detailed Pump 3-9
Photo 5-1 Unstable Conditions Within Wet Well 5-7
Photo 5-2 Horizontal Flow Past Pump Suction Flare 5-7
Photo 5-3 Surface Dimple/Surface Vortex 5-8
Photo 5-4 Flow Drift in Suction Piping 5-8
Photo 5-5 Flow Drift at Pump Suction Flange 5-9
Photo 5-6 Horizontal Beams Installed 5-16

Photo 5-7 Flow Straightening Vanes Installed 5-16
Photo 5-8 Plant Drain Extension 5-17
Photo 5-9 Revised Beam Locations 5-17

Table 5-1 Baseline Data Summary 5-2
Table 5-2 Summary of Modification Tests 5-11
Table 5-3 Summary Final Documentation Testing 5-22

1.0 INTRODUCTION

1.1 Background

Verdantas Flow Labs is conducting a physical hydraulic model study of the Nassau County – Cedar Creek Influent Pump Station. The intake currently houses three 60-mgd pumps, two 30-mgd pumps, a single 12-mgd pump, and a single 4-mgd pump. The pumps are housed within two identical rectangular wet-wells that are each supplied via 84-in influent pipes. Currently there is no interconnectivity between the wet-wells; however, one of the larger 60-mgd pumps is capable of taking flow from both wet-wells. The proposed upgrades involve removing all existing pumps and installing six new pumps, each rated at 37.5 MGD. The new extended shaft pumps will utilize some of the existing suction piping that is currently in place. The new orientation will have three pumps on each side of the wet well with a new wet well interconnect line to connect the two wet wells.

The model was used to evaluate the hydraulic conditions within the intake and to determine any adverse hydraulic phenomena that may exist within the intake. In addition, the model was used to develop recommended modifications to remediate any adverse hydraulic phenomena, which could impact pump performance.

1.2 Objectives

The objectives of this model study were as follows:

- Evaluate the performance of the intake structure to determine if any potential problems may exist with the approach flow hydraulics that may adversely impact the performance of the pumps.

- If necessary, develop modifications to the design or implement corrective measures that would mitigate or eliminate problems associated with the adverse approach flow.

- Test and document the approach flow conditions in the sump with the final recommended modifications in place.

1.3 Sump Hydraulics & Pump Problems

The pump manufacturer typically develops pump curves at the manufacturing facility. The head-flow curves, efficiencies, net positive suction head, and power requirements are usually determined by conducting a pump test with the actual prototype pump or a geometrically similar model. This pump test is conducted in a controlled environment with uniform approach flow to the pumps. Therefore, to ensure that the pump will perform as tested at the manufacturing facility; the prototype field installation must also have similarly uniform approach flow conditions.

Failure to provide uniform approach flow hydraulics can result in pump performance that differs significantly from that predicted from the performance curves. The pump may not operate at its best efficiency point, flow or head may be less than expected, power requirements may vary, and if the approach flow conditions vary enough, significant damage could occur to the pump itself.

Pump intakes are often designed to adhere to the 2024 Hydraulic Institute Standards (ANSI HI 9.8-2024). A consortium of pump manufacturers, engineers, and end users developed these standards. Failure to adhere to these standards can lead to a number of problems including air entrainment, vortex activity, skewed velocity distributions and turbulence at the pump impeller. Research has shown that these conditions can lead to fluctuating loading on pump impellers, vibration, cavitation, and decreased flow and efficiency (Sweeney and Rockwell 1982).

Following the HI standards helps to minimize adverse approach flow conditions within the pump sump. However, the standards were developed for pumps with individual capacities of 40,000 gallons per minute (gpm) or less for vertical pumps, 20,000 gpm or less in trench type wet wells, 7,000 gpm or less for "can" pumps and 5,000 gpm or less for pumps in circular wet wells. When dealing with pumps that exceed these capacities, or overall station capacities in excess of 100,000 gpm, it is necessary to utilize physical and numerical modeling techniques to investigate the hydraulic conditions within the sump.

Physical models are used to evaluate the level of temporal velocity fluctuations, or turbulence, within the pump bell. Changes in pressure are directly related to changes in velocity. Therefore, velocity fluctuations, whether temporal, or as a result of skewed approach flow, can cause pressure fluctuations on the pump impeller. These pressure fluctuations translate into a loading imbalance on the pump shaft, possibly causing vibration or pre-mature bearing wear.

Physical models are also used to evaluate the uniformity of the flow within the pump bell. Should more flow be traveling down one side of a pump bay than the other, such as that which occurs when there is flow separation at the bay entrance, the velocity may be higher on one side of the impeller or the other. This may cause pre-swirl of the flow entering the pump. Depending on the direction of the pre-swirl relative to the pump rotation, this may cause the pump to consume more or less power than anticipated, resulting in the pump operating at a point other than its best efficiency. The pre-swirl may also result in the flow hitting the impeller blade at an angle of attack other than what it was designed for. This can result in localized flow separation on the impeller. These separation zones can cause low-pressure regions, which result in localized areas of cavitation.

Vortices are another hydraulic phenomenon with which physical models are used to identify and eradicate. Vortices are localized regions of high velocity swirling flow. The velocity at the core of a vortex can be high enough that the pressure falls below the vapor pressure of the fluid. If the vortex forms below the surface, it is called a submerged vortex and can result in vapor being pulled out of suspension. If it forms as a surface vortex, it can pull a vapor core into the pump. Either of these vortices can result in air entrainment or cavitation within the pump. Depending on the system, this entrained air may be able to accumulate within the downstream piping network, possibly causing damage to other system components. The low-pressure core of a vortex can also lead to localized cavitation, noise, decreased pump capacity, and vibration.

Numerical modeling of pump sumps is a relatively new approach to investigating wet-well hydraulics. The ability of numerical models to predict the general flow patterns within the sump is constantly improving. However, numerically modeling highly mobile surface vortices presents a challenge. Research is constantly being conducted to improve the ability to numerically predict mobile vortex activity. However, at the present, physical models remain the only method available to reliably simulate mobile prototype vortex activity.

2.0 MODEL SCALING AND ACCEPTANCE CRITERIA

2.1 Model Scaling

To obtain accurate results from a physical model study, there must be dynamic similitude between the model and the prototype. To satisfy this requirement, there must be exact geometric similitude. In addition, the ratio of the dynamic pressures must also be maintained. Strictly satisfying dynamic similitude requires a 1:1 scale model. This is usually not feasible, so some compromise is made. To accomplish this, geometric similarity is maintained, and the dominant forces associated with the prototype are determined and maintained between the model and prototype.

The primary forces that affect fluid flow are viscosity, surface tension, velocity (inertial), pressure, gravity and elastic forces. In structures with a free surface, such as a pump intake, gravitational and inertial forces are far greater than the viscous and turbulent shear forces. Therefore, when modeling free surface structures, geometric similarity and the ratio of inertial to gravitational forces, or the Froude number, is maintained between the model and prototype.

Simply holding the Froude number constant violates the strict definition of dynamic similitude. However, if the model is operated within a high enough range of Reynolds numbers, viscous and surface tension scale effects may be minimized. The 2024 ANSI-9.8 Hydraulic Institute Standards recommends that the minimum Reynolds number at the pump inlet be greater than 6×10^4. Therefore, when choosing the model scale, it is necessary to ensure that the scaled flow rate will result in a high enough Reynolds number to minimize scale effects. It is common to be conservative and select a scale that results in a Reynolds number closer to 1×10^5.

Upon selecting an appropriate model or length scale, it is possible to determine relationships such as velocity, flow, and pressure between the model and prototype. This is accomplished by setting the model and prototype governing equations equal to one another. As mentioned above, the governing equation is determined by evaluating the dominating forces. These equations are typically dimensionless numbers such as the Froude, Reynolds, Weber, Euler, or Mach numbers. These common modeling relationships are shown below:

$$\textit{Froude Number} \qquad F = \frac{U}{\sqrt{gL}} = \frac{\textit{Inertial Force}}{\textit{Gravity Force}} \tag{2-1}$$

$$\textit{Reynolds Number} \qquad Re = \frac{UL}{\nu} = \frac{\textit{Inertial Force}}{\textit{Viscous Force}} \tag{2-2}$$

$$\textit{Euler Number} \qquad E = \frac{\rho U^2}{\Delta P} = \frac{\textit{Inertial Force}}{\textit{Pressure Force}} \tag{2-3}$$

$$\textit{Weber Number} \quad W = \frac{U}{\sqrt{\sigma/\rho L}} = \frac{\textit{Inertial Force}}{\textit{Surface Tension Force}} \tag{2-4}$$

$$\textit{Mach Number} \quad M = \frac{U}{\sqrt{K/\rho}} = \frac{\textit{Inertial Force}}{\textit{Compressive Force}} \tag{2-5}$$

Where:

U = characteristic velocity
g = gravitational constant
L = characteristic length
ρ = fluid density
ΔP = pressure difference
ν = kinematic viscosity of the fluid
σ = surface tension of the fluid
K = bulk modulus of elasticity of the fluid

If the governing equation is held constant between the model and prototype, the corresponding model flow rate, velocity, pressure, etc., can be solved directly. For example, setting the Froude number of the model equal to the prototype yields the following relationships, where the subscripts *p* & *m* denote prototype & model, respectively:

$$F_P = F_m \tag{2-6}$$

$$\frac{U_p}{\sqrt{gL_p}} = \frac{U_m}{\sqrt{gL_m}} \tag{2-7}$$

Using equation 2-7, the model velocity, and therefore, the flow rate Q can be solved for if the prototype velocity and length ratio is known. Typically, the model parameters are solved for based on the prototype to model length ratio, L_P/L_M, or L_R. Doing so yields the following equations for Q & U:

$$\frac{Q_p}{Q_m} = \mathrm{L}_\mathrm{R}^{5/2} \tag{2-8}$$

$$\frac{U_P}{U_M} = \sqrt{\mathrm{L}_\mathrm{R}} \tag{2-9}$$

Using these equations, it is possible to determine the flow rates at which the model should be operated. The Cedar Creek WWTP was constructed at a 1:6.85 scale. The Reynolds number at the

pump suction flare when operating at 37.5 MGD, is on the order of 1.0×10^5 with a resulting Weber number of approximately 700. All values exceed Hydraulic Institute scaling criteria.

2.2 Acceptance Criteria

In addition to choosing an appropriate scale with which to construct the model, it is important to evaluate the performance of the model against a set of pre-determined acceptance criteria. The criteria used for this model study closely follow those suggested in the 2024 Hydraulic Institute Standards and are as follows:

- No organized free surface or submerged vortices greater than a Type 1 (general rotation) should be permitted at Froude scaled flow rates. The HI standards suggest that a Type 3 vortex may be allowed to enter the pump if it occurs infrequently, such as less than 10-percent of the time; however, it is the goal of this study to eliminate any vortex greater than a Type 1. (note: these are based on Figure 2-1 below)

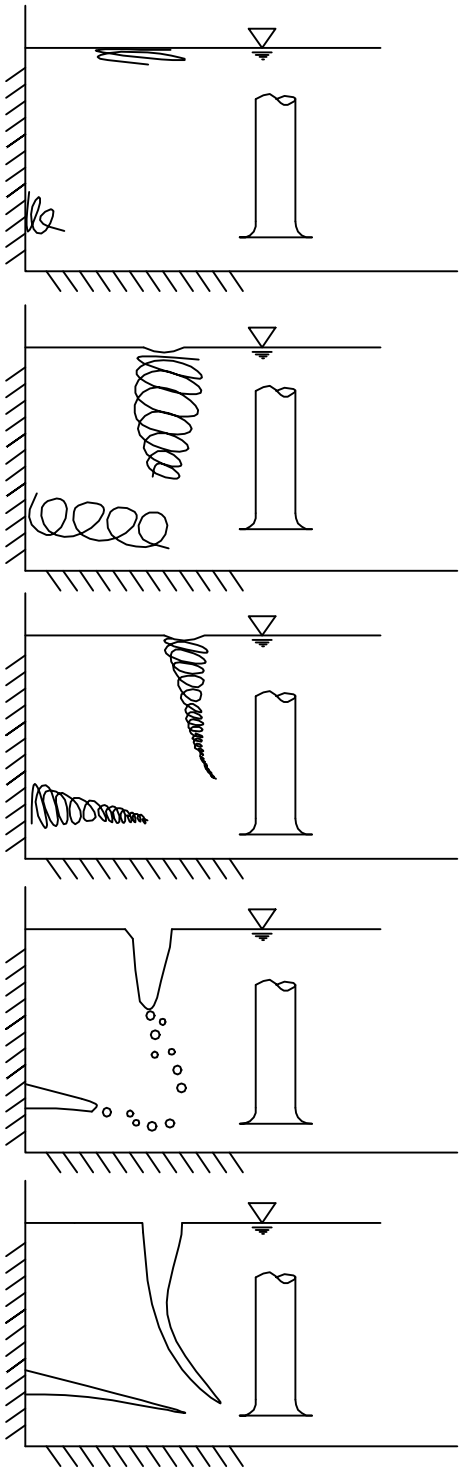
- Pre-swirl should be less than 5-degrees at the pump impeller location

- Time averaged velocities within the pump throat should not deviate more than 10 percent of the cross-sectional area average velocity.

- Time-varying velocity fluctuations (turbulence) at a point within the pump throat should be less than 10 percent.

Vortex activity is evaluated qualitatively. The Hydraulic Institute Standards suggest using a scale of 1 to 6 to rank the severity of a vortex. A scale of 1 to 5 was utilized for this study, with a Type 1 being the least severe and a Type 5 being the most severe, pulling air and trash into the intake. HI varies slightly by ranking a vortex that pulls trash into the intake as a Type 5 and one that pulls air as a Type 6. However, since the acceptance criteria do not permit vortices greater than a Type 1, this variation of the HI scale does not have any effect on the outcome of the model study. Figure 2-1 presents a graphical representation of the vortex ranking used in this study.

FIGURE 2-1
SURFACE & SUB-SURFACE VORTEX CLASSIFICATION



TYPE 1
SURFACE OR SUBSURFACE SWIRL

TYPE 2
SURFACE OR SUBSURFACE DIMPLE
COHERENT SWIRL

TYPE 3
ORGANIZED DYE CORE TO THE INTAKE
COHERENT SWIRL THROUGHOUT WATER COLUMN

TYPE 4
COHERENT SWIRL AND ORGANIZED DYE CORE
PULLING BUBBLES AND SOME AIR INTO THE INTAKE

TYPE 5
COHERENT SWIRL AND SOLID AIR/VAPOR CORE PULLING DEBRIS AND AIR INTO THE INTAKE

3.0 THE MODEL

3.1 Model Boundaries

When evaluating the portions of the pump station that are to be included in the model, it is necessary to include any components that could affect the approach flow to the pumps. This is first determined by evaluating the upstream and downstream controls. In this application, an upstream hydraulic control is a structure or component that controls the downstream flow. This may be a change in grade that results in critical flow, a sluice gate or opening that directs the flow, or simply a long stretch that results in uniform flow conditions.

The Cedar Creek WWTP receives flow via two (2) 84-in influent pipes. A portion of the length of these influent pipes were included in the model and served as the upstream model boundary. The pump intake consists of two wet wells that are connected via a interconnect line. There are six (6) pumps in total, with each wet well housing three (3) pumps. The full internal geometry of one wet well was included in the model and simulated in detail. In addition, three (3) pumps were included in the model and simulated in detail. The remaining pumps were not modeled in detail but were simulated through withdrawn flow only to simulate accurate crossflow into and out of the adjacent wet-well (simulated in detail).

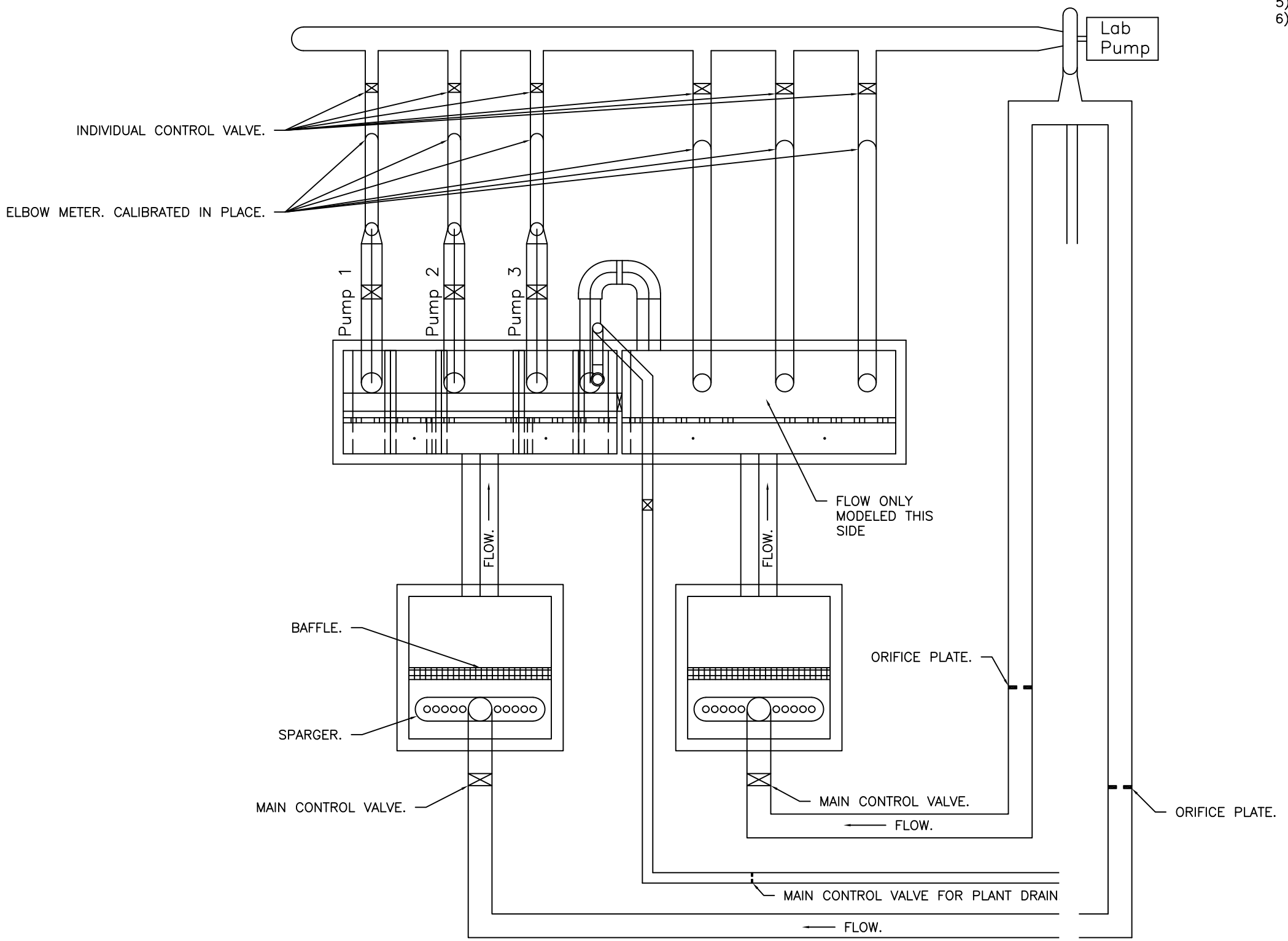
Physical model studies are used to evaluate the approach flow and ensure that the flow is uniform up to the pump impeller. Therefore, the downstream model boundary was chosen as the entrance to the pump impeller. It is not necessary to include a model pump impeller because the pump performance is tested at the manufacturer's facility. The manufacturers test was conducted with uniform approach flow conditions. Therefore, with other design considerations being equal, if those conditions can be duplicated in the prototype structure, the performance of the pump in the field should match that determined by the manufacturer.

3.2 Model Construction

The model was constructed on a raised deck to facilitate viewing and data collection. The model head box, floor, and sidewalls were constructed with waterproof wood. The model pumps, intake piping and pump bells were fabricated out of clear acrylic up to the impeller location. The additional piping was fabricated out of PVC pipe. Friction losses within the model limits are negligible when compared to form or boundary losses. Therefore, it is assumed that materials mentioned above were appropriate for model construction.

The overall model basin was constructed with a tolerance of +/- 0.25 model inches. The model pump throats were constructed to within +/- 0.06 model inches. Valves were used to control the individual pump flows as well as the total model flow. A pump was installed downstream of the model pumps to re-circulate flow back to the model head box. Flow straightening devices were installed in the model head-box to ensure that flow entering the head box was uniform. The following figures and photos show the model.

Note:
1) All dimensions given in model inches
2) All elevations given in prototype feet
3) Basin construction tolerances ±0.25"
4) Head box construction tolerances ±0.50"
5) Acrylic intake structures construction tolerances ±0.06"
6) Acrylic intake bell location tolerances ±0.13"

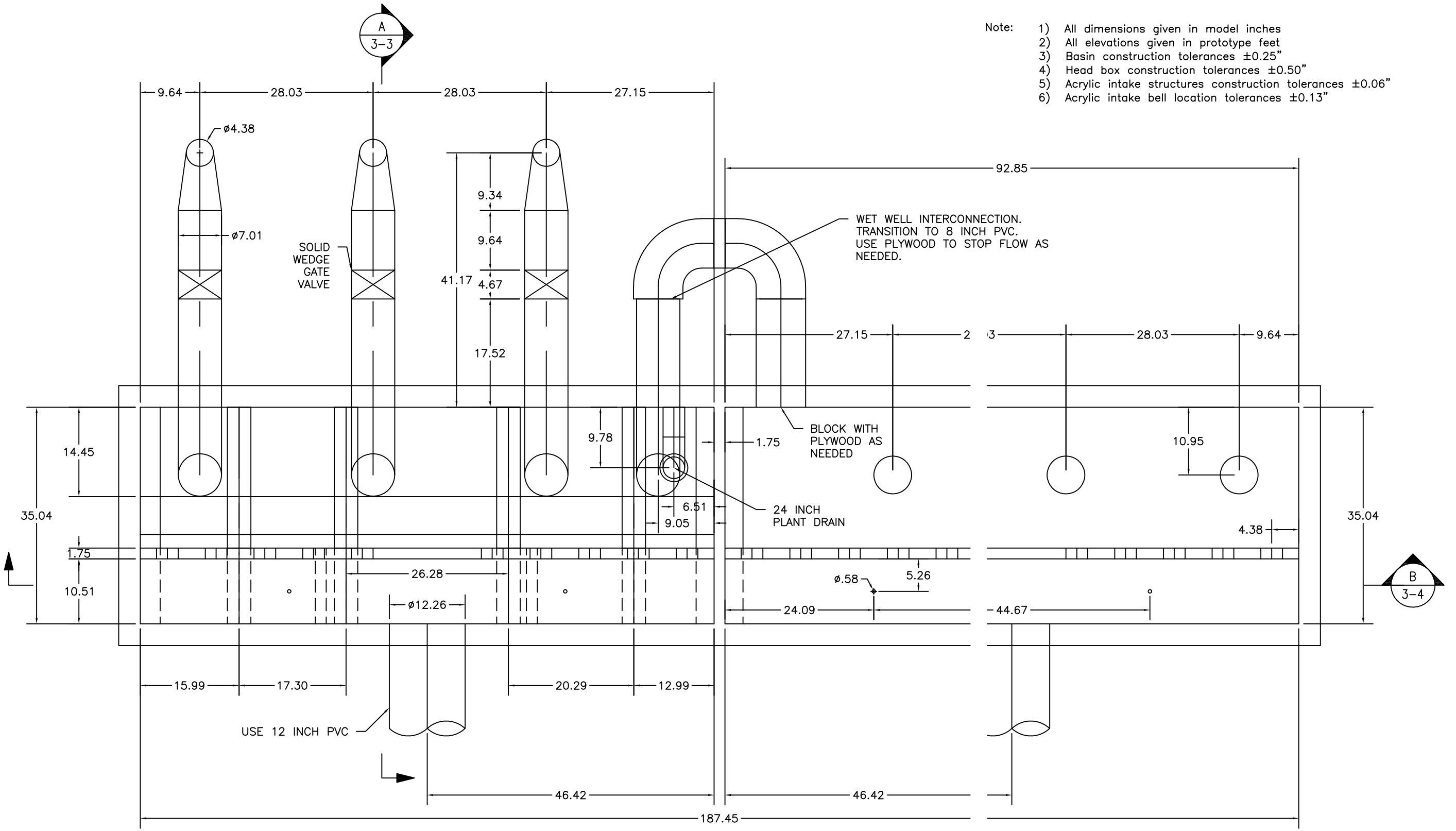


Model Scale: 1 model inch =6.85 prototype inches (1:6.85)

NO.	DATE:	REVISION	DRAWN:	CHK. BY:
2	1/21/2026	Changed reducing elbows to LR. Added Plant Drain and INTERCONNECTION	KDAVY	MHAVICE

DRAWN: K. Davy	DATE: 8/5/2025	PROJECT NO:	FIGURE 3-1 (REV-2)
FILE NO: OVERVIEW	CHECKED:	035.0000035320	MODEL OVERVIEW
			Cedar Creek WWTP Influent Pump Station
			CDM Smith

S3C067-11G
Page 2259 of 2953
Nassau County DPW



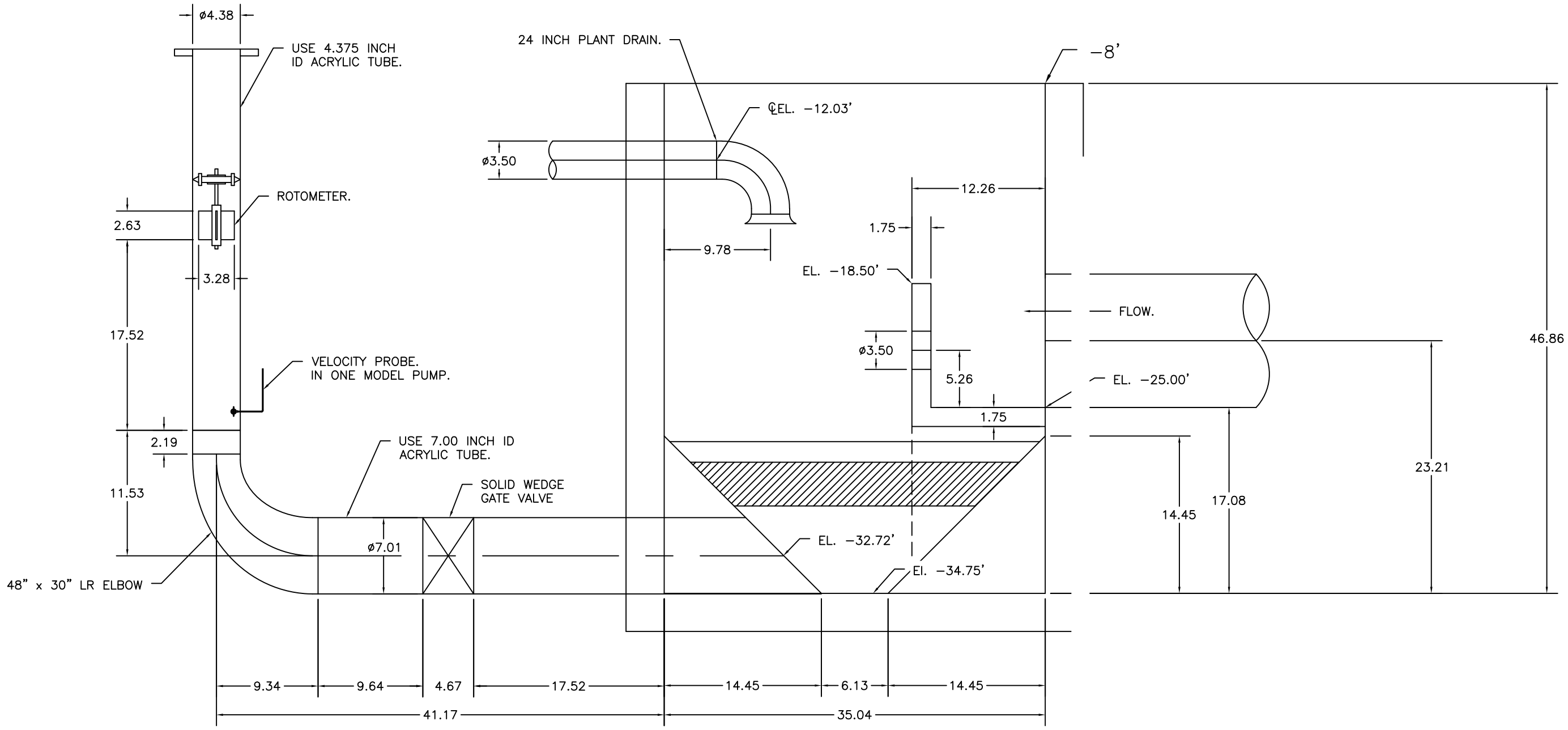
Model Scale: 1 model inch =6.85 prototype inches (1:6.85)

NO.	DATE:	REVISION	DRAWN:	CHK. BY:
2	1/21/2026	Changed reducing elbows to LR. Added Plant Drain and INTERCONNECTION	KDAVY	MHAVICE

DRAWN: K. Davy	DATE: 8/5/2025	PROJECT NO:	FIGURE 3-2 (REV-2)
FILE NO: Plan	CHECKED:	035.0000035320	MODEL LAYOUT DETAILS
			Cedar Creek WWTP Influent Pump Station
			CDM Smith

S3C067-11G
Page 2260 of 2953
Nassau County DPW

Note:
1) All dimensions given in model inches
2) All elevations given in prototype feet
3) Basin construction tolerances ±0.25”
4) Head box construction tolerances ±0.50”
5) Acrylic intake structures construction tolerances ±0.06”
6) Acrylic intake bell location tolerances ±0.13”



Model Scale: 1 model inch =6.85 prototype inches (1:6.85)

SECTION A

NO.	DATE:	REVISION	DRAWN:	CHK. BY:
2	1/21/2026	Changed reducing elbows to LR. Added Plant Drain and INTERCONNECTION	KDAVY	MHAVICE

DRAWN: K. Davy	DATE: 8/5/2025	PROJECT NO:
FILE NO: SECTION A	CHECKED:	035.0000035320

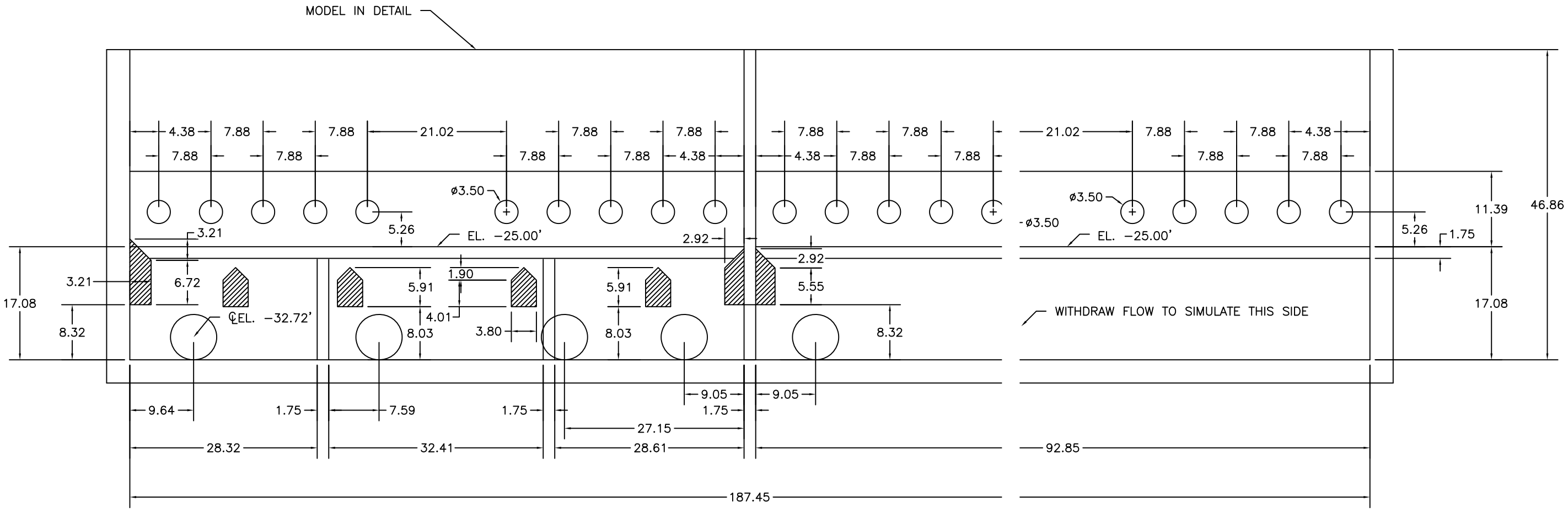
FIGURE 3-3 (REV-2)

MODEL SECTION A DETAILS

Cedar Creek WWTP Influent Pump Station
CDM Smith

S3C067-11G
Page 2261 of 2953
Nassau County DPW

Note:
1) All dimensions given in model inches
2) All elevations given in prototype feet
3) Basin construction tolerances ±0.25”
4) Head box construction tolerances ±0.50”
5) Acrylic intake structures construction tolerances ±0.06”
6) Acrylic intake bell location tolerances ±0.13”



SECTION B

Model Scale: 1 model inch =6.85 prototype inches (1:6.85)

NO.	DATE:	REVISION	DRAWN:	CHK. BY:
2	1/21/2026	Changed reducing elbows to LR. Added Plant Drain and INTERCONNECTION	KDAVY	MHAVICE

DRAWN: K. Davy	DATE: 8/5/2025	PROJECT NO:	FIGURE 3-4 (REV-2)
FILE NO: SECTION B	CHECKED:	035.0000035320	MODEL SECTION B DETAILS Cedar Creek WWTP Influent Pump Station CDM Smith

S3C067-11G
Page 2262 of 2953
Nassau County DPW



Photo 3-1 Model Overview



Photo 3-2 Model Trough Openings



Photo 3-3 Model Wet Well



Photo 3-4 Model Plant Drain

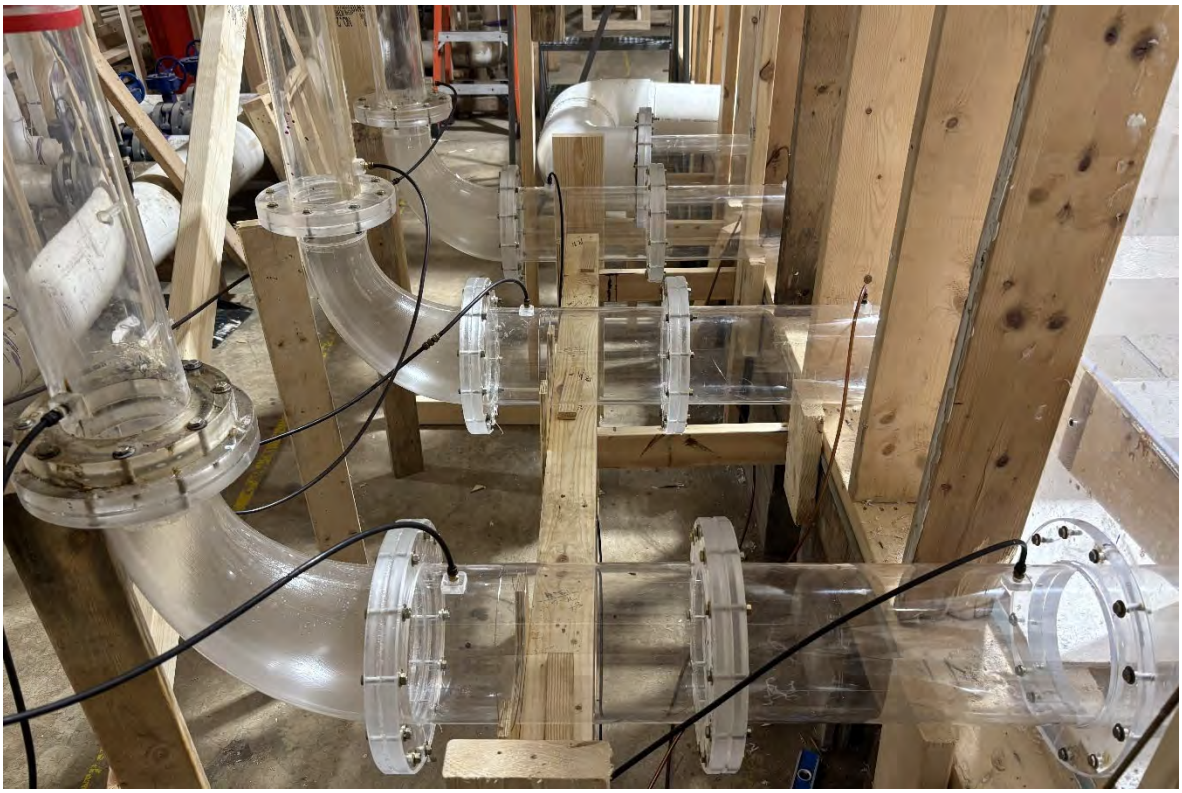


Photo 3-5 Model Suction Piping

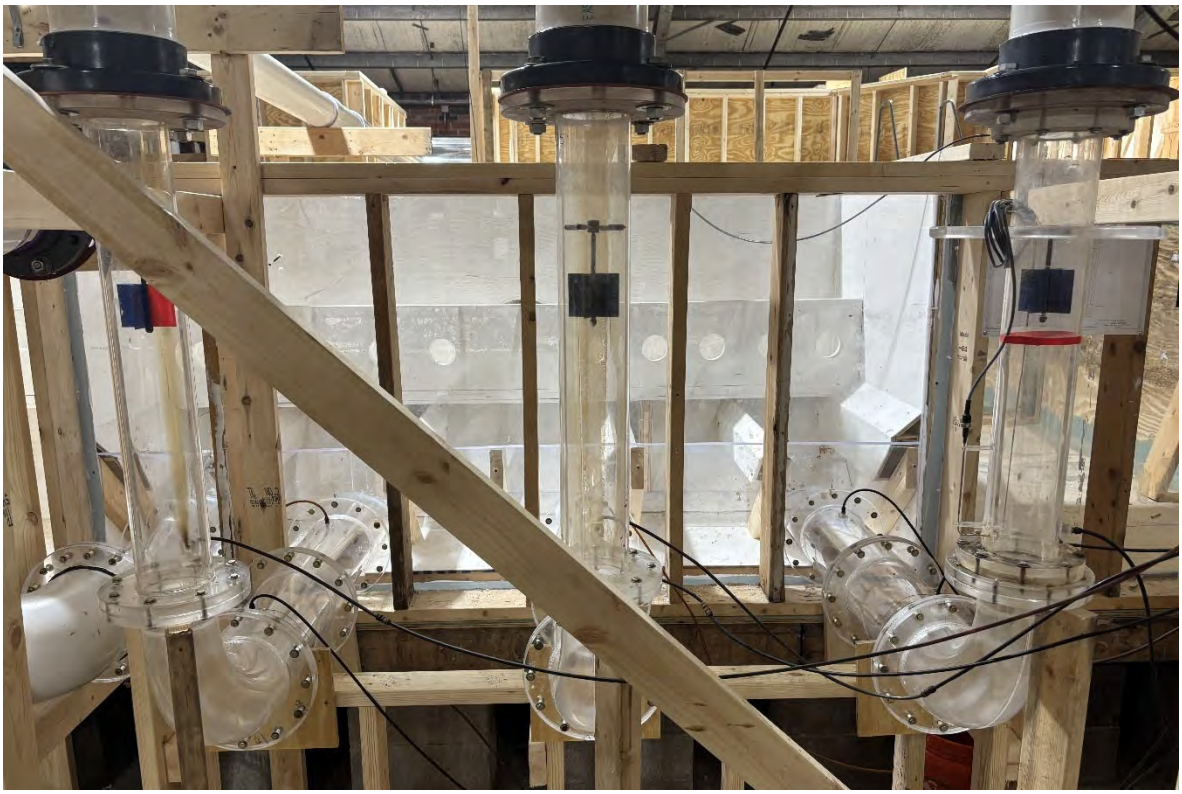


Photo 3-6 Model Pumps

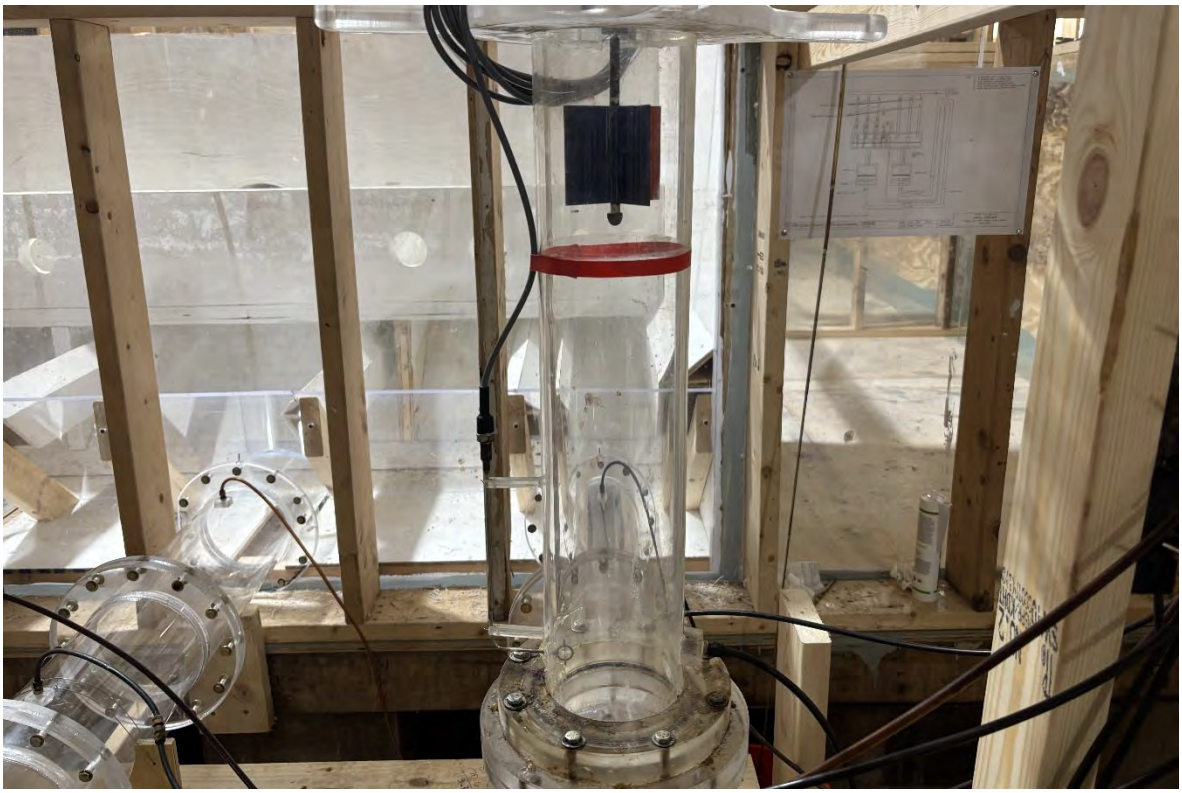


Photo 3-7 Model Detailed Pump

4.0 INSTRUMENTATION AND TESTING PROCEDURES

4.1 Instrumentation and Data Collection

The individual model pump flow rates, as well as the total model flow rate were determined with an ASME standard orifice meter with an accuracy of +/- 2 percent or better. U-tube manometers were used to measure the manometer deflection. Valves were adjusted in the model piping until the manometer deflections indicated that the proper flow rates were set.

The water levels in the pump sump were recorded with a staff gauge referenced to the sump floor with an accuracy of 3-mm (0.01-ft) or better. Vortex formation was visually observed. Dye was used to aid in the visualization of vortex formation. Vortex strength was rated according to the scale presented in Figure 2-1. Digital photographs and video footage were also used to document vortex formation.

Velocity fluctuations and turbulence levels were measured just upstream of the pump bell. A free spinning miniature propeller Model 412 Nixon Streamflow probe was used to measure the velocities. A data acquisition board was connected to the Nixon probe and recorded approximately 9000 samples over a 30-second period. The software program HPVEE was used to record this data and determine the mean and standard deviation of the velocity data. The pump bell was attached to a turn-column, which allowed the velocity probe to be rotated 360 degrees. Velocities were collected at eight (8) points around the pump bell, at a fixed radius, in 45-degree increments.

A swirl meter was installed in each detailed pump to measure the level of pre-swirl of flow entering the pump. Each swirl meter consists of four (4) straight vanes mounted on a shaft. The swirl angle can be calculated with the following equation:

$$\theta = \tan^{-1}\left(\frac{\pi dn}{u}\right)$$

Where: u = average axial velocity
d = diameter of the pipe in which the swirl meter is installed
n = revolutions per second of the swirl meter

4.2 Test Program

Testing is conducted in three phases, baseline, modification, and final documentation testing. Each of these phases is described below:

- Baseline Testing: Tests were conducted with the proposed intake structure. These tests were conducted to evaluate the approach flow conditions, and to determine if any

adverse hydraulic phenomena were present. In general, vortex activity, pre-swirl, velocity distribution, turbulence levels, and overall approach flow conditions were evaluated.

- Modification Testing: Tests were conducted to develop modifications that would alleviate or minimize any potentially damaging hydraulic conditions within the sump. These tests were conducted systematically to minimize design changes while still meeting the pre-determined acceptance criteria.

- Final Documentation Testing: Following review of the draft report and any witness testing, documentation testing may be conducted to verify that the recommended modifications are effective for a range of expected operating conditions.

5.0 TEST RESULTS

5.1 Baseline Testing

Baseline tests were conducted with several possible operating conditions. These tests are conducted at varying water levels and pump operating combinations. In general, the following observations were made:

1. Baseline testing indicated that the trough baffles installed in each wet well were effective at eliminating air entrainment into the pumps across all operating conditions.
2. Given the orientation of the trough baffle openings, however, concentrated influent flow did not re-distribute vertically downwards. This resulted in overall vertical circulation within the wet well and unstable conditions entering the pumps. This instability was more pronounced with more pumps in operation but as pumps were taken offline conditions improved.
3. The more stable conditions within the wet well allowed for organized surface vortices to form. These vortices were infrequent but intermittently organized into a well-organized, air entraining vortex that entered into each pump.
4. Conditions entering the suction piping remained unstable. Frequent flow oscillations and wrapping were observed in the horizontal suction piping approaching the reducing elbows. Once through the elbows, conditions remained unstable passed the pump suction flange.
5. Overall, pre-swirl was elevated and unstable with frequent stalling and burst swirl observed in each operating conditions.

A summary of the baseline testing is shown in Table 5-1

Table 5-1 Baseline Data Summary

Note: A velocity probe was installed in Pump 1 for all tests (See Figure 3-1 for pump notation). Pre-swirl meters were installed in all pumps. Velocity fluctuations should be less than 10%, pre-swirl should be less than 5.0-degrees and no vortices greater than Type 1 or weak type 2 should enter the pump.

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 1	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.6	4.2	2.5	1.5
Pump 2	37.5	I 3-4	none	none	none	none	No probe installed			6.0
Pump 3	37.5	none	none	none	none	none	No probe installed			1.7
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Influent flow through both influent pipes

Intermittent surface vortex activity observed
Recirculation observed in the wet well
Flow drift observed throughout suction piping
Pre-swirl high and unstable

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 2	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-5.9	4.1	5.9	1.0
Pump 2	37.5	none	none	none	none	none	No probe installed			8.2
Pump 3	37.5	none	none	none	none	none	No probe installed			1.9
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Influent flow through pipe feeding wet well 1

Unstable conditions entering each pump
Recirculation observed in the wet well
Flow drift observed throughout suction piping
Pre-swirl high and unstable

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 3	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-7.7	8.7	6.7	1.9
Pump 2	0									
Pump 3	37.5	none	none	none	none	none	No probe installed			2.7
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Influent flow through both influent pipes

Unstable conditions entering each pump
Recirculation observed in the wet well
Flow drift observed throughout suction piping
Pre-swirl high and unstable

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 4	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.7	7.8	6.1	0.2
Pump 2	37.5	none	none	none	none	none	No probe installed			1.7
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Influent flow through pipe feeding wet well 1

Unstable conditions entering each pump
Recirculation observed in the wet well
Flow drift observed throughout suction piping
Pre-swirl high and unstable

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 5	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	48.75	none	none	none	none	none	-9.0	4.4	2.5	0.6
Pump 2	0									
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Influent flow through pipe feeding wet well 1

Unstable conditions entering the pump
Flow drift observed throughout suction piping
Pre-swirl high and unstable

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 6	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	48.75	I 3-4	none	none	none	none	-9.0	7.2	2.3	1.1
Pump 2	0									
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Influent flow through pipe feeding wet well 2

Unstable conditions entering the pump
Intermittent surface vortex activity observed
Flow drift observed throughout suction piping
Pre-swirl high and unstable

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 7	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.5	3.8	6.0	0.2
Pump 2	37.5	I 3-4	none	none	none	none	No probe installed			1.7
Pump 3	37.5	none	none	none	none	none	No probe installed			2.4
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Influent flow through pipe feeding wet well 2

Unstable conditions entering each pump
Recirculation observed in the wet well
Intermittent surface vortex activity observed
Flow drift observed throughout suction piping
Pre-swirl high and unstable

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 8	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	I 3-4	none	none	none	none	-5.6	5.9	2.7	0.2
Pump 2	37.5	none	none	none	none	none	No probe installed			0.7
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Influent flow through pipe feeding wet well 2

Unstable conditions entering each pump
Recirculation observed in the wet well
Intermittent surface vortex activity observed
Flow drift observed throughout suction piping
Pre-swirl high and unstable

Baseline	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 9	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-5.8	4.6	3.8	0.2
Pump 2	37.5	none	none	none	none	none	No probe installed			1.5
Pump 3	37.5	none	none	none	none	none	No probe installed			1.0
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – High Water Level = El (-) 18.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Influent flow through both influent pipes

Unstable conditions entering each pump
Recirculation observed in the wet well
Flow drift observed throughout suction piping
Pre-swirl high and unstable

The photos below show a variety of the hydraulic phenomena observed during testing.

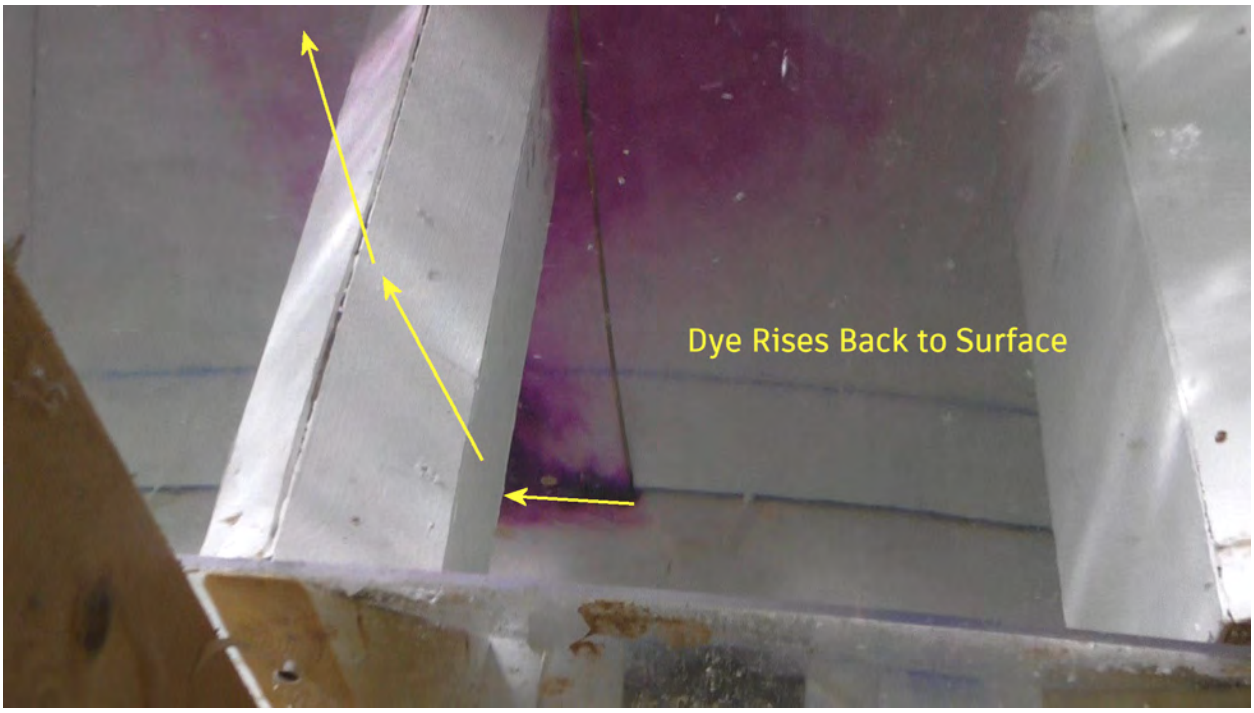


Photo 5-1 Unstable Conditions Within Wet Well

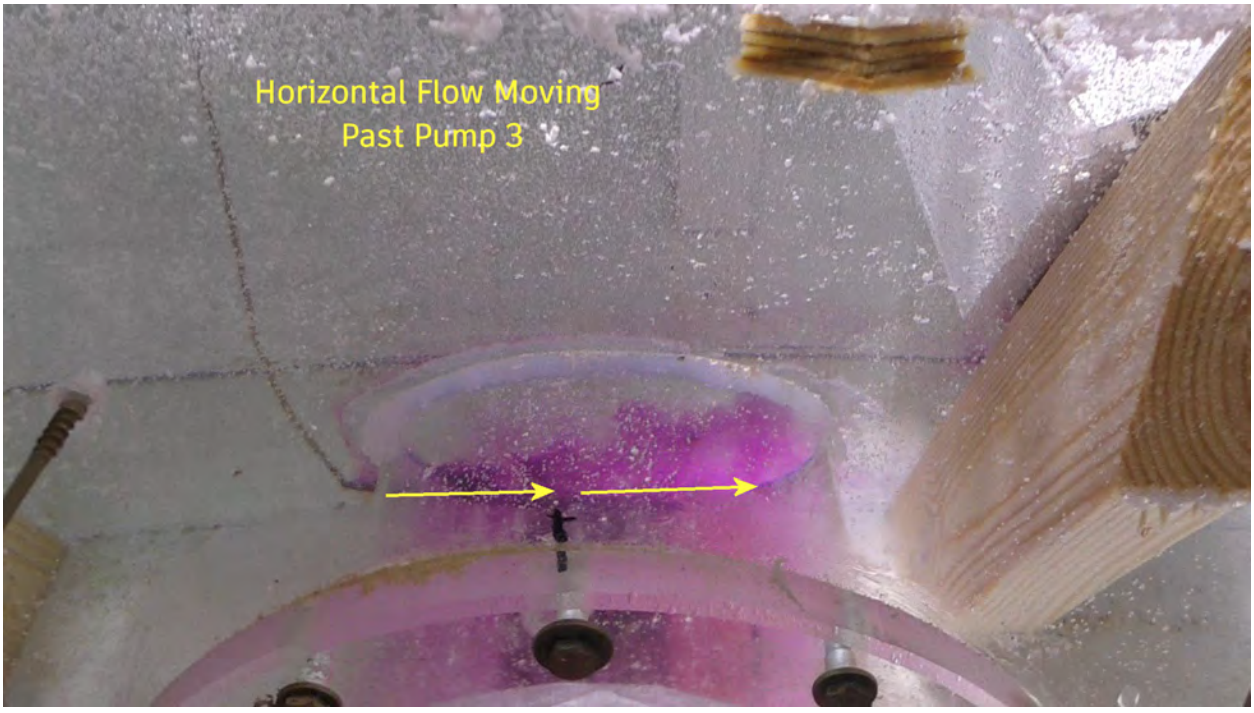


Photo 5-2 Horizontal Flow Past Pump Suction Flare

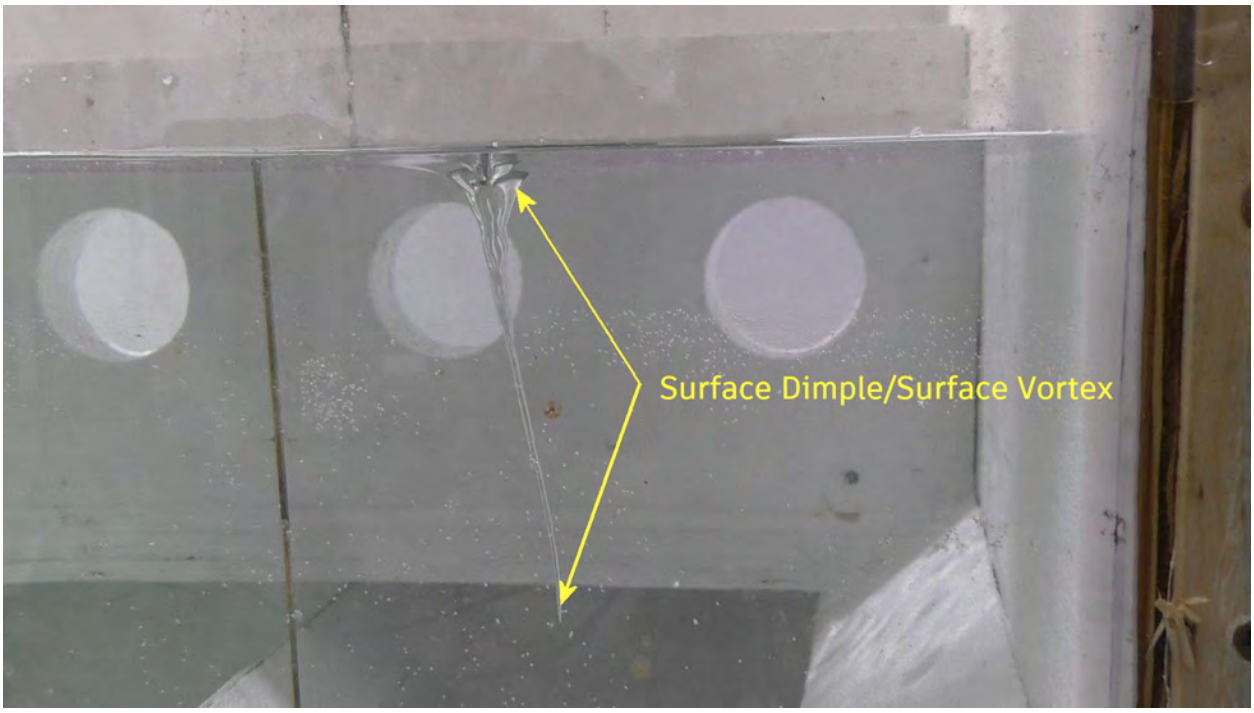


Photo 5-3 Surface Dimple/Surface Vortex

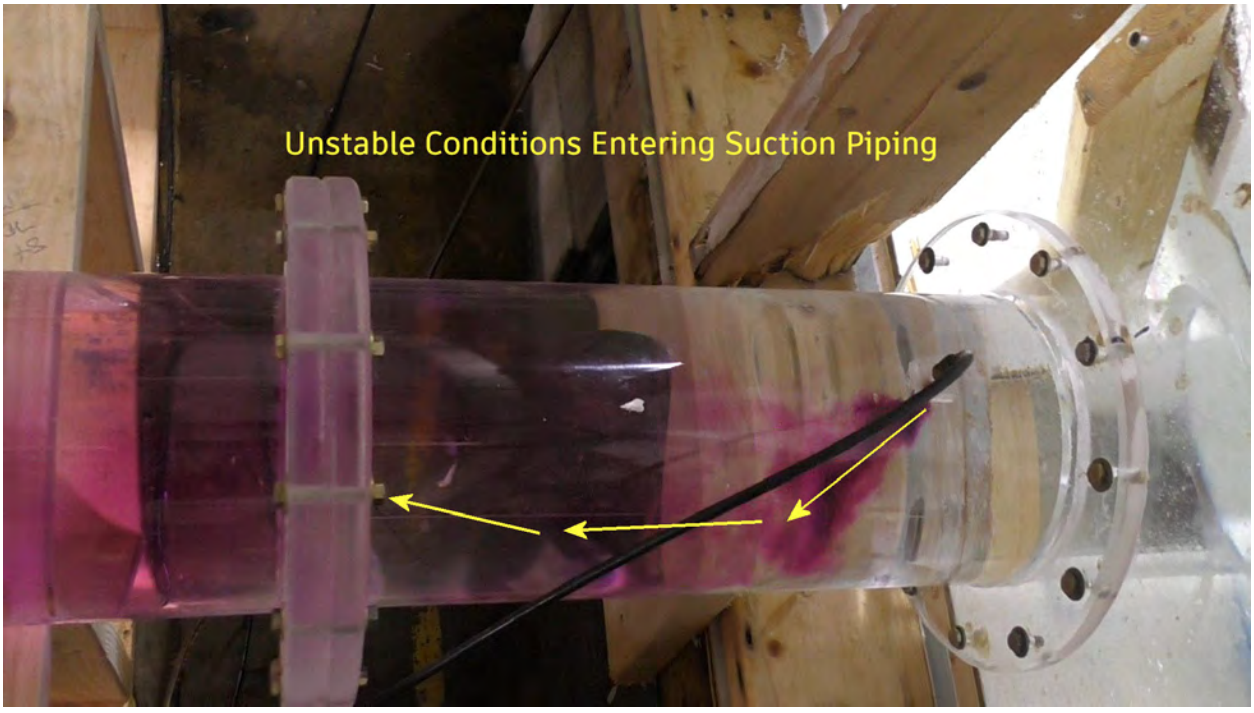


Photo 5-4 Flow Drift in Suction Piping

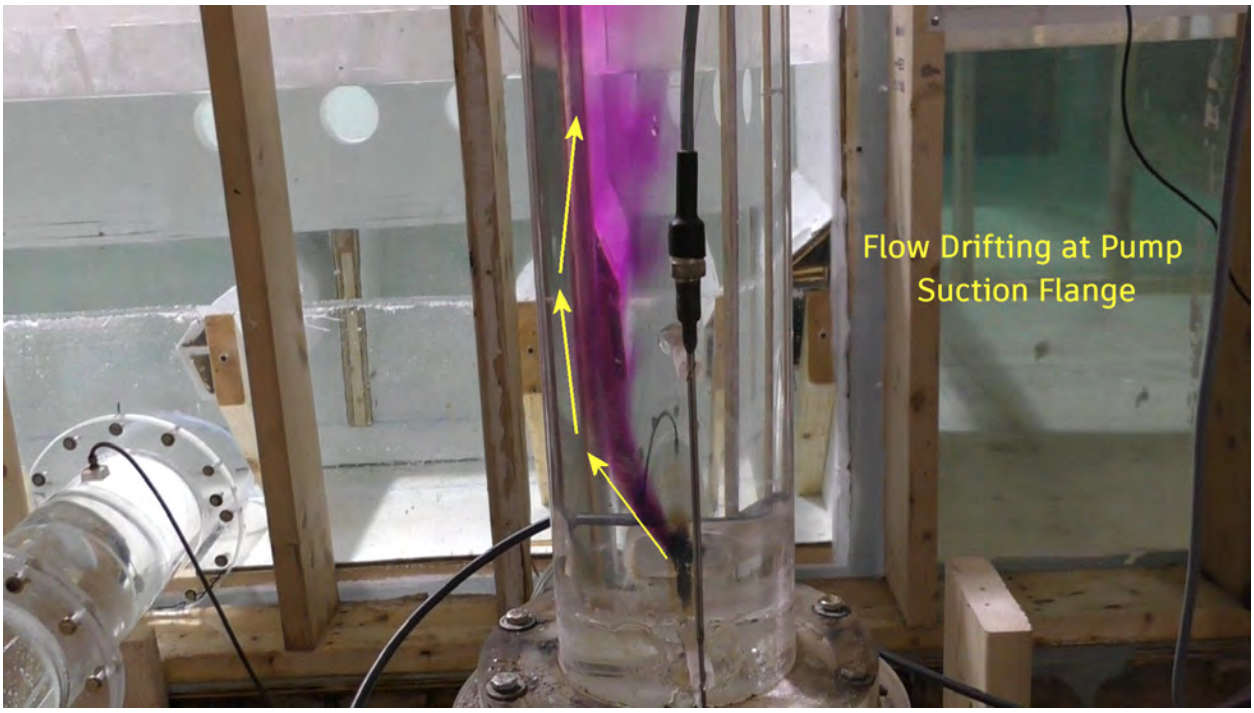


Photo 5-5 Flow Drift at Pump Suction Flange

5.2 Modification Testing

Modification tests were conducted to improve the approach flow conditions within the wet well and to bring velocity and turbulence levels within criteria. Complete data sets and the range of anticipated operating conditions will be investigated during documentation testing. In general:

1. A series of six (6) flow straightening vanes were installed in the suction piping supplying each pump and were effective at stabilizing flow at the pump suction flange. With vanes installed, strong surface vortex activity was still observed.
2. A series of four (4) horizontal beams were installed in the wet well and were effective at eliminating all surface vortex activity and stabilized overall conditions within the wet well.
3. With modifications installed, pre-swirl was low and stable. Velocity and turbulence variations were within criteria across the full range of expected operating conditions.
4. Additional testing was conducted with the plant drain extended to El. (-) 21.30 ft in the wet well and was in operation at 14.16 MGD. Flow entered the wet well under the water surface, which prevented air entrainment and surface oscillations from occurring. Additionally, there was no change to approach conditions with the plant drain in operation, and stable conditions were observed at the pump suction flange.
5. Given the orientation of the horizontal beam installed above Pump 3, extending the plant drain down resulted in interference between the beam and the piping. Removing this beam allowed for surface vortices to organize while operating Pump 3 at a runout flow. The horizontal beam was re-installed in a revised location which eliminated the surface vortex. The revised beam locations remained effective at eliminating surface vortex formation for all remaining conditions.
6. Additional testing was conducted with a 48-in x 36-in reducing elbow and a 36-in x 30-in reducer positioned after the elbow for Pump 1. The additional testing showed similar results to previous testing, with pre-swirl low and stable and velocity and turbulence variations within HI criteria.

Table 5-2 summarizes the modification testing.

Table 5-2 Summary of Modification Tests

Mod	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 1	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-7.2	4.5	2.8	1.2
Pump 2	37.5	I 3-4	none	none	none	none	No probe installed			1.5
Pump 3	37.5	none	none	none	none	none	No probe installed			1.9
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed

Unstable conditions entering each pump
Recirculation observed in the wet well
Intermittent surface vortex activity observed
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Mod	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 2	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-4.5	4.3	3.4	1.0
Pump 2	37.5	none	none	none	none	none	No probe installed			1.5
Pump 3	37.5	none	none	none	none	none	No probe installed			1.5
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Note: The following modification tests were conducted after the in-person witness test and contain results of tests conducted with the extended plant drain.

Mod	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 3	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	0									
Pump 2	0									
Pump 3	48.75	I 2-3	none	none	none	none	No probe installed			0.9
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well – one removed due to interference with pipe drain
Plant drain extended to El. (-) 21.30 ft

Surface vortex over Pump 3
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Mod	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 4	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	0									
Pump 2	0									
Pump 3	48.75	none	none	none	none	none	No probe installed			0.7
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well – revised location
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Mod	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 5	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-4.4	4.7	9.3	1.2
Pump 2	37.5	none	none	none	none	none	No probe installed			1.9
Pump 3	37.5	none	none	none	none	none	No probe installed			0.2
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Note: All additional testing was conducted during documentation. The following pictures and figures show the recommended modifications installed.



Photo 5-6 Horizontal Beams Installed

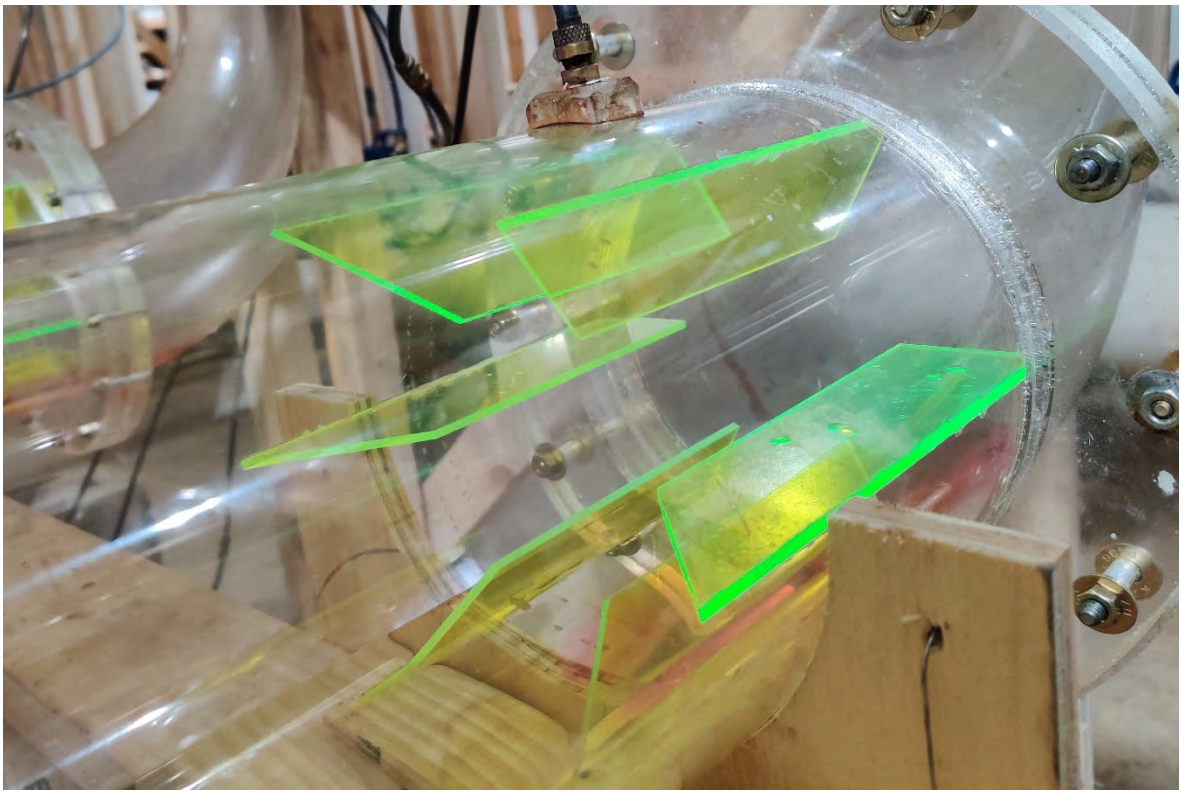


Photo 5-7 Flow Straightening Vanes Installed



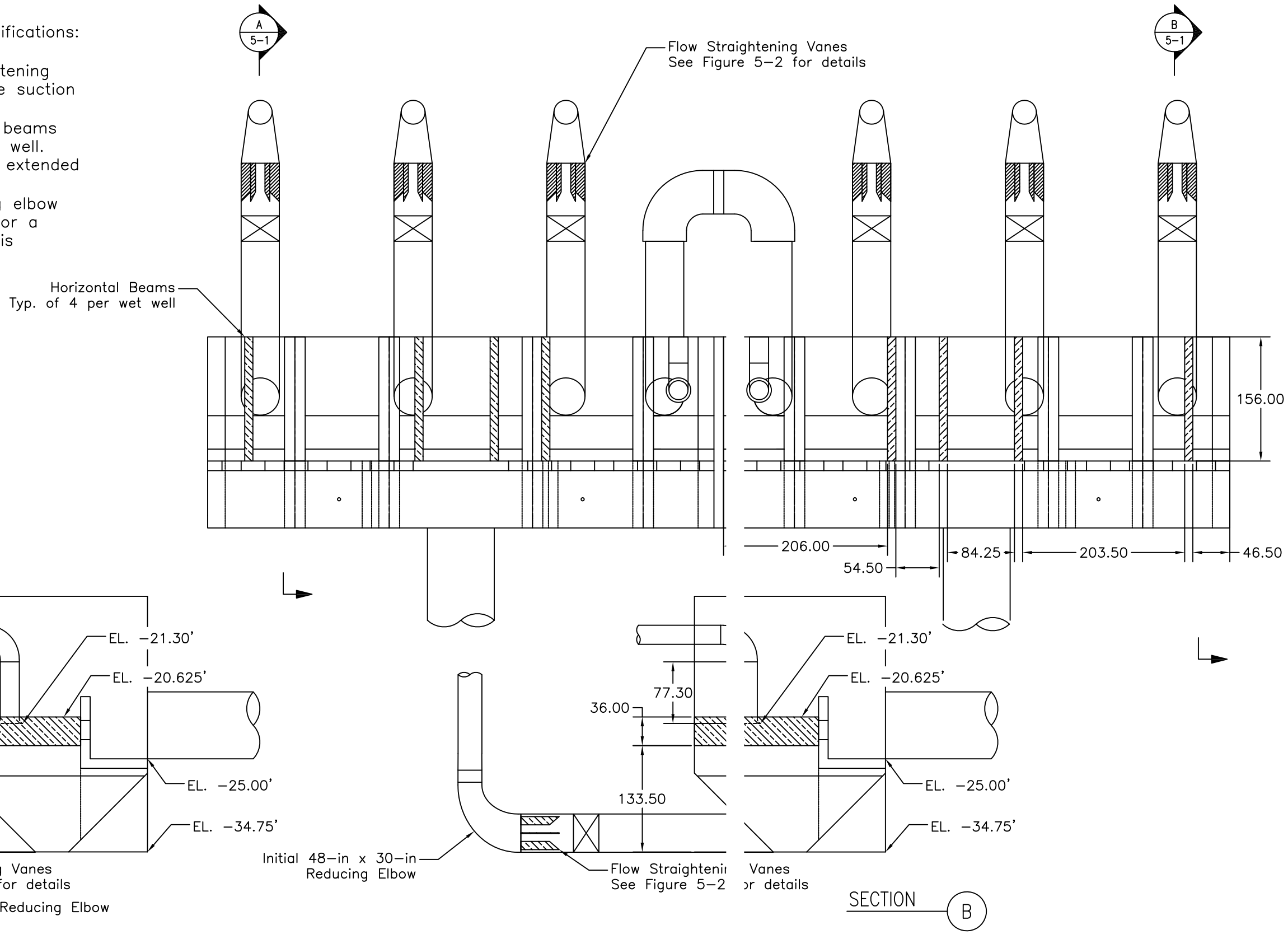
Photo 5-8 Plant Drain Extension



Photo 5-9 Revised Beam Locations

The following are recommended modifications:

1. A series of six (6) flow straightening vanes should be installed in the suction piping supplying every pump.
2. A series of four (4) horizontal beams should be installed in each wet well.
3. The plant drain pipe should be extended to El. (–) 21.30 ft.
4. Both a 48–in x 36–in reducing elbow with a 36–in x 30–in reducer or a 48–in x 30–in reducing elbow is acceptable for operation.



Note: Drawing intended for reference only. Not to be used as construction drawing.

Notes: 1. All dimensions given in pr otype inches
2. All elevations given in pro otype feet

NO.	DATE:	REVISION	DRAWN:	CHK. BY:
1	4/7/2026	PLANT DRAIN EXTENDED AND HATCHING FOR ADDED BEAMS CHANGED	CAC	MKH
2	6/8/2026	EXISTING BEAM REMOVED AND SECOND PLANT DRAIN INCORPORATED	STB	MKH

DRAWN: C. Carley	DATE: 4/7/2026	PROJECT NO:
FILE NO: Plan	CHECKED: M. Havice	035.0000035320

FIGURE 5–1 (REV 2)
MODIFICATION OVERVIEW
Cedar Creek WWTP Influent Pump Station
CDM Smith

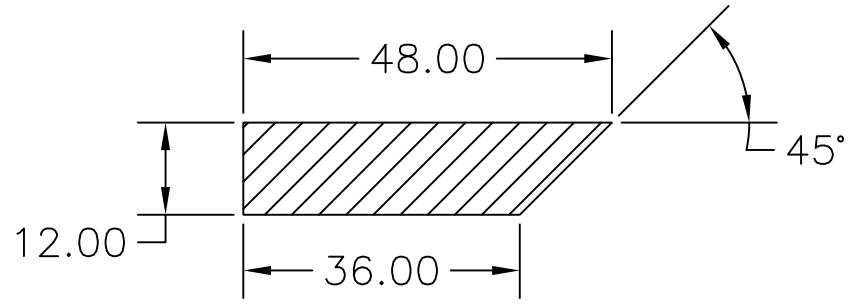
S3C067-11G
Page 2286 of 2953
Nassau County DPW

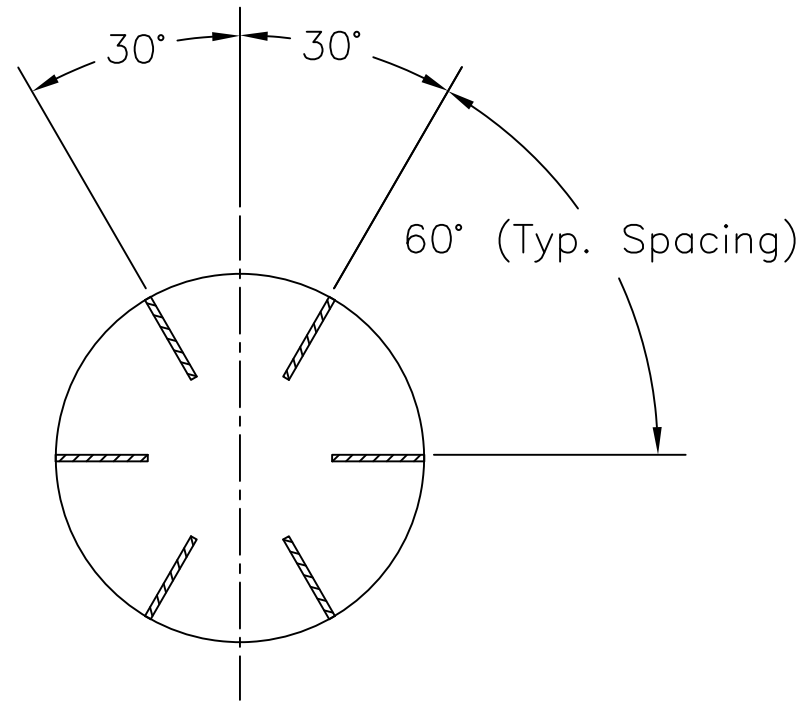
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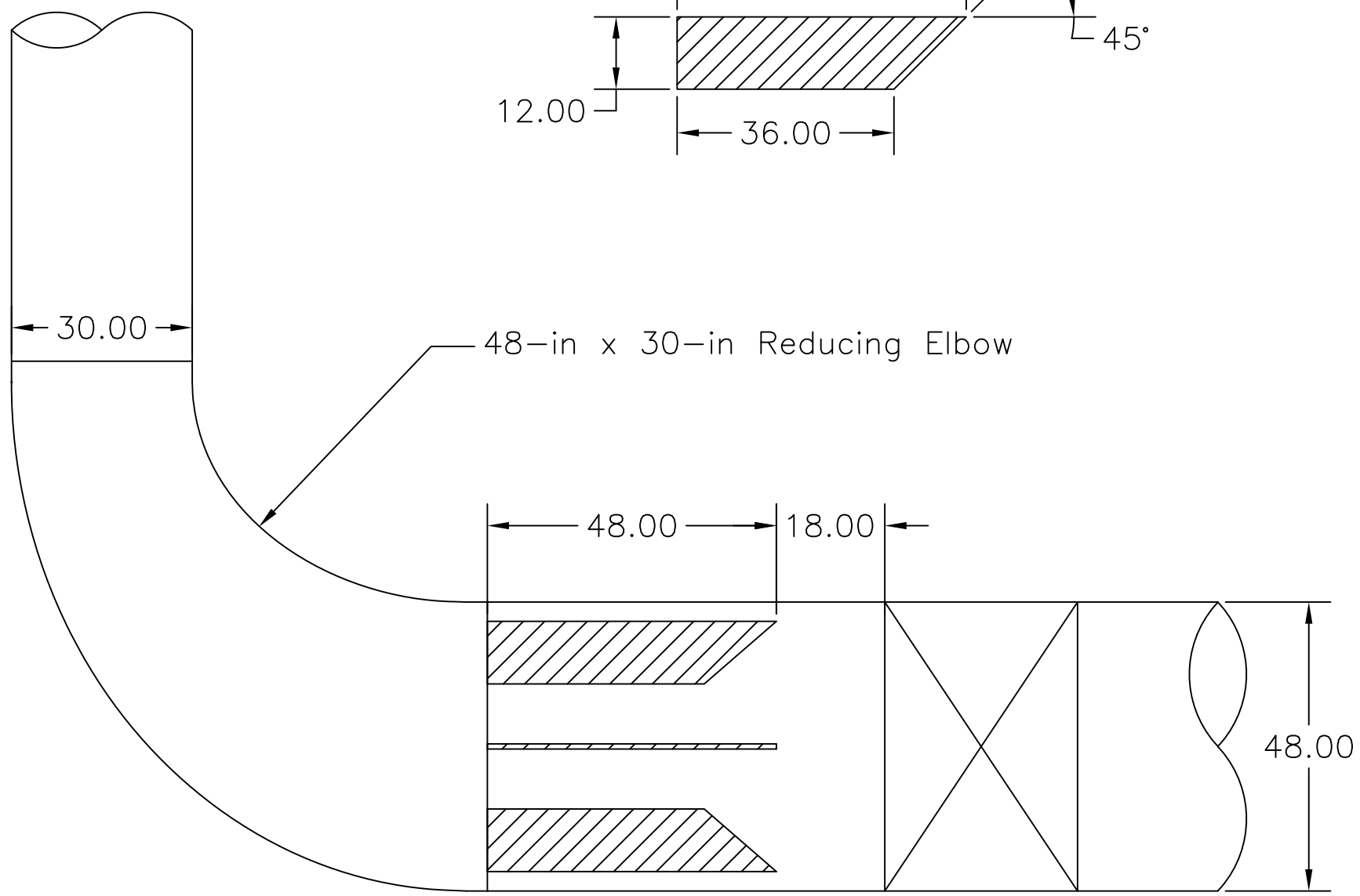
Page 2287 of 2953

Nassau County DPW

VANE DETAIL







Note: Drawing intended for reference only. Not to be used as construction drawing.

Notes: 1. All dimensions given in pro type inches
2. All elevations given in prot ype feet

NO.	DATE:	REVISION	DRAWN:	CHK. BY:
1	4/7/2026	PLANT DRAIN EXTENDED AND HATCHING FOR PROPOSED BEAM CHANGED	CAC	MKH

DRAWN: C. Carley	DATE: 2/24/2026	PROJECT NO:
FILE NO:	CHECKED: M. Havice	035.0000035320

FIGURE 5–2 (REV 2)

RECOMMENDED MODIFICATIONS – VANE DETAILS

Cedar Creek WWTP Influent Pump Station

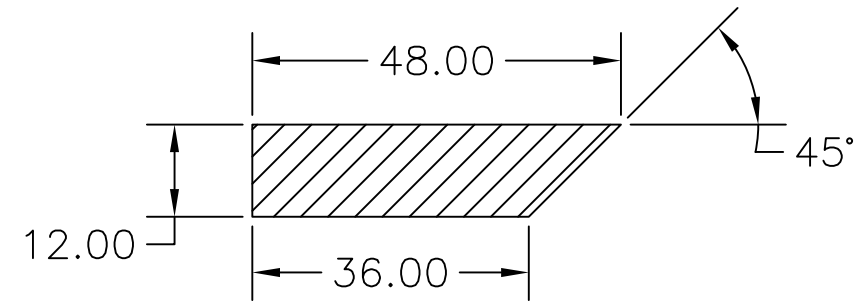
CDM Smith

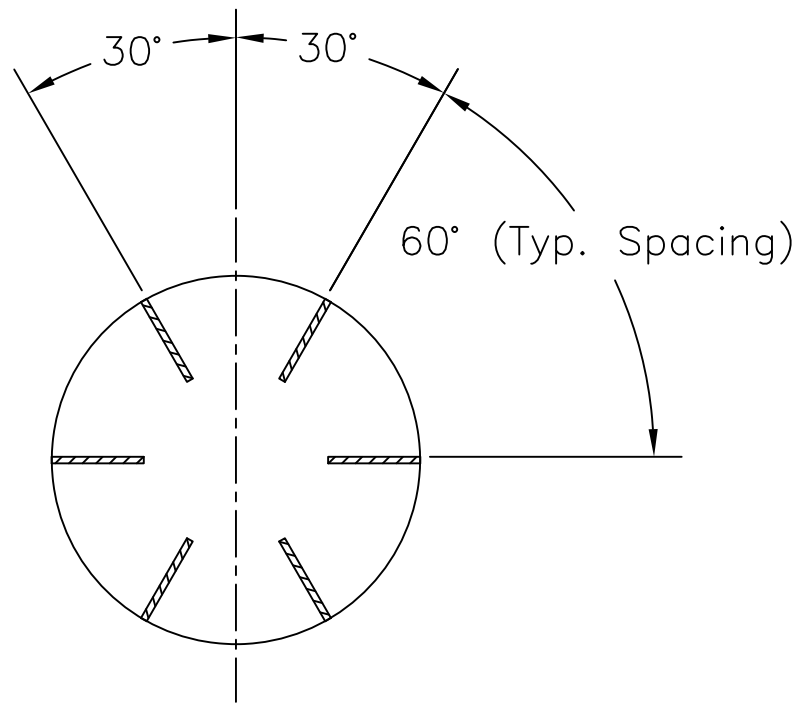
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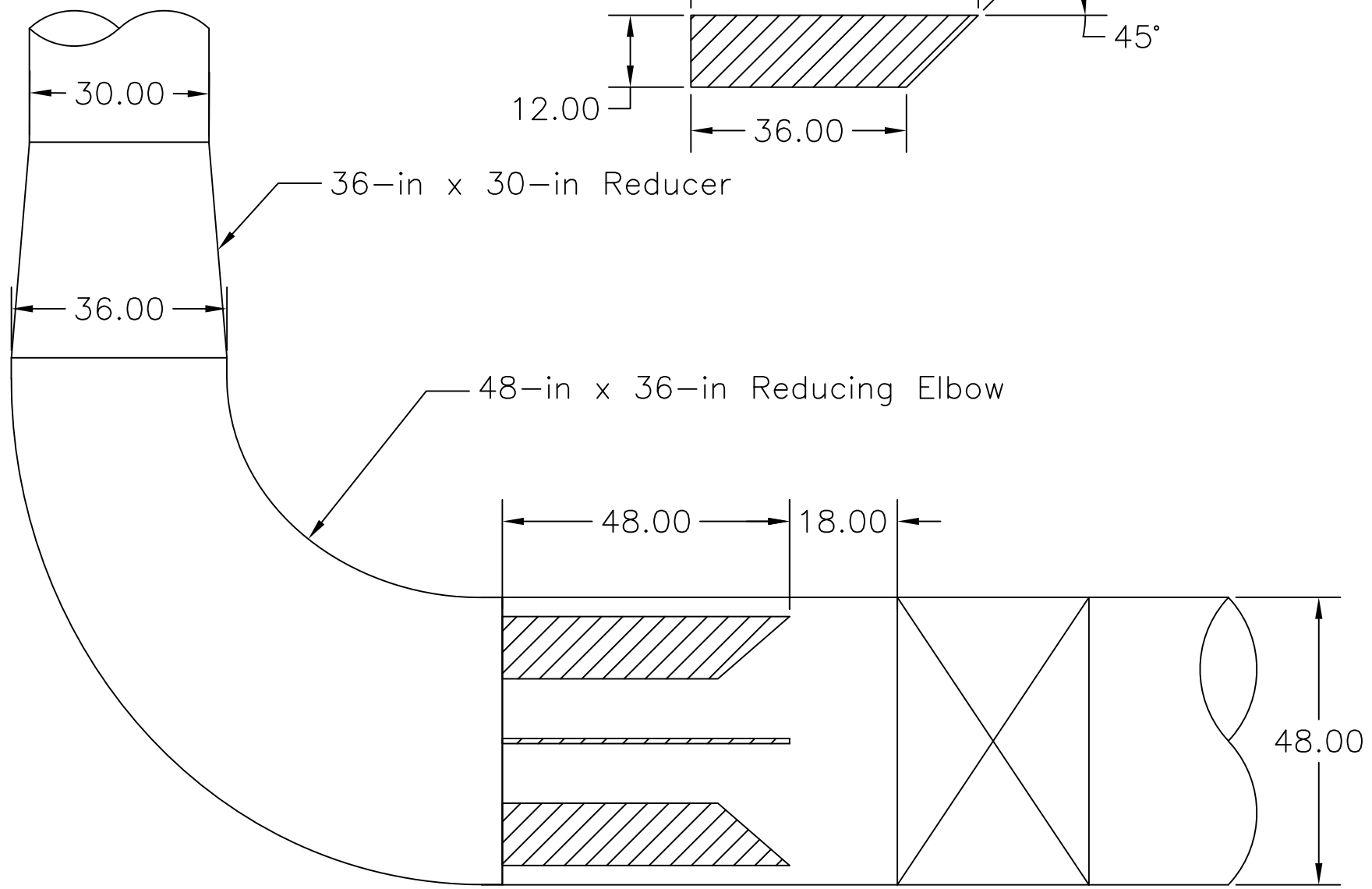
Page 2288 of 2953

Nassau County DPW

VANE DETAIL







Note: Drawing intended for reference only. Not to be used as construction drawing.

Notes: 1. All dimensions given in pro type inches
2. All elevations given in prot ype feet

NO.	DATE:	REVISION	DRAWN:	CHK. BY:
1	4/7/2026	PLANT DRAIN EXTENDED AND HATCHING FOR PROPOSED BEAM CHANGED	CAC	MKH

DRAWN: C. Carley	DATE: 6/23/2026	PROJECT NO:
FILE NO:	CHECKED: M. Havice	035.0000035320

FIGURE 5–3 (REV 2)

RECOMMENDED MODIFICATIONS – VANE DETAILS

Cedar Creek WWTP Influent Pump Station

CDM Smith

5.3 Witness Testing

A formal witness was held on Tuesday, Mar. 3rd. During the witness test, the model was demonstrated with and without the recommended modifications in place. Video of both baseline testing and final documentation testing will be submitted with the final report.

5.4 Final Documentation Testing

Final documentation testing was conducted to verify the effectiveness of the recommended modifications. The following modifications are recommended and were installed during documentation testing.

- Flow straightening vanes installed
- A series of four (4) horizontal beams installed in the wet well
- The plant drain was extended to El. (-) 21.30 ft
- A 48-in x 36-in reducing elbow and a 36-in x 30-in reducer positioned after the elbow for Pump 1

Table 5-3 shows the final documentation test data.

Table 5-3 Summary Final Documentation Testing

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 1	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-7.2	5.2	2.9	0.5
Pump 2	37.5	none	none	none	none	none	No probe installed			0.2
Pump 3	37.5	none	none	none	none	none	No probe installed			0.2
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Influent flow through pipe feeding wet well 1

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 2	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.8	4.0	2.9	0.7
Pump 2	0									
Pump 3	37.5	none	none	none	none	none	No probe installed			0.5
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 3	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-5.3	4.1	2.8	0.2
Pump 2	37.5	none	none	none	none	none	No probe installed			1.5
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Influent flow through pipe feeding wet well 1

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 4	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	48.75	none	none	none	none	none	-5.3	2.9	1.9	0.2
Pump 2	0									
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Influent flow through pipe feeding wet well 1

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 5	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	48.75	none	none	none	none	none	-8.3	6.3	1.9	0.4
Pump 2	0									
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Influent flow through pipe feeding wet well 2

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 6	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-7.9	5.5	4.7	0.2
Pump 2	37.5	none	none	none	none	none	No probe installed			1.0
Pump 3	37.5	none	none	none	none	none	No probe installed			1.9
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Influent flow through pipe feeding wet well 2

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 7	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-8.1	6.0	2.8	0.5
Pump 2	37.5	none	none	none	none	none	No probe installed			1.0
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Influent flow through pipe feeding wet well 2

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 8	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.3	5.8	6.6	0.7
Pump 2	37.5	none	none	none	none	none	No probe installed			1.0
Pump 3	37.5	none	none	none	none	none	No probe installed			1.0
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – High Water Level = El (-) 18.50 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Influent flow through pipe feeding wet well 1

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Note: The following tests were conducted after the witness test with the plant drain extended below the surface and was in operation for all scenarios.

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 9	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-8.3	6.7	2.9	1.0
Pump 2	37.5	none	none	none	none	none	No probe installed			0.5
Pump 3	37.5	none	none	none	none	none	No probe installed			0.5
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 10	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.3	4.9	4.2	1.5
Pump 2	37.5	none	none	none	none	none	No probe installed			2.2
Pump 3	37.5	none	none	none	none	none	No probe installed			1.0
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 11	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.6	6.1	5.4	0.5
Pump 2	0									
Pump 3	37.5	none	none	none	none	none	No probe installed			0.2
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 12	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.7	3.6	6.8	1.5
Pump 2	37.5	none	none	none	none	none	No probe installed			1.0
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 13	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-5.6	3.8	4.4	0.2
Pump 2	0									
Pump 3	0									
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 14	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	0									
Pump 2	37.5	none	none	none	none	none	No probe installed			0.7
Pump 3	0									
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 15	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	0									
Pump 2	0									
Pump 3	37.5	none	none	none	none	none	No probe installed			0.2
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 16	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	48.75	none	none	none	none	none	-6.8	4.1	6.4	1.3
Pump 2	0									
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 17	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	0									
Pump 2	48.75	none	none	none	none	none	No probe installed			0.6
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 18	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.0	6.0	7.3	0.7
Pump 2	37.5	none	none	none	none	none	No probe installed			1.9
Pump 3	37.5	none	none	none	none	none	No probe installed			1.5
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – High Water Level = El (-) 18.50 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Note: The following tests were conducted with Pump 1 48-in x 30-in reducing elbow removed and replaced with a 48-in x 36-in reducing elbow and a 36-in x 30-in reducer on top of the elbow. The new elbow was positioned in pump 1 location for all tests.

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 19	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-7.3	5.8	6.0	1.0
Pump 2	37.5	none	none	none	none	none	No probe installed			0.2
Pump 3	37.5	none	none	none	none	none	No probe installed			0.2
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft
48-in x 36-in reducing elbow and 36-in x 30-in reducer installed for Pump 1

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 20	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-7.1	5.6	3.5	0.7
Pump 2	37.5	none	none	none	none	none	No probe installed			0.2
Pump 3	37.5	none	none	none	none	none	No probe installed			0.2
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 112.5 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft
48-in x 36-in reducing elbow and 36-in x 30-in reducer installed for Pump 1

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 21	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-7.5	6.0	5.9	1.2
Pump 2	37.5	none	none	none	none	none	No probe installed			0.5
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft
48-in x 36-in reducing elbow and 36-in x 30-in reducer installed for Pump 1

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 22	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-6.9	5.6	5.8	1.5
Pump 2	0									
Pump 3	0									
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft
48-in x 36-in reducing elbow and 36-in x 30-in reducer installed for Pump 1

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 23	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	48.75	none	none	none	none	none	-5.7	2.5	3.7	0.2
Pump 2	0									
Pump 3	0									
WD	0									

Comment: Water Level – Low Water Level = El (-) 20.30 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 48.75 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft
48-in x 36-in reducing elbow and 36-in x 30-in reducer installed for Pump 1

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

Doc	Prototype Flow	Vortex Activity (I = Intermittent C = Constant)					Velocity & Turbulence (Vel = % of average)			Pre-Swirl
Test 24	(MGD)	Surface	Back wall	Side wall	Floor	Midflow	Min. Vel.	Max. Vel.	Max. Turb. %	Max (deg.)
Pump 1	37.5	none	none	none	none	none	-7.3	5.4	5.2	1.2
Pump 2	37.5	none	none	none	none	none	No probe installed			0.2
Pump 3	37.5	none	none	none	none	none	No probe installed			0.2
WD	37.5	Simulating flow from adjacent wet well								

Comment: Water Level – High Water Level = El (-) 18.50 ft (Wet Well Invert = El. (-) 34.75 ft)

Notes: 150 MGD total influent flow
Plant drain operating at 14.16 MGD
Influent flow through both influent pipes

Mods Installed:
Flow straightening vanes installed
Horizontal beams installed in the wet well
Plant drain extended to El. (-) 21.30 ft
48-in x 36-in reducing elbow and 36-in x 30-in reducer installed for Pump 1

Surface vortex activity eliminated by horizontal beams
Stabilized flow observed at the pump suction flange
Pre-swirl low and stable

6.0 INITIAL CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

Baseline testing indicated that the trough baffles installed in each wet well were effective at eliminating air entrainment into the pumps across all operating conditions. Given the orientation of the trough baffle openings, however, concentrated influent flow did not re-distribute vertically downwards. This resulted in overall vertical circulation within the wet well and unstable conditions entering the pumps. This instability was more pronounced with more pumps in operation but as pumps were taken offline conditions improved. The more stable conditions within the wet well allowed for organized surface vortices to form. These vortices were infrequent but intermittently organized into a well-organized, air entraining vortex that entered into each pump. Conditions entering the suction piping remained unstable. Frequent flow oscillations and wrapping were observed in the horizontal suction piping approaching the reducing elbows. Once through the elbows, conditions remained unstable passed the pump suction flange. Overall, pre-swirl was elevated and unstable with frequent stalling and burst swirl observed in each operating conditions.

A series of six (6) flow straightening vanes were installed in the suction piping supplying each pump and were effective at stabilizing flow at the pump suction flange. With vanes installed, strong surface vortex activity was still observed. A series of four (4) horizontal beams were installed in the wet well and were effective at eliminating all surface vortex activity and stabilized overall conditions within the wet well. With modifications installed, pre-swirl was low and stable. Velocity and turbulence variations were within criteria across the full range of expected operating conditions. Additional testing was conducted with the plant drain extended to El. (-) 21.30 ft in the wet well and was in operation at 14.16 MGD. Flow entered the wet well under the water surface, which prevented air entrainment and surface oscillations from occurring. Additionally, there was no change to approach conditions with the plant drain in operation, and stable conditions were observed at the pump suction flange. Given the orientation of the horizontal beam installed above Pump 3, extending the plant drain down resulted in interference between the beam and the piping. Removing this beam allowed for surface vortices to organize while operating Pump 3 at a runout flow. The horizontal beam was re-installed in a revised location which eliminated the surface vortex. The revised beam locations remained effective at eliminating surface vortex formation for all remaining conditions. Additional testing was conducted with a 48-in x 36-in reducing elbow and a 36-in x 30-in reducer positioned after the elbow for Pump 1. The additional testing showed similar results to previous testing, with pre-swirl low and stable and velocity and turbulence variations within HI criteria.

6.2 Recommendations

It is recommended that flow straightening vanes be installed in the suction piping supplying the pumps. A series of four (4) horizontal beams should be installed in each wet well. The plant drain

should be extended to El. (-) 21.30 ft. The recommended modifications can be seen in Figures 5-1 through 5-2.

7.0 REFERENCES

Hydraulic Institute Standards, 2024. American National Standard for Pump Intake Design. Hydraulic Institute, Parsippany, New Jersey, 07054-3802

Sweeney, C.E. and G.E. Rockwell, 1982. Pump Sump Design Acceptance Through Hydraulic Model Testing. Proc. of the International Association for Hydraulic Research: Symposium on Operating Problems of Pump Stations and Power Plants. Amsterdam, The Netherlands, pp. 13-17, September 1982.

Appendix C Cast Iron Piping Condition Assessment Report

Condition Assessment Report

of the

Cast Iron Piping within the Influent Pump Station

at

The Cedar Creek Wastewater Treatment Plant

In

Wantagh, NY

Submitted to:

CDM Smith

CPI Project Number: CD0146, Rv. 0

April 2026

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Table of Contents

1. Introduction 2
2. Background..... 3
3. Methodology..... 3
4. Inspection Findings..... 4
5. Conclusions & Recommendations..... 8
6. Photographs 10

Appendix A – UT Location Drawings

1. Introduction

Corrosion Probe, Inc. (CPI) is pleased to provide this report on the Ultrasonic Testing of Ductile Iron Piping within the Influent Pump Station at the Cedar Creek WWTP in Wantagh, NY.

This report documents the inspection findings, data, analysis, and recommendations, and is respectfully submitted for your review, use, and consideration by,

The Staff of Corrosion Probe, Inc.



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2. Background

As part of a facility upgrades project, CDM Smith requested that CPI perform an assessment of various sections of the suction and discharge piping between the wet wells and grit tanks. This included potential line stop locations on the discharge piping before the utility tunnels. The inspected piping is presumed to be original to the facility and installed circa 1970. A number of fittings near the grit tanks were replaced in 1988 in addition to a number of pipe sections near the pumps were replaced with ductile iron. All piping inspected is presumed to be 48-inch diameter cast iron piping. It is unknown if the piping was internally lined, but it would be common practice around the time of installation for a coal tar epoxy or cement mortar lining to have been installed. Specifications provided by the client indicate that "Pump discharge piping shall be class 100 cast iron pipe with class 125 flanged fittings...". In addition, the specifications indicate the piping within the utility tunnel to be insulated with "...2" block foamglas insulation".

3. Methodology

On March 4th, 2026, CPI performed an inspection of the ductile iron piping in the influent pump station and utility tunnels. Pipes and locations to be inspected were coordinated with CDM Smith and Cedar Creek WWTP staff prior to mobilizing as well as with those present on site during the inspection. The following inspection techniques were utilized while performing the assessment of the Cedar Creek WWTP facility:

i. Careful visual examination of the pump room piping, line stop locations and lengths of the force mains within the gallery, flanges, and hardware to identify and document the presence of corrosion. Pertinent observations and measurements were recorded during the inspection.

ii. Pipe wall thickness measurements were collected via ultrasonic testing (UT). CPI used the A-scan method (i.e., discrete point-measurement) for this inspection.

    a. Prior to use, the UT gauges were calibrated to generic coupons of the material being tested. The acoustic velocity of gray cast iron will change between pipe sections, even across a single pipe section, but wall thickness measurements appear to be generally reliable based on repeatability and as compared to applicable standards.

    b. Removal of the external coating/surface grinding was not required for CPI to perform UT as CPI utilizes an echo-to-echo function. This allows the gauge to ignore thin, well adhered coatings while measuring the thickness of the denser metal substrate.

iii. In some locations UT could not be performed due to significant surface corrosion, scale, insulation, or where the piping bears on the support or out of reach. Those locations are empty and gray in the related results tables below. CPI removed surface corrosion and loose scale with brass wire brush and scraper where able.

While on site CPI conducted inspections via UT and careful visual inspection. The UT gauge utilized for measurements was a Danatronics ECHO 9DLW. UT uses sound waves to evaluate different properties of materials, including thickness.

A location and a position were documented for each UT data point collected. The location corresponds to a specific ring around the pipe, and the position represents the circumferential position around the pipe at that location. The convention used for the position is shown below in **Figure 1.** Collected measurements are presented in the **Tables** below. Locations of UT measurements can be found in **Appendix A** attached.

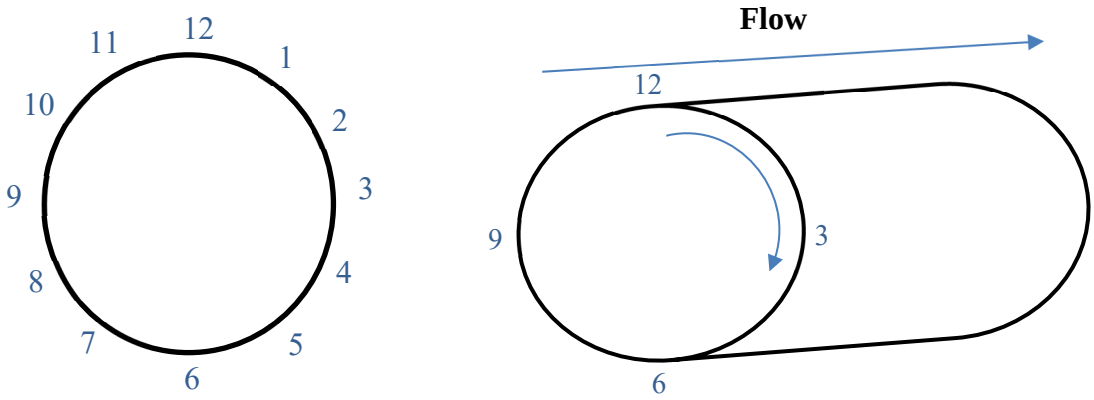


Figure 1 - UT measurement circumferential Positions (i.e., clock positions)

4. Inspection Findings

The coatings throughout the dry well appear to be in poor condition. Top layers of coating have generally failed on the original components with minor surface corrosion observed throughout. Pale red primer was observed at a number of these coating failure locations and tested on site for the presence of lead. In situ lead checks indicated that the pale red primer likely contains some amount of lead. This pale red coating was also observed on the tee fittings within the utility tunnel at testing locations.

The pipe wall thickness at proposed line stop locations was measured within the dry well. The UT measurements can be found in **Table 1** below with **Table 2** providing an estimate of the internal diameter at each location. The coating on the pipe was in overall poor condition. The coating appeared to have three separate layers and was noted to be flaking along a majority of the pipe at the line stop locations. Surface corrosion can be seen where the coating has peeled off or was flaking. The pipe diameter was measured in a number of locations with a consistent external diameter measured to be approximately 50.89”. This is consistent with AWWA C108-53/A21.8-1953 for 48” diameter cast iron, centrifugally cast in sand-lined molds (50.80”). Note that the values referenced in this report did not change between the 1953 edition and the 1975 edition of this standard for 48” diameter piping.

CPI briefly inspected the suction pipe below Line stop 1. It was found to be in poor external condition, so much so that CPI was unable to obtain any measurements due to the irregular, corroded surface. Any existing coating had failed (Photo 4). Manufacturer's markings on the pipe segment appear to indicate Class B pipe manufactured in 1969. This is presumably a reference to AWWA C100 with Class B indicating a 200-feet head pressure rating with a nominal wall thickness of 1.42". The hardware is significantly corroded as well. (Photo 5).

Line stops 2 and 3 were in generally better external condition than Line stop 1. The coating on the piping in both cases was observed to be poorly bonded, if at all, revealing the second coat and primer underneath (Photos 6 & 7). Manufacturer's markings on the adjacent base bends appear to indicate Class B 48" pipe manufactured in 1970 (Photo 8). The exterior coating of both line stops exhibits severe and widespread failure, including extensive peeling and flaking, delamination and cracking, and areas of complete coating loss exposing bare metal. Coating deterioration is most pronounced around flanged joints and bolt heads, along the pipe barrel and at transitions and areas where moisture may accumulate. The remaining coating appears brittle and poorly adhered, providing little to no effective corrosion protection (Photos 9-13).

The pipes are supported by concrete pedestals, which appear intact and properly aligned. The concrete surfaces appear structurally sound but show staining, discoloration, and localized surface wear consistent with moisture exposure. There is no visible cracking or displacement of structural support noted at this time.

The two force mains in the utility tunnels run downstream from Line stops 2 and 3. Facility employees had removed portions of insulation to allow for CPI to inspect the pipes and measure pipe wall thickness. Sections of approximately 6"-12" strips were removed where physically possible. All UT measurements can be found in **Table 3** below. Areas unavailable for UT are noted in Table 2 via blank grey sections. Overall the condition of the pipe from the surface is good. The coating was noted to be intact at all locations where insulation was removed (Photos 14-18). The insulation was different on the elbows and tees compared to the straights. The insulation on the straights was a block foamglas insulation, whereas the elbows and tees were a more fibrous type. A few areas with minor rust staining were found amongst the segments inspected (Photos 19-22).

Table 1: UT Measurements at Line Stop Locations

Line Stop UT Measurements (inches)													
Location	Type	Class	Clock Position								MAX.	MIN.	NOM.	MIN/ NOM
			12:00	1:30	3:00	4:30	6:00	7:30	9:00	10:30				
LS1A	Straight	AWWA C108-53 - A/100	0.765	0.780	0.788	0.760	0.785				0.788	0.760	1.060	72%
LS1B	Straight	AWWA C108-53 - A/100	0.783	0.791	0.693	0.784	0.772	0.780	0.763	0.775	0.791	0.693	1.060	65%
LS2	Straight	AWWA C108-53 - A/100		0.790	0.779	0.788	0.773	0.778	0.781	0.768	0.790	0.768	1.060	72%
LS3	Straight	AWWA C108-53 - A/100		0.781	0.769	0.780	0.786	0.792	0.786		0.792	0.769	1.060	73%

Analysis of the line stop locations is based on the presumption of 48” diameter, Class 100, cast iron pipe centrifugally cast in sand lined molds, per AWWA C108-53/A21.8-1953. Note that the standard values for this specific piping did not change between the 1953 edition and the 1975 edition. Both editions were reviewed for this assessment. Allowable minus tolerance for this diameter of piping would have been 0.10” with an additional minus tolerance of 0.02” allowable over an area not exceeding 8” in any direction. This tolerance would allow for a minimum permitted wall thickness, upon delivery, of 0.94”-0.96” or approximately 89% less than the standard nominal wall thickness.

Table 2: UT Measurements on Utility Tunnel Force Mains

Line Stop Internal Diameter Estimate (inches)					
Location	Type	Class	AVG Wall Thickness	OD	ID
LS1A	Straight	AWWA C108-53 - A/100	0.78	50.89	50.11
LS1B	Straight	AWWA C108-53 - A/100	0.77	50.89	50.12
LS2	Straight	AWWA C108-53 - A/100	0.78	50.89	50.11
LS3	Straight	AWWA C108-53 - A/100	0.78	50.89	50.11

Table 3: UT Measurements at Utility Tunnel Force Mains

Force Main 48" Diameter Pipe UT Measurements (inches)													
Location	Type	Class	Clock Position								MAX.	MIN.	NOM.	MIN/ NOM
			12:00	1:30	3:00	4:30	6:00	7:30	9:00	10:30				
3	Elbow	ASME B16.1			0.724	0.667	0.708	0.782			0.782	0.667	2.000	33%
4	Tee - Branch	ASME B16.1						0.804	0.809	0.802	0.809	0.802	2.000	40%
5	Tee - Strt	ASME B16.1				0.804	0.792	0.802	0.796		0.804	0.792	2.000	40%
6	Tee - Branch	ASME B16.1		0.810	0.804	0.809					0.810	0.804	2.000	40%
7	Tee - Strt	ASME B16.1			0.804	0.809	0.806	0.803			0.809	0.803	2.000	40%
8	Tee - Branch	ASME B16.1	0.807				0.808	0.802	0.807	0.799	0.808	0.799	2.000	40%
9	Tee - Strt	ASME B16.1				0.806	0.808	0.806	0.810		0.810	0.806	2.000	40%
10	Elbow	ASME B16.1			0.765	0.880	0.822				0.880	0.765	2.000	38%
11	Elbow	ASME B16.1			0.567	0.625	0.810				0.810	0.567	2.000	28%
12	Straight	AWWA C108-53 - A/100			0.769	0.784	0.778				0.784	0.769	1.060	73%
13	Straight	AWWA C108-53 - A/100				0.781	0.768	0.778	0.774		0.781	0.768	1.060	72%
14	Straight	AWWA C108-53 - A/100			0.781	0.763	0.780				0.781	0.763	1.060	72%
15	Straight	AWWA C108-53 - A/100			0.812	0.802	0.798	0.804	0.808		0.812	0.798	1.060	75%
16	Straight	AWWA C108-53 - A/100			0.790	0.768	0.783	0.782	0.787		0.790	0.768	1.060	72%

Analysis of the utility tunnel force mains is based on the presumption of 48” diameter, Class 100, cast iron pipe centrifugally cast in sand lined molds, per AWWA C108-75/A21.8-1975, for the straight sticks of piping and 48” diameter, Class 125, cast iron fittings. ASME B16.1 was referenced for the analysis of the fittings. Standards minus tolerances for ASME B16.1 allow for permitted wall thickness upon delivery to be no less than 87.5% of the nominal wall thickness, or 1.75”. Due to insulation and, primarily, access constraints, a limited number of UT positions were able to be measured on the utility tunnel piping.

5. Conclusions & Recommendations

The coatings on the piping within the dry well are considered to be generally failed. CPI would recommend recoating be considered to prevent future, and ongoing, external corrosion of these components. The suction piping and piping at the lower level below the operating floor most prominently exhibit external corrosion. Testing for hazardous materials within the existing coatings and appropriate measures should be taken during removal and surface preparation activities. A polyamidoamine epoxy (such as Tnemec 69 series) should be considered for external recoating of exposed piping, or insulated piping exposed to overhead dripping or leaks. If existing coatings are well bonded to the piping, a sweep blast surface preparation followed by the appropriate primer and polyamidoamine epoxy coating can be applied.

It is common in force mains, particularly at the headworks or front end of a wastewater treatment plant, for erosion to occur, particularly at changes of direction of process flow. Erosion is the mechanical removal of material by loose particles flowing over the material surface. It commonly occurs when grit is entrained or turbulence exacerbates material removal, such as at or near pumps. Erosion is different than corrosion, which degrades material through chemical or electrochemical interactions. Corroded or degraded materials are typically softer than the original materials, making them even more susceptible to erosion. The mode of erosion exacerbating losses where corrosion degradation already exists is commonly termed erosion-corrosion. The extent of erosion-corrosion is based on a number of factors including the rate of flow, process fluid pH, temperature, presence of aggressive ions such as chlorides, viscosity and amount of suspended solids.

Cement mortar lining and epoxy coating systems (more currently) are commonly specified for internal protection of ferrous metal force mains and piping. At the time of installation, coal tar coatings or cement mortar linings would have likely been installed in these pipes. CPI would recommend reviewing any historic documents which may indicate what type of lining system was originally installed. These systems, epoxy and cement mortar, work well to prevent chemical attack of the metal substrates, but will typically break down over time due to physical mechanisms of deterioration, such as erosion. Notably, cement mortar linings will deteriorate faster than epoxy linings due to erosion as well as through acid attack from underdeposit corrosion and in the presence of headspace formation. Installation factors will also affect the service life of these protective linings. Breaches in the lining, poor film quality and dry film thickness, poor surface preparation, or damage from installation will contribute to early failures. Cement mortar linings are more susceptible to biogenic sulfide corrosion, particularly in headspaces, if a sufficient slime layer is allowed to build up on surfaces allowing the propagation of bacteria, most commonly a thiobacillus species, due to insufficient scouring velocity of the process flow or heavy solids accumulation at the invert. Changes in direction of process flow, most common at elbows, crosses, reducers, wyes and tees, create concentration points for more aggressive erosion. In addition to these fittings, valves and segments of piping adjacent to pumps will also experience increased turbulence.

Once any protective lining is deteriorated and the substrate metal is exposed to the process wastewater, electrolytic or oxygen-driven corrosion will deteriorate the ferrous metal pipe wall.

As the corrosion product forms on the internal surface of the pipe wall, the erosive properties of the process flow will strip the corrosion product from the surface, exposing “fresh” metal which will readily corrode.

The wall thickness measurements obtained through UT do not include the thickness of any exterior coatings or interior linings, including cement mortar. The sound waves emitted and received by the UT gauge will travel through the pipe wall and reflect off the back surface, inner face, of the pipe wall instead of carrying through any internal lining, i.e. cement mortar, due to the difference in densities and material properties. An echo-to-echo function is utilized when an external coating is present to negate the thickness of the coating as well.

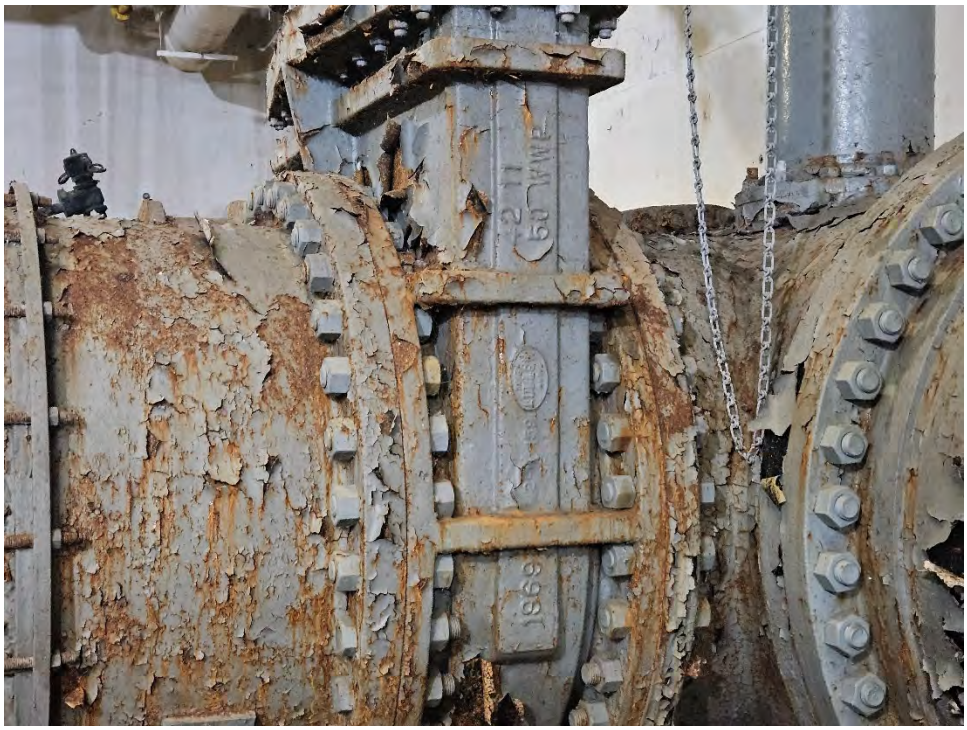
The discharge piping at proposed line stop locations and the straight sections of piping in the utility tunnels appear to be in generally good condition. Wall thickness measurements indicate some amount of loss throughout the tested locations. An engineer should review remaining wall thicknesses with operational pressures and spans between supports to determine any concerns for continued service. Should the piping still be suitable for service, CPI recommends a robust lining system be installed, such as a 100% solids epoxy coating system. These types of linings are more durable than a cement mortar lining and will perform for an extended period of time. Quality assurance should be performed to confirm film quality and installed thicknesses are established per specifications.

The fittings in the utility tunnels appear to have been subjected to significant thinning of the pipe walls. As compared to the presumed pipe class per the provided specification, the losses are significant. It is possible that these fittings are not original or are otherwise a different class than what is dictated in the provided specification. CPI recommends fully removing the insulation from these fittings to observe the manufacturer’s marking on the fitting which would indicate the class and year of installation. The elbows, Locations 10 and 11, appear to indicate preferential thinning towards the spring line at the outside of the elbow. This would be expected in this type of system due to erosion-corrosion. Only a limited number of positions were able to be tested on these fittings during this inspection. CPI recommends subsequent testing to verify the amount of thinning on these fittings by removing all insulation on the component. The Location 3 elbow also exhibits irregular or preferential thinning and should be further inspected as well to verify wall thickness losses throughout the fitting. Losses appear more significant than would be anticipated as compared to the straight sections of piping. It is likely that these fittings are not as dictated in the specification and further review and analysis should be performed.

6. Photographs



Photograph 1- Line stop 1B


Photograph 2- Typical coating failures near line stop 1A



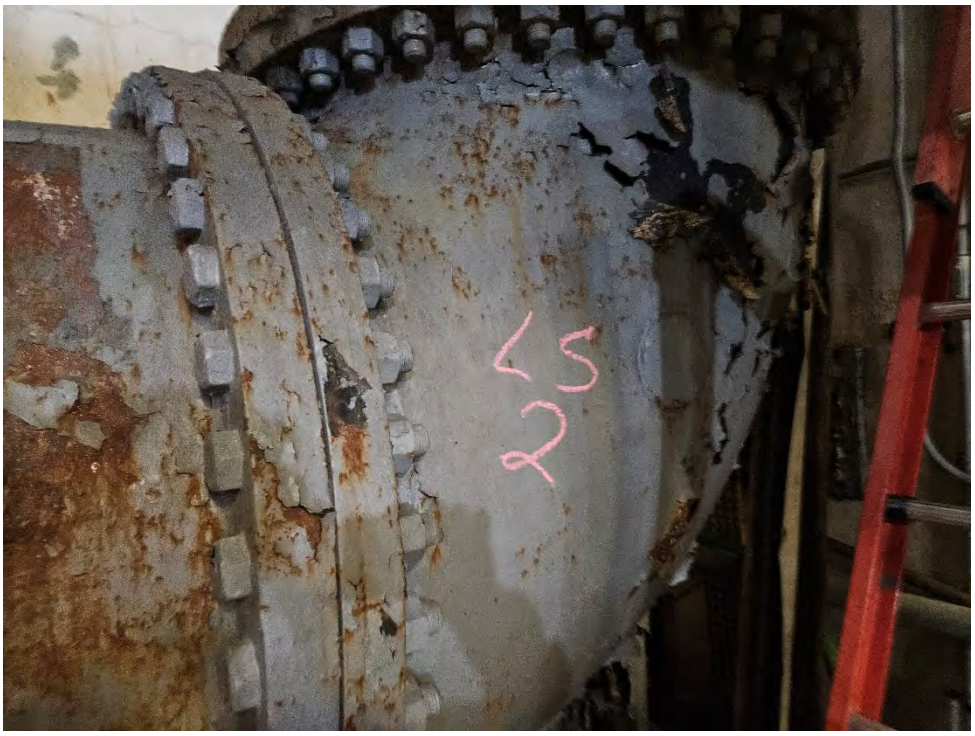
Photograph 3- Surface corrosion through coating failures
Typical throughout



Photograph 4- Suction piping underneath area of Line stop 1
Note the manufacturer markings 1969 48 B



Photograph 5- Hardware condition on suction piping



Photograph 6- Base bend adjacent to line stop 2



Photograph 7- Line stop 2 location
Note the peeling coating and surface corrosion at the connection



Photograph 8- Base bend below line stop 3
Note the manufacturer markings 1970 48 B



Photograph 9- Close up of manufacturer's marking on base bend
Line stop 2



Photograph 10- Line stop 3 coating peeling, flaking and delamination



Photograph 11- Transition from dry well to utility tunnel
Note the surface corrosion and rust bleed through failing coatings



Photograph 12- Coating conditions upstream of line stop 2



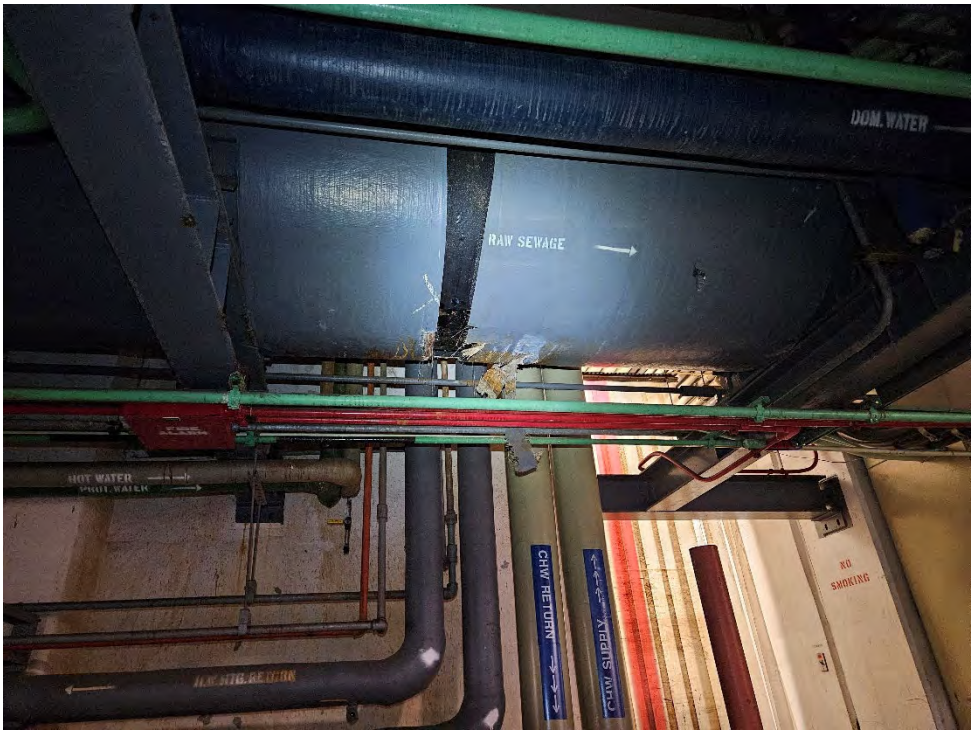
Photograph 13- Overview of coating condition at line stops 2&3
Note the corrosion at the flanged connections



Photograph 14- UT location 16 with insulation removed
Note intact coating on pipe surface



Photograph 15- Close up of piping showing granular/rough coating



Photograph 16- Limited access to pipe circumference due to other utilities
Note staining on insulation (Location 14)



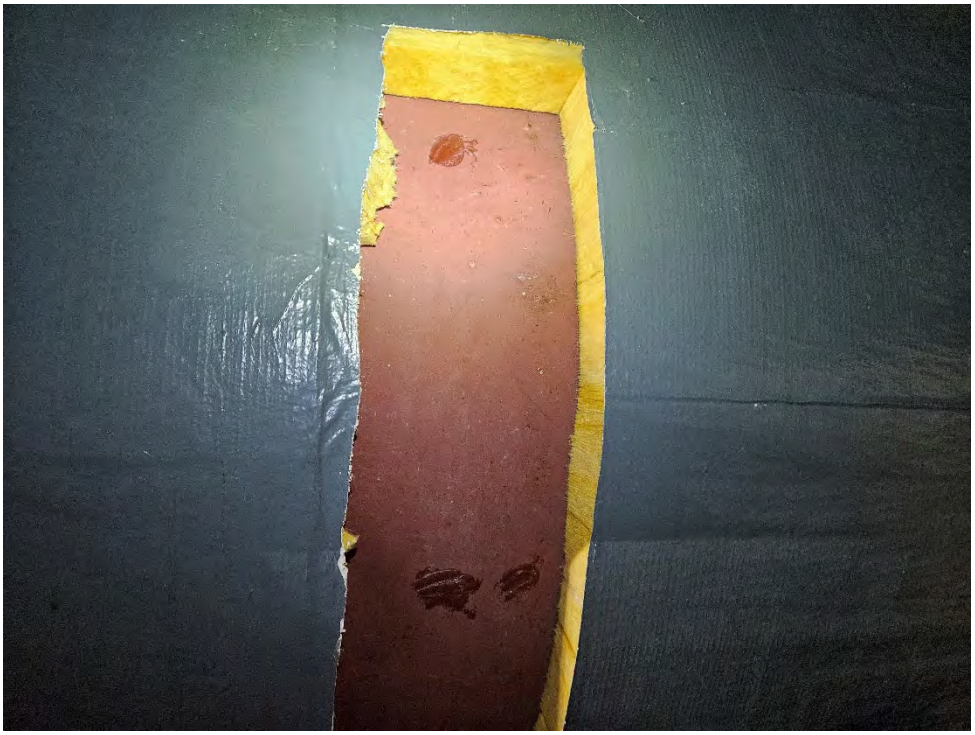
Photograph 17- Leak from above at crown of inspected piping
Location 14



Photograph 18- Closeup of pipe surface at Location 14
Note minor, isolated surface corrosion at coating failures



Photograph 19- UT locations 8-9 tee fitting


Photograph 20- Insulation on tee fittings appears to be a newer vintage on tee fittings; different coating system as well

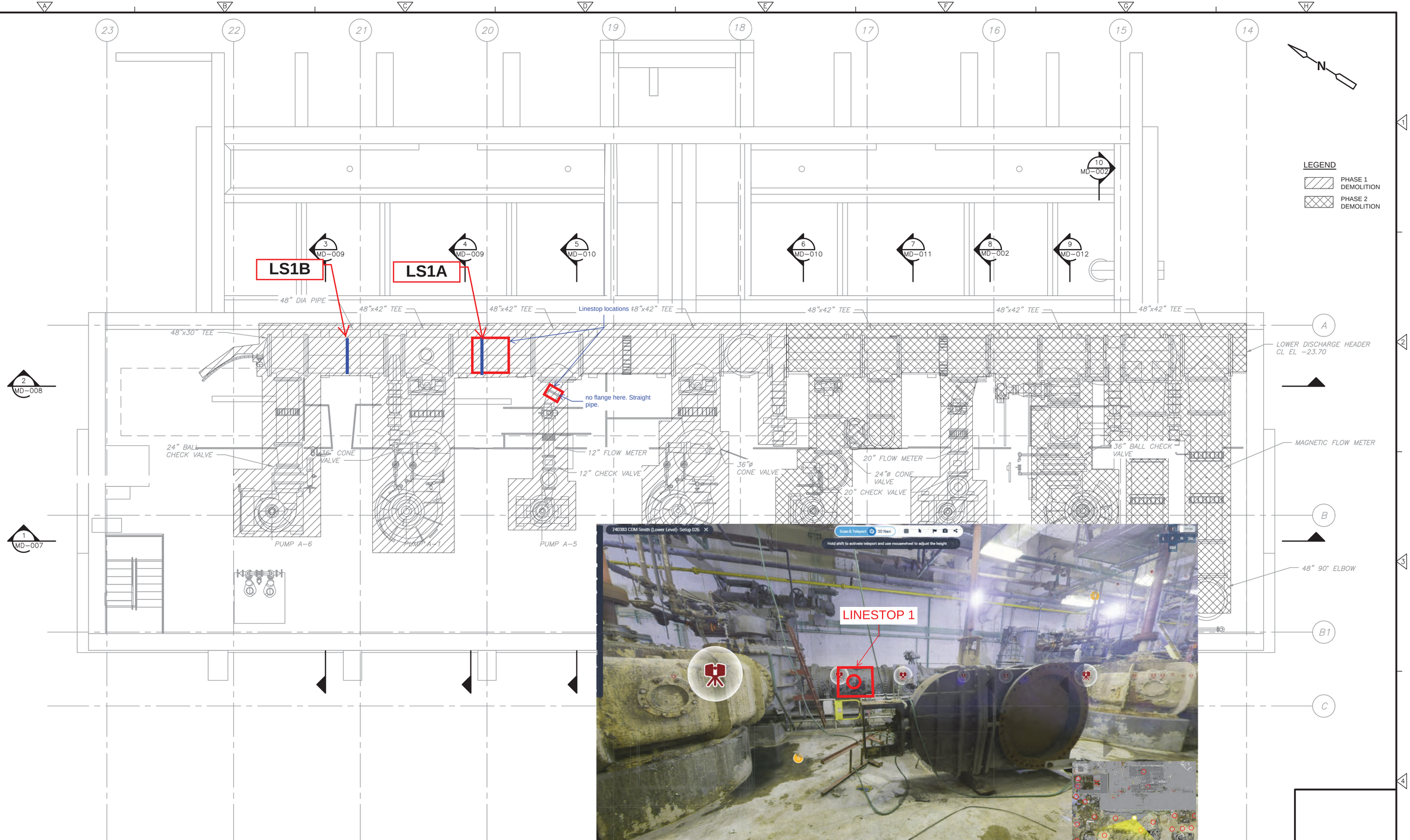


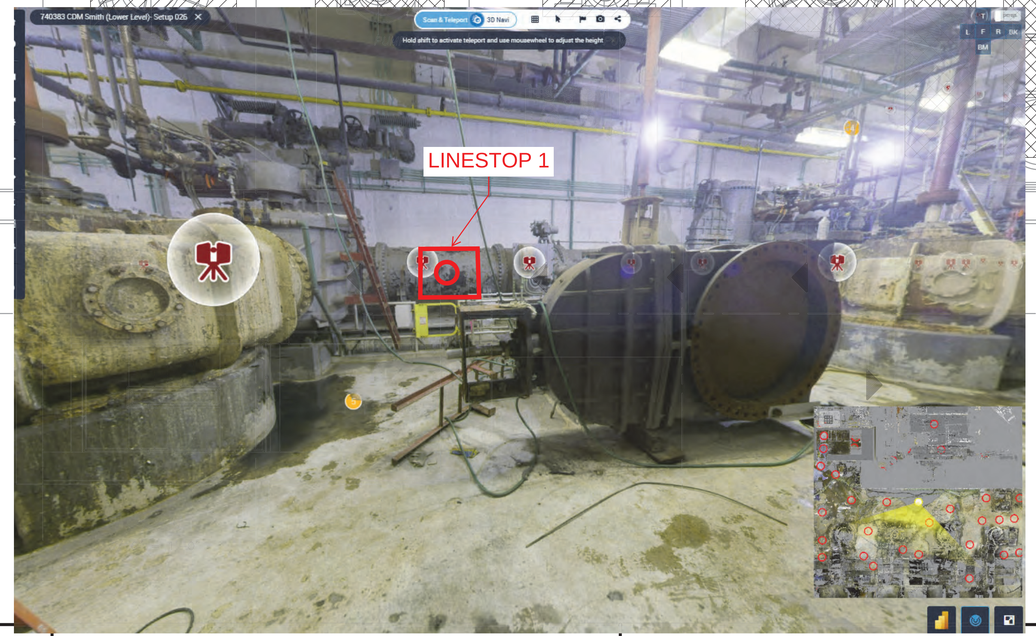
Photograph 21- UT location 11 pipe elbow


Photograph 22- Close up of removed insulation area
Note the surface corrosion

Appendix A
UT Location Drawings

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DESIGNED BY: B. VORHIS
DRAWN BY: GANETH
SHEET CHK'D BY: H. SZEGLOWSKI
CROSS CHK'D BY: X
APPROVED BY: X
DATE: JUNE 2025

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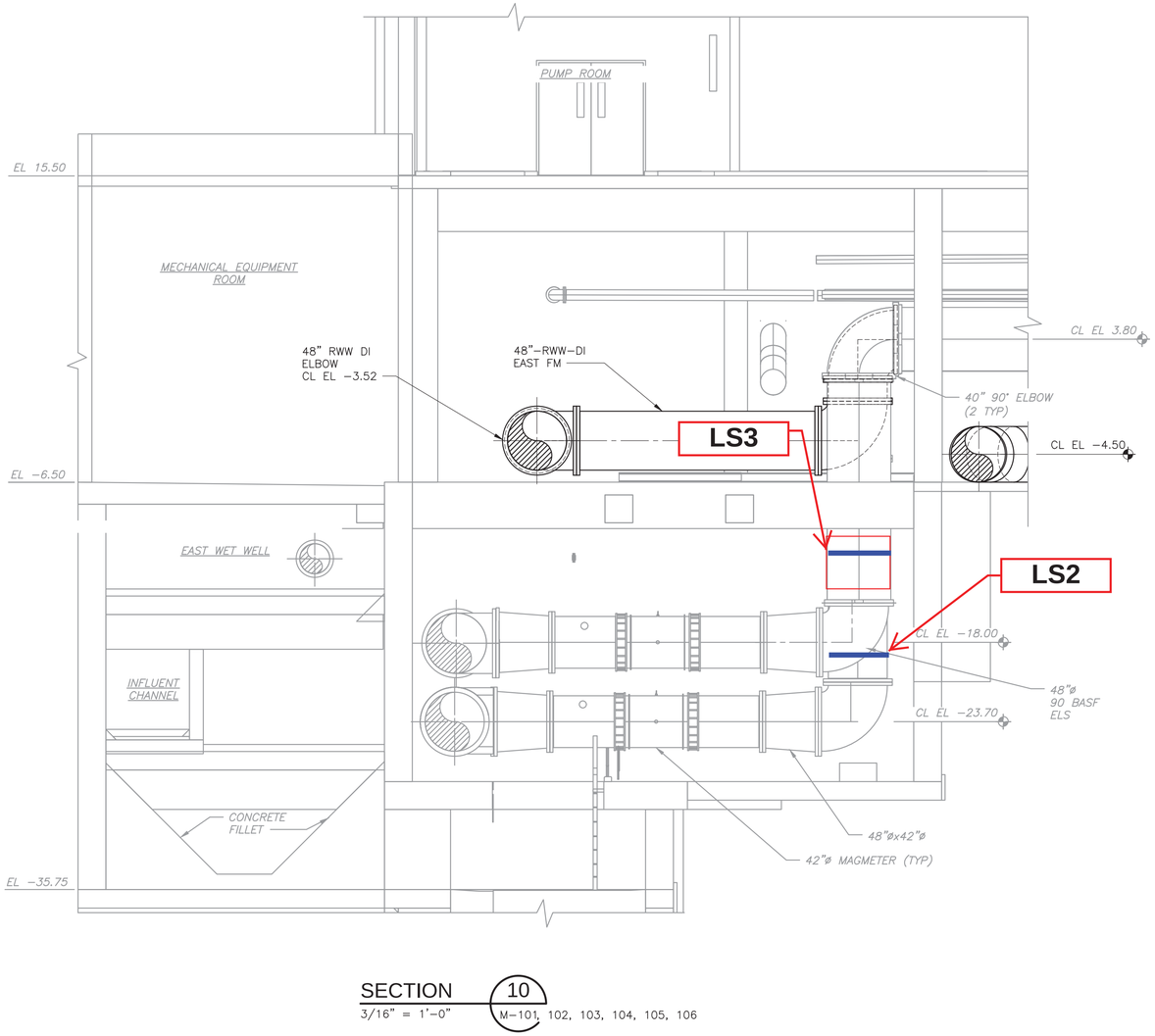
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INFLUENT PUMP STATION IMPROVEMENTS

DEMOLITION INFLUENT PUMPING SYSTEM - PLAN AT EL.(-28.00)

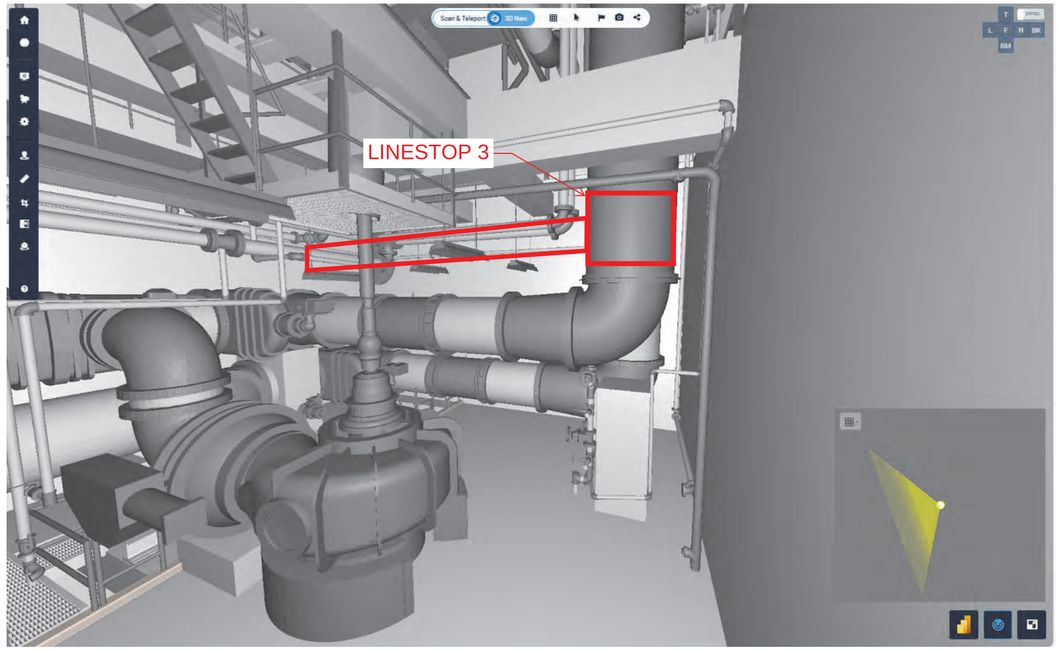
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FILE NAME: MD002PSPL.DWG

SHEET NO.
MD-002

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SECTION 10
3/16" = 1'-0"
M-101, 102, 103, 104, 105, 106



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DESIGNED BY: B. VORHIS
DRAWN BY: P. VEERA
SHEET CHK'D BY: H. SZEGLOWSKI
CROSS CHK'D BY: X
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DATE: JUNE 2025

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INFLUENT PUMP STATION IMPROVEMENTS

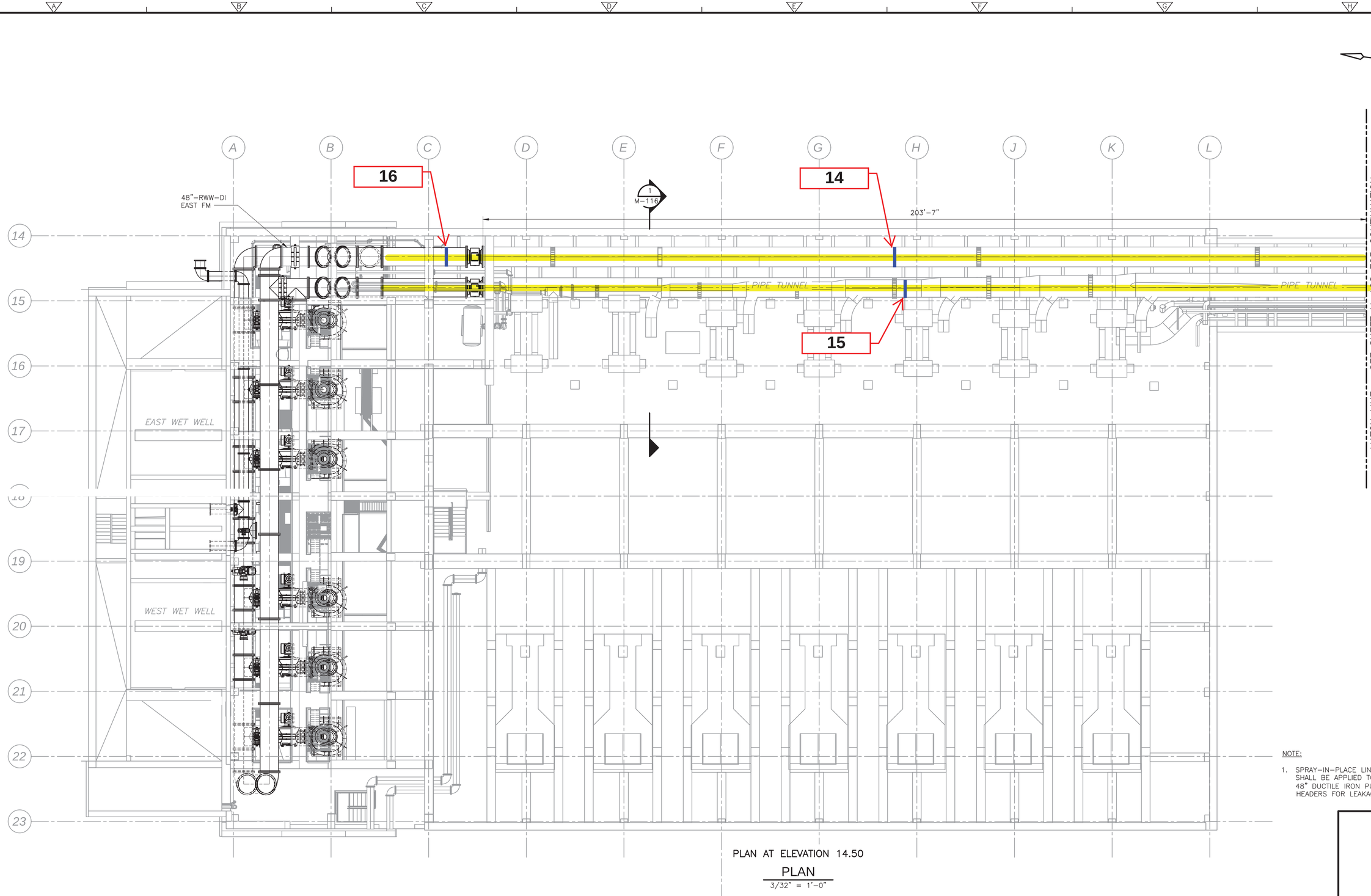
PHASE1 INFLUENT
PUMPING SYSTEM- SECTION 10

PROJECT NO. 5044-300615
FILE NAME: M117PSSC.DWG

SHEET NO.
M-117

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NOTE:

1. SPRAY–IN–PLACE LINING (SIPP) SHALL BE APPLIED TO THE EXISTING 48" DUCTILE IRON PUMP DISCHARGE HEADERS FOR LEAKAGE SEALING.

PLAN AT ELEVATION 14.50

PLAN

3/32" = 1'–0"

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DESIGNED BY: B. VORHIS
DRAWN BY: P. VEERA
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APPROVED BY: X
DATE: JANUARY 2026

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NASSAU COUNTY, NEW YORK

CEDAR CREEK WATER POLLUTION CONTROL PLANT
INFLUENT PUMP STATION IMPROVEMENTS

MECHANICAL PLAN 1

PROJECT NO. 5044–300615
FILE NAME: M107PSPL.dwg

SHEET NO.
M-107

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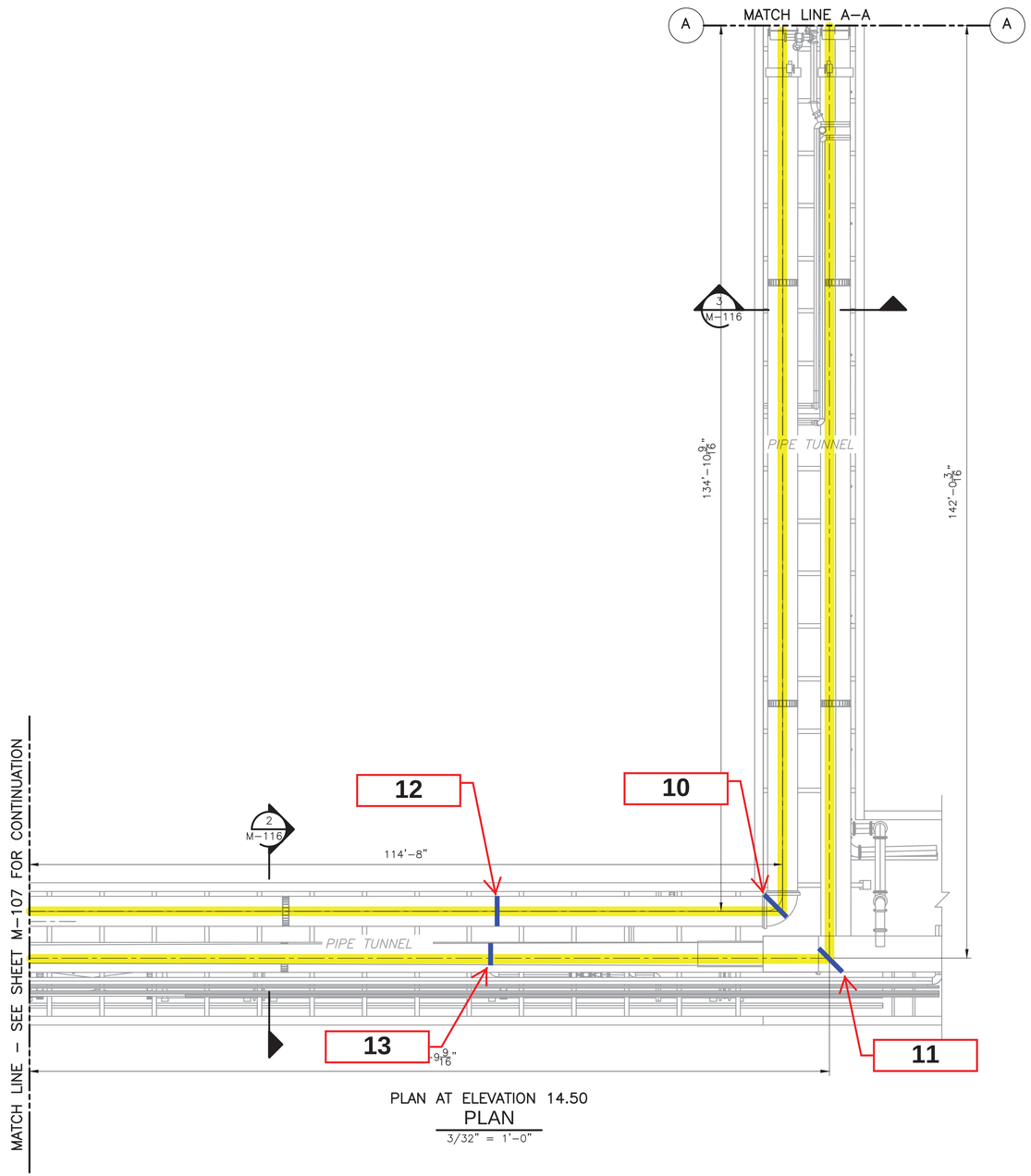
S3C067-11G

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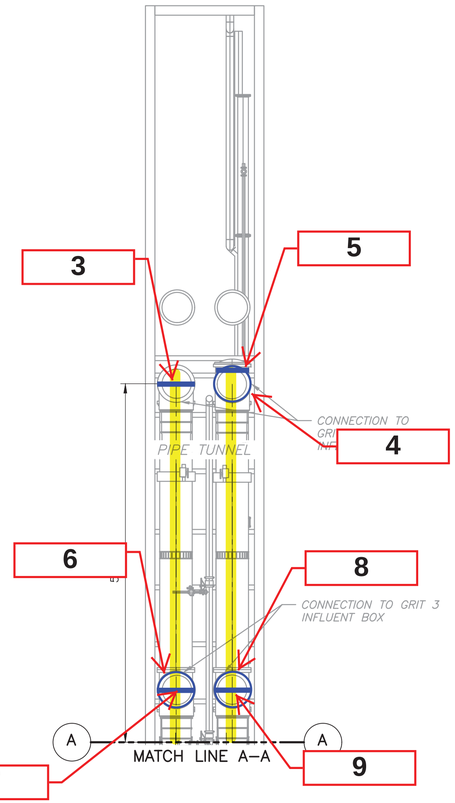
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PLAN AT ELEVATION 14.50

PLAN

3/32" = 1'–0"



PLAN AT ELEVATION 14.50

PLAN

3/32" = 1'–0"

NOTE:

1. SPRAY–IN–PLACE LINING (SIPP) SHALL BE APPLIED TO THE EXISTING 48" DUCTILE IRON PUMP DISCHARGE HEADERS FOR LEAKAGE SEALING.
2. SIPP SHALL BE HELD BACK ATLEAST 3" FROM ANY VALVE SEALING SURFACES.
3. SIPP SHALL EXTEND THROUGH THE TEE CONNECTION AT EACH GRIT INFLUENT BOX.

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: B. VORHIS
DRAWN BY: P. VEERA
SHEET CHK'D BY: H. SZEGLOWSKI
CROSS CHK'D BY: X
APPROVED BY: X
DATE: JANUARY 2026

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DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK WATER POLLUTION CONTROL PLANT
INFLUENT PUMP STATION IMPROVEMENTS

MECHANICAL PLAN 2

PROJECT NO. 5044–300615
FILE NAME: M108PSPL.DWG

SHEET NO.
M-108

75% SUBMITTAL - NOT FOR CONSTRUCTION

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Appendix D Hazardous Building Materials Assessment Data

INSPECTION REPORT
FOR ASBESTOS-CONTAINING MATERIALS, POLYCHLORINATED BIPHENYLS, LEAD-BASED PAINT

Performed at:

Cedar Creek Water Pollution Control Plant
Influent Pumping System Improvements
3340 Merrick Road, Wantagh, NY 11783

Performed for:

CDM Smith
324 S Service Road, Suite 204
Melville, NY 11747

Prepared by:

LiRo Engineers, Inc.
235 East Jericho Turnpike
Mineola, NY 11501

LiRo Job No. 26-091-1307

May 20, 2026

TABLE OF CONTENTS

1.0 BACKGROUND 1

2.0 SCOPE OF WORK 1

3.0 FILE SEARCH RESULTS 1

4.0 SUMMARY OF INSPECTION RESULTS 1

4.1 ASBESTOS CONTAINING MATERIALS (ACM) 1

Table 4.1: Summary of ACM Inspection Results 2

4.2 LEAD-BASED PAINT (LBP) 3

4.3 POLYCHLORINATED BIPHENYLS (PCB'S) 12

4.4 UNIVERSAL/HAZARDOUS WASTE 13

5.0 CONCLUSION AND RECOMMENDATIONS 14

6.0 AREAS NOT ACCESSIBLE 14

7.0 REPORT CERTIFICATIONS 15

APPENDICES

APPENDIX A: ..... Analytical Results & Chain-of-Custody

APPENDIX B: ..... Sample Location Drawing(s)

APPENDIX C: ..... Photograph(s)

APPENDIX D: ..... Personnel Certification(s)

APPENDIX E: ..... Laboratory Accreditation(s)

APPENDIX F: ..... File History

LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

EXECUTIVE SUMMARY

LiRo Engineers, Inc. (LiRo) was contracted by CDM Smith to perform an environmental survey of suspect building materials. The purpose of this survey was to develop an inventory of asbestos-containing materials (ACM), PCB and lead based paint that may be impacted by the proposed renovation project at the Cedar Creek Water Pollution Control Plant located at 3340 Merrick Road, Wantagh, NY 11783.

The extent of the project was determined via the 75% Submittal Drawings by CDM Smith, dated January 2026.

LiRo performed this limited environmental survey based to identify, quantify and gather bulk samples of any suspect materials that may be impacted by the work. The laboratory analysis of each sampled material has been included in this report; a summary of the laboratory analysis results is as follows:

- **Materials are assumed to be ACM, as indicated in the initial asbestos survey performed by D&B and reported 03/2017:**
  - **Elevation -28.00 and -35.75 - Gasket Material**
  - **Elevation -28.00 - Vibration Dampening Cloth on Exhaust Units**
  - **Elevation 15.50 – Electrical Cabinets - Backer Board/Transite Panel**
- **Results from the D&B survey report dated March 2017 have been reviewed and the following materials tested positive asbestos containing:**
  - **Cementitious Pipe Insulation Fitting/Elbow (Green Pipe) - Basement**
- **Surface wipes did not detect any evidence of fluid PCB leaks or contamination.**
- **Surface coatings were determined to be lead-based paint (>1.0 mg/cm2).**
- **Fluorescent bulbs were discovered within the survey area that will be impacted by the work of this project. These materials must be disposed of as Universal Waste items. These bulbs are assumed to have PCB containing ballasts that must be disposed of as Hazardous Waste items.**

Section 4.0 of this report includes the details of the inspection for each suspect material within the designated survey area. Details therein include material descriptions and their respective locations, as well as their analytical results

LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

1.0 BACKGROUND

LiRo Engineers, Inc. (LiRo) has completed a limited environmental survey for the presence of asbestos-containing materials (ACM), polychlorinated biphenyls (PCBs), lead-based paint (LBP) at the following buildings:

Site: Cedar Creek WPCP
Address: 3340 Merrick Road, Wantagh, NY 11783

The inspectors responsible for this project are:

Rosemarie Salerno	EPA Lead Inspector	Cert. No.: LBP-R-111498-3	Exp.: 04/11/2027
	NYS DOL Asbestos Inspector	Cert. No.: 25-61V89-SHAB	Exp.: 10/2026
Chuks Okoh	EPA Lead Inspector	Cert. No.: LBP-R-18740-4	Exp.: 01/27/2029
	NYS DOL Asbestos Inspector	Cert. No.: 25-6LTSG-SHAB	Exp.: 12/2026

Site Visit(s): May 7, 2026 and May 8, 2026

The laboratories used in the analysis of the samples were:

EMSL Analytical: 117 East 30th Street New York, New York, 10016
NVLAP No.: 200546-0 NYS DOL ELAP No.: 11480

Long Island Analytical: 110 Colin Drive, Holbrook, New York, 11741
NYS DOL ELAP No.: 11693

2.0 SCOPE OF WORK

Interior and exterior areas were inspected at Cedar Creek WPCP in relation to the proposed renovations as detailed in the 75% Submittal Drawings by CDM Smith, dated January 2026. The inspection was characterized by a close visual inspection of all accessible areas. Suspect materials found were sampled and inventoried for quantity, condition, and friability.

3.0 FILE SEARCH RESULTS

An asbestos inspection report from D & B Engineers and Architects, P.C., dated March 2017 was reviewed. The following materials tested positive for asbestos:

- **Cementitious Pipe Insulation Fitting/Elbow**

4.0 SUMMARY OF INSPECTION RESULTS

4.1 ASBESTOS CONTAINING MATERIALS (ACM)

Asbestos Guidelines

Guidelines used for the Asbestos inspection were established by the Environmental Protection Agency (EPA) in the Guidance for Controlling Asbestos Containing Materials in Buildings, Office of Pesticides and Toxic Substances, DOC #560/5-85-024, and 40 CFR Part 763, Asbestos Hazard Emergency Response Act (AHERA).

Field information was organized as per the AHERA concept of homogenous area (HA). That is, suspect ACM with similar age, appearance, application, and texture was grouped together, sampled, and assessed for condition.

Bulk samples of suspect ACM were analyzed by Polarized Light Microscopy (PLM) with dispersion staining, as described in 40 CFR Part 763 and the National Emissions Standard for Hazardous Air Pollutants (NESHAPS).

All samples were initially analyzed by using Polarized Light Microscopy. Samples which yielded a negative PLM result, and which are classified as a "non-friable" material were then re-analyzed utilizing transmission Electron Microscopy methodology.

Inspection Scope and Material Assessment

The asbestos inspection involved a thorough visual examination of all areas likely to be impacted by the proposed renovation activities. Suspect materials were identified, sampled, and inventoried. Photos of survey areas and materials are presented in Appendix C.

Materials, which are expected to be impacted by the proposed scope of work, have been confirmed to contain asbestos.

A summary of the inspection results in present in Table 4.1.

Table 4.1: Summary of ACM Inspection Results

HA No.	Location	Material	No. of Samples	Results	Quantity	Notes
1	Roof Level 50.50	Top Membrane	2	No Asbestos Detected (NAD)	0.0	PACM roofing in the D&B report has been determined to not contain asbestos
2	Roof Level 50.50	Felt paper on Roof Deck Insulation	2	NAD	0.0	
3	Roof Level 50.50	Roof Deck Insulation	2	NAD	0.0	
4	Roof Level 50.50	Bottom Tar Coating	2	NAD	0.0	
5	Elevation 30.50	Ceramic Tile Grout	2	NAD	0.0	----
6	Elevation 30.50	Ceramic Tile Backing	2	NAD	0.0	----
7	Elevation 4.50 Force Main	Big Pipe - Insulation Wrap (Blue)	3	NAD	0.0	----
8	Elevation 4.50 Force Main	Big Pipe – Insulation Black Cork/Foam Material	3	NAD	0.0	----
9	Elevation -28.00 (Sub-Basement Dry Well)	Centrifugal Pumps Gasket Material	2	NAD	0.0	New
10	Elevation 30.50	Duct/HVAC Insulation (Vertical)	2	NAD	0.0	----
-	**Elevation -28.00 and -35.75**	**Gasket Material**	-	**Assumed ACM**	**200.0 SF**	**Old - Inaccessible**

HA No.	Location	Material	No. of Samples	Results	Quantity	Notes
-	Elevation 15.50	Assumed Underlayment beneath the Terrazzo Flooring	-	Not Observed	0.0	PACM underlayment in the D&B report has been confirmed to not be present (no suspect ACM)
-	**Elevation -28.00**	**Vibration Dampening Cloth on Exhaust Units**	-	**Assumed ACM**	**8.0 SF**	**Inaccessible as the duct was still in use**
-	Throughout	Vinyl Wire Insulation	-	Non-Suspect	0.0	----
-	**Elevation 15.50 – Electrical Cabinets**	**Backer Board/Transite Panel**	-	**Assumed ACM**	**500.0 SF**	**Inaccessible due to Live Electric**
-	Elevation -6.50/4.50	Assumed Backer Board/Transite Panel and Braided Wiring	-	Not Observed	0.0	Confined Space Area
-	Elevation -6.50/4.50	Metal Backer Board and Vinyl Wire Insulation	-	Non-Suspect	0.0	Confined Space Area
File History – D&B Engineers, March 2017						
-	**Elevation -28.00**	**Cementitious Pipe Insulation Fitting/Elbow**	-	**ACM**	**50.0 LF**	----
-	**Elevation -6.50**	**Cementitious Pipe Insulation Fitting/Elbow**	-	**ACM**	**10.0 LF**	----
-	**Elevation 15.50**	**Cementitious Pipe Insulation Fitting/Elbow**	-	**ACM**	**10.0 LF**	----
				Total ACM Quantity	**708.0 SF / 70.0 LF**	

*** Quantities of material to be impacted will be developed as the exact scope of renovations is determined through the design process.**

An asbestos-containing material (ACM) is any material containing more than one percent (1%) asbestos. Any material not listed or addressed must be assumed ACM. If any materials that are not listed are encountered, all work must cease and representatives from CDM Smith must be contacted immediately.

4.2 LEAD-BASED PAINT (LBP)

Field Survey Procedures

The random sampling protocol described in the 40 CFR Part 745, U.S. EPA Lead Renovation, Repair, and Painting Rule was utilized in developing the sampling procedures for this LBP survey. Random sampling of a facility or structure that has similar characteristics such as construction materials, painting histories, and date of construction is considered an appropriate methodology. The survey was conducted in accordance with the U.S EPA Standards.

Inspection Scope and Material Assessment

The random sampling protocol described in the 40 CFR Part 745, U.S. EPA Lead Renovation, Repair, and Painting Rule was utilized in developing the sampling procedures for this LBP survey using a handheld X-Ray Fluorescence (XRF) unit. The XRF unit automatically calibrates each time the device is turned on. The calibration is accomplished

by sampling the tungsten shield and adjusting its sampling results to match the known response of the tungsten. This calibration was conducted at the beginning and end of testing. Paint containing greater than or equal to 1.0 milligram per square centimeter (mg/cm^2) of lead was considered LBP.

Inspection Scope and Material Assessment

The LBP inspection involved the visual inspection of the area to be affected, and the collection of XRF readings from all suspect surfaces. The following table provides a summary of laboratory analyses of the samples:

Table 4.2 – LBP (XRF) SUMMARY OF INSPECTION RESULTS (SIRT)

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
1	Calibration					0.5	
2						0.5	
3						0.5	
4						-0.1	
5						-0.2	
6						-0.1	
7	-28 Level	Basement Dry Well	Door	Brown	Metal	0.3	Poor
8	**-28 Level**	**Basement Dry Well**	**Door Frame**	**Brown**	**Metal**	**1.3**	**Poor**
9	-28 Level	Basement Dry Well	Door	Brown	Metal	0.2	Poor
10	**-28 Level**	**Basement Dry Well**	**Door Frame**	**Brown**	**Metal**	**1.1**	**Poor**
11	-28 Level	Basement Dry Well	Wall	White	Plaster	-0.3	Poor
12	-28 Level	Basement Dry Well	Wall	White	Plaster	0.1	Poor
13	-28 Level	Basement Dry Well	Wall	White	Plaster	0.0	Poor
14	-28 Level	Basement Dry Well	Wall	White	Plaster	0.2	Poor
15	-28 Level	Basement Dry Well	Elevator Door	Brown	Metal	-0.2	Poor
16	-28 Level	Basement Dry Well	Elevator Door	Brown	Metal	-0.2	Poor
17	**-28 Level**	**Basement Dry Well**	**Elevator Door Frame**	**Brown**	**Metal**	**1.2**	**Poor**
18	**-28 Level**	**Basement Dry Well**	**Elevator Door Frame**	**Brown**	**Metal**	**2.1**	**Poor**

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
19	-28 Level	Basement Dry Well	Centrifugal Pumps 1	Yellow	Metal	0.0	Poor
20	-28 Level	Basement Dry Well	Centrifugal Pumps 1	Grey	Metal	0.2	Poor
21	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 2**	**Yellow**	**Metal**	**3.4**	**Poor**
22	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 2**	**Grey**	**Metal**	**2.1**	**Poor**
23	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 3**	**Yellow**	**Metal**	**1.8**	**Poor**
24	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 3**	**Grey**	**Metal**	**2.4**	**Poor**
25	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 4**	**Yellow**	**Metal**	**3.2**	**Poor**
26	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 4**	**Grey**	**Metal**	**1.1**	**Poor**
27	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 5**	**Yellow**	**Metal**	**1.6**	**Poor**
28	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 5**	**Grey**	**Metal**	**2.2**	**Poor**
29	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 6**	**Yellow**	**Metal**	**1.4**	**Poor**
30	**-28 Level**	**Basement Dry Well**	**Centrifugal Pumps 6**	**Grey**	**Metal**	**1.2**	**Poor**
31	-28 Level	Basement Dry Well	Centrifugal Pumps 7	Yellow	Metal	0.3	Poor
32	-28 Level	Basement Dry Well	Centrifugal Pumps 7	Grey	Metal	0.2	Poor
33	-28 Level	Basement Dry Well	Top Big Pipes	Grey	Metal	0.2	Poor
34	-28 Level	Basement Dry Well	Top Big Pipes	Grey	Metal	0.2	Poor
35	-28 Level	Basement Dry Well	Top Big Pipes	Grey	Metal	-0.3	Poor
36	-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Grey	Metal	0.2	Poor
37	-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Grey	Metal	0.2	Poor

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
38	-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Grey	Metal	-0.3	Poor
39	-28 Level	Basement Dry Well	Platforms/Pads	Grey	Concrete	-0.1	Poor
40	-28 Level	Basement Dry Well	Platforms/Pads	Grey	Concrete	0.2	Poor
41	-28 Level	Basement Dry Well	Platforms/Pads	Grey	Concrete	0.2	Poor
42	-28 Level	Basement Dry Well	Platforms/Pads	Grey	Metal	-0.3	Poor
43	-28 Level	Basement Dry Well	Platforms/Pads	Grey	Metal	-0.2	Poor
44	-28 Level	Basement Dry Well	Platforms/Pads	Grey	Metal	0.2	Poor
45	**-28 Level**	**Basement Dry Well**	**Pipes Support**	**Grey**	**Metal**	**2.1**	**Poor**
46	**-28 Level**	**Basement Dry Well**	**Pipes Support**	**Grey**	**Metal**	**1.7**	**Poor**
47	**-28 Level**	**Basement Dry Well**	**Pipes Support**	**Grey**	**Metal**	**2.2**	**Poor**
48	**-28 Level**	**Basement Dry Well**	**Centrifugal Pipes**	**Red**	**Metal**	**3.1**	**Poor**
49	**-28 Level**	**Basement Dry Well**	**Centrifugal Pipes**	**Red**	**Metal**	**1.1**	**Poor**
50	**-28 Level**	**Basement Dry Well**	**Centrifugal Pipes**	**Red**	**Metal**	**2.7**	**Poor**
51	**-28 Level**	**Basement Dry Well**	**Centrifugal Pipes**	**Red**	**Metal**	**1.3**	**Poor**
52	-28 Level	Staircase	Wall	Tan	Plaster	0.3	Poor
53	-28 Level	Staircase	Wall	Tan	Plaster	0.2	Poor
54	-28 Level	Staircase	Wall	Tan	Plaster	0.2	Poor
55	-28 Level	Staircase	Wall	Tan	Plaster	0.1	Poor
56	**-28 Level**	**Staircase**	**Closed Strigent**	**Tan**	**Metal**	**2.8**	**Poor**
57	**-28 Level**	**Staircase**	**Closed Strigent**	**Tan**	**Metal**	**2.2**	**Poor**
58	**-28 Level**	**Staircase**	**Open Strigent**	**Tan**	**Metal**	**1.7**	**Poor**
59	**-28 Level**	**Staircase**	**Open Strigent**	**Tan**	**Metal**	**1.9**	**Poor**

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
60	**-28 Level**	**Staircase**	**Riser**	**Tan**	**Metal**	**2.1**	**Poor**
61	**-28 Level**	**Staircase**	**Riser**	**Tan**	**Metal**	**3.1**	**Poor**
62	**-28 Level**	**Staircase**	**Underneath Staircase**	**Tan**	**Metal**	**2.4**	**Poor**
63	**-28 Level**	**Staircase**	**Underneath Staircase**	**Tan**	**Metal**	**2.2**	**Poor**
64	-28 Level	Staircase	Open Strigent	Grey	Metal	0.0	Poor
65	-28 Level	Staircase	Closed Strigent	Grey	Metal	-0.1	Poor
66	-28 Level	Staircase	Riser	Grey	Metal	0.1	Poor
67	-28 Level	Staircase	Riser	Grey	Metal	0.2	Poor
68	-28 Level	Staircase	Wall	Grey	Plaster	-0.3	Poor
69	-28 Level	Staircase	Wall	Grey	Plaster	0.1	Poor
70	-28 Level	Staircase	Underneath Staircase	Grey	Metal	0.2	Poor
71	-28 Level	Staircase	Underneath Staircase	Grey	Metal	0.3	Poor
72	-28 Level	Basement Dry Well	Column	White	Concrete	-0.4	Poor
73	-28 Level	Basement Dry Well	Column	White	Concrete	-0.3	Poor
74	-28 Level	Basement Dry Well	Column	White	Concrete	0.1	Poor
75	-28 Level	Basement Dry Well	Wall	White	Brick Mortar	0.2	Poor
76	-28 Level	Basement Dry Well	Wall	White	Brick Mortar	-0.2	Poor
77	-28 Level	Basement Dry Well	Waste Pipes	Grey	Cast Iron	-0.3	Poor
78	-28 Level	Basement Dry Well	Waste Pipes	Grey	Cast Iron	0.1	Poor
79	-28 Level	Basement Dry Well	Waste Pipes	Beige	Cast Iron	0.2	Poor
80	**-14 Level**	**Centrifugal Pipe Perimeter**	**Staircase Platform Support**	**Brown**	**Metal**	**2.1**	**Poor**
81	**-14 Level**	**Centrifugal Pipe Perimeter**	**Staircase Platform Support**	**Brown**	**Metal**	**3.4**	**Poor**

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
82	-14 Level	Centrifugal Pipe Perimeter	Wall	White	Concrete	-0.4	Poor
83	-14 Level	Centrifugal Pipe Perimeter	Wall	White	Concrete	0.2	Poor
84	-14 Level	Centrifugal Pipe Perimeter	Wall	White	Concrete	0.3	Poor
85	-14 Level	Centrifugal Pipe Perimeter	Handrail	Grey	Metal	0.1	Poor
86	-14 Level	Centrifugal Pipe Perimeter	Tread	Grey	Metal	-0.3	Poor
87	-14 Level	Centrifugal Pipe Perimeter	Baluster	Grey	Metal	-0.3	Poor
88	**-6.5 Level**	**Staircase-Basement Walk Way**	**Wall**	**Tan**	**Ceramic**	**2.1**	**Poor**
89	**-6.5 Level**	**Staircase-Basement Walk Way**	**Wall**	**Tan**	**Ceramic**	**1.6**	**Poor**
90	**-6.5 Level**	**Staircase-Basement Walk Way**	**Wall**	**Tan**	**Ceramic**	**2.8**	**Poor**
91	**-6.5 Level**	**Staircase-Basement Walk Way**	**Wall**	**Tan**	**Ceramic**	**2.4**	**Poor**
92	-6.5 Level	Staircase-Basement Walk Way	Wall	White	Plaster	0.3	Poor
93	-6.5 Level	Staircase-Basement Walk Way	Wall	White	Plaster	0.1	Poor
94	-6.5 Level	Staircase-Basement Walk Way	Wall	White	Plaster	-0.3	Poor
95	**-6.5 Level**	**Staircase-Basement Walk Way**	**Wall**	**White**	**Plaster**	**3.3**	**Poor**
96	**-6.5 Level**	**Staircase-Basement Walk Way**	**Door**	**Brown**	**Metal**	**2.6**	**Poor**

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
97	-6.5 Level	Staircase-Basement Walk Way	Door Frame	Brown	Metal	1.5	Poor
98	-6.5 Level	Staircase-Basement Walk Way	Door	Brown	Metal	2.5	Poor
99	-6.5 Level	Staircase-Basement Walk Way	Door Frame	Brown	Metal	1.0	Poor
100	-6.5 Level	Staircase-Basement Walk Way	Closed Strigent	Tan	Metal	2.2	Poor
101	-6.5 Level	Staircase-Basement Walk Way	Closed Strigent	Tan	Metal	1.1	Poor
102	-6.5 Level	Staircase-Basement Walk Way	Open Strigent	Tan	Metal	2.4	Poor
103	-6.5 Level	Staircase-Basement Walk Way	Open Strigent	Tan	Metal	1.0	Poor
104	-6.5 Level	Staircase-Basement Walk Way	Riser	Tan	Metal	2.2	Poor
105	-6.5 Level	Staircase-Basement Walk Way	Riser	Tan	Metal	1.1	Poor
106	-6.5 Level	Staircase-Basement Walk Way	Underneath Staircase	Tan	Metal	2.4	Poor
107	-6.5 Level	Staircase-Basement Walk Way	Underneath Staircase	Tan	Metal	1.9	Poor
108	4.5 Level	Stairwell-Bearing Access Platforms	Closed Strigent	Tan	Metal	2.2	Poor
109	4.5 Level	Stairwell-Bearing Access Platforms	Closed Strigent	Tan	Metal	1.1	Poor
110	4.5 Level	Stairwell-Bearing Access Platforms	Open Strigent	Tan	Metal	2.4	Poor

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
111	4.5 Level	Stairwell-Bearing Access Platforms	Open Strigent	Tan	Metal	1.0	Poor
112	4.5 Level	Stairwell-Bearing Access Platforms	Riser	Tan	Metal	2.2	Poor
113	4.5 Level	Stairwell-Bearing Access Platforms	Riser	Tan	Metal	1.1	Poor
114	4.5 Level	Stairwell-Bearing Access Platforms	Underneath Staircase	Tan	Metal	2.4	Poor
115	4.5 Level	Stairwell-Bearing Access Platforms	Underneath Staircase	Tan	Metal	1.0	Poor
116	4.5 Level	Stairwell-Bearing Access Platforms	Wall	Tan	Ceramic	1.1	Poor
117	4.5 Level	Stairwell-Bearing Access Platforms	Wall	Tan	Ceramic	1.4	Poor
118	4.5 Level	Stairwell-Bearing Access Platforms	Wall	Tan	Ceramic	1.3	Poor
119	4.5 Level	Stairwell-Bearing Access Platforms	Wall	Tan	Ceramic	1.2	Poor
120	4.5 Level	Stairwell-Bearing Access Platforms	Ceiling	Tan	Plaster	0.1	Poor
121	15.5 Level	Stairwell-Ground Floor Ref	Closed Strigent	Tan	Metal	2.2	Poor
122	15.5 Level	Stairwell-Ground Floor Ref	Closed Strigent	Tan	Metal	2.6	Poor
123	15.5 Level	Stairwell-Ground Floor Ref	Open Strigent	Tan	Metal	2.4	Poor
124	15.5 Level	Stairwell-Ground Floor Ref	Open Strigent	Tan	Metal	2.3	Poor
125	15.5 Level	Stairwell-Ground Floor Ref	Riser	Tan	Metal	2.2	Poor
126	15.5 Level	Stairwell-Ground Floor Ref	Riser	Tan	Metal	1.1	Poor
127	15.5 Level	Stairwell-Ground Floor Ref	Underneath Staircase	Tan	Metal	2.4	Poor
128	15.5 Level	Stairwell-Ground Floor Ref	Underneath Staircase	Tan	Metal	1.8	Poor

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
129	**15.5 Level**	**Stairwell-Ground Floor Ref**	**Wall**	**Tan**	**Ceramic**	**2.3**	**Poor**
130	**15.5 Level**	**Stairwell-Ground Floor Ref**	**Wall**	**Tan**	**Ceramic**	**2.2**	**Poor**
131	**15.5 Level**	**Stairwell-Ground Floor Ref**	**Wall**	**Tan**	**Ceramic**	**1.6**	**Poor**
132	**15.5 Level**	**Stairwell-Ground Floor Ref**	**Wall**	**Tan**	**Ceramic**	**2.1**	**Poor**
133	15.5 Level	Stairwell-Ground Floor Ref	Ceiling	Tan	Plaster	-0.3	Poor
134	15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Tan	Metal	0.3	Poor
135	15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Tan	Metal	0.2	Poor
136	15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Tan	Metal	0.2	Poor
137	15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Green	Metal	0.2	Poor
138	15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Green	Metal	-0.3	Poor
139	15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Green	Metal	0.2	Poor
140	15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Green	Metal	0.2	Poor
141	30.5 Level	HVAC Demolition Overall Plan	Wall	Beige	Plaster	-0.3	Poor
142	30.5 Level	HVAC Demolition Overall Plan	Wall	Beige	Plaster	-0.1	Poor
143	30.5 Level	HVAC Demolition Overall Plan	Wall	Beige	Plaster	0.2	Poor

Test No.	Floor	Room	Component	Color	Substrate	XRF Reading (mg/cm^2)	Paint Condition (Intact, Fair, or Poor)
144	30.5 Level	HVAC Demolition Overall Plan	Wall	Beige	Plaster	0.2	Poor
145	**30.5 Level**	**HVAC Demolition Overall Plan**	**Wall**	**Brown**	**Ceramic**	**1.6**	**Poor**
146	**30.5 Level**	**HVAC Demolition Overall Plan**	**Wall**	**Brown**	**Ceramic**	**1.1**	**Poor**
147	**30.5 Level**	**HVAC Demolition Overall Plan**	**Wall**	**Brown**	**Ceramic**	**2.2**	**Poor**
148	**30.5 Level**	**HVAC Demolition Overall Plan**	**Wall**	**Brown**	**Ceramic**	**1.8**	**Poor**
149	30.5 Level	HVAC Demolition Overall Plan	HVAC/Duct Coating	Grey	Canvas	-0.3	Poor
150	30.5 Level	HVAC Demolition Overall Plan	HVAC/Duct Coating	Grey	Canvas	0.2	Poor
151	30.5 Level	HVAC Demolition Overall Plan	HVAC/Duct Coating	Grey	Canvas	0.2	Poor
152	Calibration					0.5	
153						0.5	
154						0.5	
155						-0.1	
156						-0.2	
157						-0.2	

Surface coatings were determined to be lead-containing paint. Many of these surfaces will be impacted by the proposed work. The removal of coatings, intact or damaged, will need to be performed by an EPA licensed lead paint abatement contractor, and disposed of as hazard waste in accordance with US EPA and NYS DEC regulations.

4.3 POLYCHLORINATED BIPHENYLS (PCB'S)

Definition

Polychlorinated biphenyls (PCBs) are a group of organic compounds used in the manufacture of plastics, as lubricants, and dielectric fluids in transformers, in protective coating for wood, metal, and concrete, and in adhesives, wire

coating, and so forth. They are highly toxic to aquatic life and persist in the environment for long periods of time. They can accumulate in food chains and may produce harmful side effects at high concentrations.

LiRo collected wipe samples from surfaces to identify any evidence of PCB contamination. Only a single sample from Confined Space Area -6.5 was determined by lab testing to have a quantifiable concentration of PCB, which was below the 1.0 mg/kg action level (see Appendix B and Table 4.3 below). No bulk sealants or caulking that may be suspect PCB containing materials were observed.

Inspection Scope and Material Assessment

Table 4.3 – Summary of PCB Inspection Results - Wipes

Homogeneous Area	Location	Description of Material	Results [mg/kg]	PCB Containing	Notes
1	Main Floor (15.50)	Concrete Pad	<50.0	No	-
2	Sub-Basement (-28.00)	Concrete Pad	<50.0	No	-
3	Sub-Basement (-28.00)	Concrete Pad	<50.0	No	-
4	Sub-Basement (-28.00)	Concrete Pad	<50.0	No	-
5	Sub-Basement (-28.00)	Concrete Pad	<50.0	No	-
6	Confined Space Area (-6.50)	Concrete Pad	<50.0	No	-
7	Confined Space Area (-6.50)	Concrete Pad	0.314	No	-
Total Estimated PCB Containing Material Quantity				**0.0 SF**	

Materials sampled tested negative for PCBs (> 1 mg/kg).

Fluorescent light fixtures are presumed to utilize PCB containing ballasts that would impose certain obligations in regards to the hazardous waste nature of the ballasts if these items require replacement/removal as part of the scope of work at each/any location. **Light fixtures/ballasts were observed on site that would be impacted by the work of this project. Any presumed PCB ballasts must be removed as hazardous waste.**

4.4 UNIVERSAL/HAZARDOUS WASTE

Field Survey Procedures

The Contractor is responsible for the removal, characterization, transport and disposal of any universal wastes within the work area. Hazardous wastes of the following types may be managed as universal waste:

- Aerosol cans that contain a product and/or propellant that is hazardous.
- Batteries such as lead/acid, lead, nickel-cadmium, silver, lithium, lithium-ion, or mercury
- Lamps such as fluorescent tubes, compact fluorescent lamps (CFLs), light emitting diodes (LEDs), and mercury vapor lamps.
- Paint that is an architectural or structural coating, such as oil-based paints, stains and varnishes, single part epoxies, or bridge paint.

- Thermostats and other mercury-containing equipment (MCE) such as thermometers, barometers, manometers, temperature and pressure gauges, or mercury switches.

Inspection Scope and Material Assessment

During our survey, LiRo performed "room to room" observations of the building and identified building components, fixtures, and stored items that may be considered a universal waste.

Fluorescent light fixtures contain fluorescent bulbs that would impose certain obligations in regards to the universal a waste nature of the bulbs if these items require replacement/removal as part of the scope of work at each/any location. L**ight bulbs were observed on site that would be impacted by the work of this project.**

Any exit signs/smoke detectors/air condition units must also be removed as universal waste.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Materials, which are expected to be impacted by the proposed scope of work, have been shown by laboratory analysis to contain asbestos. Materials that could not be accessed for bulk sampling have been assumed to be asbestos containing.

In the event that any ACM or Presumed ACM needs to be impacted by the project, a licensed abatement contractor must perform the removal of all friable and non-friable ACM. LiRo Engineers, Inc. believes that the implementation of these recommendations will serve to best protect human health and the environment.

To ensure that the removal of the aforementioned ACM is properly and effectively carried out, the following recommendations are proposed by LiRo Engineers, Inc.

A. Develop and implement a schedule that outlines the time frame for removal of asbestos-containing materials.

B. Develop complete and concise specifications to effectively deal with removal of the asbestos-containing material. These specifications should be developed to comply with all applicable Federal, State, and Local regulations.

C. Retain the service of an independent testing laboratory to monitor the quality of the air before, during, and after the removal work. Retain all documentation and correspondence from the removal contractor, the testing laboratory, and related items in a permanent record.

Surface wipes did not detect any evidence of fluid PCB leaks or contamination.

Fluorescent light fixtures & Presumed PCB-Containing Ballasts are to be removed as part of this project. The fluorescent light bulbs are universal waste items, and the fixtures are presumed to be PCB-containing hazardous waste.

The Contractor is advised that the Work of the Contract may impose certain obligations and requirements mandated by the US Department of Labor Occupational Safety & Health Administration regulations, Title 29 CFR 1926.62 Lead Exposure in Construction, relative to the potential exposure to lead by its employees. The Contractor assumes entire responsibility and liability for complying fully in all respects with these regulations. Additionally, the removal

of coatings, intact or damaged, will need to be performed by an EPA licensed lead paint abatement contractor, and disposed of as hazard waste in accordance with US EPA and NYS DEC regulations.

6.0 AREAS NOT ACCESSIBLE

LiRo Engineers, Inc. inspected and sampled materials, which were observable and accessible to the survey team, at the time of inspection. It is possible however, that additional suspect asbestos-containing material (ACM) may exist inside other concealed spaces, which were not accessible without using destructive means such as concealed insulation/waterproofing tars and/or braided wire insulation. Any materials that have not been tested and/or found asbestos positive must be presumed asbestos-containing material (PACM).

7.0 REPORT CERTIFICATIONS

LiRo Engineers, Inc. certifies that the information contained herein is based on the physical and visual inspections conducted by LiRo Engineers, Inc. and data collected during the inspection survey.



Rosemarie Salerno
Associate



Chris Zanoni
Vice President

LiRo Engineers, Inc.
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APPENDIX A

ANALYTICAL RESULTS & CHAIN-OF-CUSTODY

EMSL Analytical, Inc.

10-39 45th Road Long Island City, NY 11101
Tel/Fax: (212) 290-0051 / (212) 290-0058
http://www.EMSL.com / manhattanlab@emsl.com

EMSL Order: 032605329
Customer ID: LIRO50A
Customer PO: 26-091-1307
Project ID:

Attention: Rosemarie Salerno
Liro Engineers, Inc.
235 East Jericho Turnpike
Mineola, NY 11501

Phone: (516) 672-4888
Fax: (516) 937-5421
Received Date: 05/09/2026 8:26 AM
Analysis Date: 05/09/2026 - 05/12/2026
Collected Date: 05/08/2026

Project: 26-091-1307/ Cedar Creek WPCP 3340 Merrick Rd., Wantagh NY

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 1		**Description**	Roof - Level 50-50 - Top Membrane		
032605329-0001		**Homogeneity**	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	White/ Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	White/ Black		100.00% Other	**None Detected**
Sample ID 2		**Description**	Roof - Level 50-50 - Top Membrane		
032605329-0002		**Homogeneity**	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	White/ Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	White/ Black		100.00% Other	**None Detected**
Sample ID 3		**Description**	Roof - Level 50-50 - Felt paper on roof deck inside		
032605329-0003		**Homogeneity**	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black		100.00% Other	**None Detected**
Sample ID 4		**Description**	Roof - Level 50-50 - Felt paper on roof deck inside		
032605329-0004		**Homogeneity**	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black	<1.00% Fibrous (other)	100.00% Other	**None Detected**
Sample ID 5		**Description**	Roof - Level 50-50 - Roof deck insulation		
032605329-0005		**Homogeneity**	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black		100.00% Other	**None Detected**

Initial report from: 05/12/2026 08:42:11

EMSL Analytical, Inc.
10-39 45th Road Long Island City, NY 11101
Tel/Fax: (212) 290-0051 / (212) 290-0058
http://www.EMSL.com / manhattanlab@emsl.com

EMSL Order: 032605329
Customer ID: LIRO50A
Customer PO: 26-091-1307
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 6 *032605329-0006*		**Description** Roof - Level 50-50 - Roof deck insulation **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black		100.00% Other	**None Detected**
Sample ID 7 *032605329-0007*		**Description** Roof - Level 50-50 - Bottom tar coating **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black		100.00% Other	**None Detected**
Sample ID 8 *032605329-0008*		**Description** Roof - Level 50-50 - Bottom tar coating **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black		100.00% Other	**None Detected**
Sample ID 9 *032605329-0009*		**Description** Elevation 30-5 - Ceramic tile grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	05/09/2026	Gray		20.00% Ca Carbonate 25.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10 *032605329-0010*		**Description** Elevation 30-5 - Ceramic tile grout **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	05/10/2026	Gray		20.00% Ca Carbonate 1.00% Mica 24.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11 *032605329-0011*		**Description** Elevation 30-5 - Ceramic tile packing **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	05/09/2026	Gray		25.00% Ca Carbonate 20.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial report from: 05/12/2026 08:42:11

EMSL Analytical, Inc.
10-39 45th Road Long Island City, NY 11101
Tel/Fax: (212) 290-0051 / (212) 290-0058
http://www.EMSL.com / manhattanlab@emsl.com

EMSL Order: 032605329
Customer ID: LIRO50A
Customer PO: 26-091-1307
Project ID:

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 12 *032605329-0012*		**Description**	Elevation 30-5 - Ceramic tile packing		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	05/10/2026	Gray		25.00% Ca Carbonate 1.00% Mica 24.00% Non-fibrous (other) 50.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13 *032605329-0013*		**Description**	Elevation 4-5 Force Main - Big pipe insulation wrap (blue)		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Silver/ Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Silver/ Beige		100.00% Other	**None Detected**
Sample ID 14 *032605329-0014*		**Description**	Elevation 4-5 Force Main - Big pipe insulation wrap (blue)		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Silver/ Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Silver/ Beige		100.00% Other	**None Detected**
Sample ID 15 *032605329-0015*		**Description**	Elevation 4-5 Force Main - Big pipe insulation wrap (blue)		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Silver/ Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Silver/ Beige		100.00% Other	**None Detected**
Sample ID 16 *032605329-0016*		**Description**	Elevation 4-5 Force Main - Big pipe insulation black cork/foam material		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black		100.00% Other	**None Detected**
Sample ID 17 *032605329-0017*		**Description**	Elevation 4-5 Force Main - Big pipe insulation black cork/foam material		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black		100.00% Other	**None Detected**

Initial report from: 05/12/2026 08:42:11

EMSL Analytical, Inc.
10-39 45th Road Long Island City, NY 11101
Tel/Fax: (212) 290-0051 / (212) 290-0058
http://www.EMSL.com / manhattanlab@emsl.com

EMSL Order:	032605329
Customer ID:	LIRO50A
Customer PO:	26-091-1307
Project ID:	

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 18 *032605329-0018*		**Description** Elevation 4-5 Force Main - Big pipe insulation black cork/foam material **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Black		100.00% Other	**None Detected**
Sample ID 19 *032605329-0019*		**Description** Elevation - 28 (sub basement) - Centrifugal pumps gaskets **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	Gray		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	Gray		100.00% Other	**None Detected**
Sample ID 20 *032605329-0020*		**Description** Elevation - 28 (sub basement) - Centrifugal pumps gaskets **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	05/11/2026	White/ Red/ Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	05/12/2026	White/ Red/ Beige		100.00% Other	**None Detected**
Sample ID 21 *032605329-0021*		**Description** Elevation - 30 - 5 - Duck/HVAC insulation (vertical) **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	05/09/2026	Yellow	90.00% Glass	10.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 22 *032605329-0022*		**Description** Elevation - 30 - 5 - Duck/HVAC insulation (vertical) **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	05/10/2026	Tan/ Various/ Yellow	45.00% Cellulose 15.00% Glass	40.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial report from: 05/12/2026 08:42:11

EMSL Analytical, Inc.
10-39 45th Road Long Island City, NY 11101
Tel/Fax: (212) 290-0051 / (212) 290-0058
http://www.EMSL.com / manhattanlab@emsl.com

EMSL Order:	032605329
Customer ID:	LIRO50A
Customer PO:	26-091-1307
Project ID:	

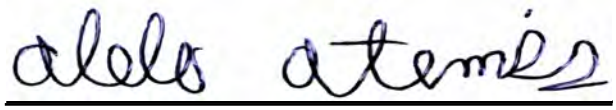
Test Report:Asbestos Analysis of Bulk Material

The samples in this report were submitted to EMSL for analysis by Asbestos Analysis of Bulk Materials via NYS ELAP Approved Methods. The reference number for these samples is the EMSL Order ID above. Please use this reference number when calling about these samples.

Report Comments:

Sample Receipt Date:	5/9/2026	Sample Receipt Time:	8:26 AM
Analysis Completed Date:	5/11/2026	Analysis Completed Time:	11:21 PM

Analyst(s):



Aldo Atemis PLM NYS 198.1 Friable (3)



Jessica Macdonald PLM NYS 198.1 Friable (3)

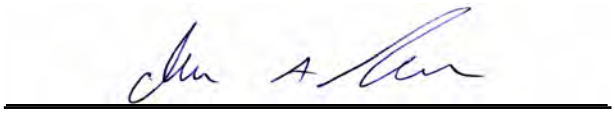


Kerrie Gibson PLM NYS 198.6 NOB (16)



Steven Dutter TEM NYS 198.4 NOB (16)

Samples reviewed and approved by:



Charles Johnson, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. Estimation of uncertainty available upon request. This report is a summary of multiple methods of analysis, fully compliant reports are available upon request. All samples examined for the presence of vermiculite when analyzed via NYS 198.1. A combination of PLM and TEM analysis may be necessary to ensure consistently reliable detection of asbestos. Polarized-light microscopy is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government . Quantitative transmission electron microscopy is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos containing. NOB= Non friable organically bound; N/A= Not applicable VCM= Vermiculite containing material.

Samples analyzed by EMSL Analytical, Inc. Long Island City, NY NYS ELAP 11506, NVLAP Lab Code 101048-9

Initial report from: 05/12/2026 08:42:11

032605329

LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

ASBESTOS BULK SAMPLING CHAIN-OF-CUSTODY

Site Name/Location: Cedar Creek WPCP 3340 Merrick Rd., Wantagh. NY	LiRo Job #: 26-091-1307
Inspector(s): CHUKS-OKOH, CHUKS / SALERNO ROSEMARIE	Date: 5/8/2026

HA #	Sample #	SAMPLE LOCATION	MATERIAL DESCRIPTION	CONDITION GOOD	CONDITION POOR	QTY	NOTES
1	1	ROOF - LEVEL 50.50	TOP MEMBRANE	☐	☑		
	2						
2	3		FELT PAPER ON ROOF DECK INSUL.	☐	☑		
	4						
3	5		ROOF DECK INSULATION	☐	☑		
	6						
4	7		BOTTOM TAR COATING	☐	☑		
	8						
5	9	ELEVATION 30.5	CERAMIC TILE GROUT	☐	☐		
	10						
6	11		CERAMIC TILE BACKING	☐	☐		
	12						

EMSL LONG ISLAND CITY LAB
RECEIVED
2026 MAY -9 A 8:26

COMMENTS *Analyze using Methods: ELAP 198.1(PLM Bulk) / ELAP 198.6(PLM Bulk) / ELAP 198.4 (TEM Bulk) / ELAP 198.8 (PLM SOF-V) If requested only.*
TAT: 24 hr. for PLM Friable / 48 hr. for PLM NOB or VCM / 48 hr. for TEM NOB
Stop at first positive per homogenous area. Analyze all samples by layer.
Inconclusive results require TEM analysis within 24 hr. TAT of initial analysis. e-mail results to salernor@liro-hill.com, CHUKS-OKOH@LIRO.COM

Relinquished By (Print/Date/Time)	Relinquished By (Print/Date/Time)	Received By (Print/Date/Time)	PLM Analysis (signature/time)
Chuks-Okoh, Chuks 5/8/26		Nathan Caldwell 5/9/26 08:26	
Relinquished By (Signature)	**Relinquished By (Signature)**	**Received By (Signature)**	**TEM Analysis (signature/time)**

Pg 1 of 2

S3C067-11G
Page 2370 of 2953
Nassau County DPW
OrderID: 032605329

032605329

LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

ASBESTOS BULK SAMPLING CHAIN-OF-CUSTODY

Site Name/Location: Cedar Creek WPCP 3340 Merrick Rd., Wantagh. NY	LiRo Job #: 26-091-1307
Inspector(s): CHUKS-OKOH, CHUKS / SALERNO ROSEMARIE	Date: 5/8/2026

HA #	Sample #	SAMPLE LOCATION	MATERIAL DESCRIPTION	CONDITION GOOD	CONDITION POOR	QTY	NOTES
7	13	ELEVATION 4.5 FORCE MAIN	BIG PIPE INSULATION WRAP (BLUE)	☐	☑		
	14	↓					
	15						
8	16		BIG PIPE INSULATION BLACK CORK/FOAM MATERIAL	☐	☑		
	17						
	18						
9	19	ELEVATION −28 (SUBBASEMENT)	CENTRIFUGAL PUMPS GASKETS	☐	☑		
	20	↓					
10	21	ELEVATION 30.5	DUCT/HVAC INSULATION (VERTICAL)	☐	☑		
	22	↑					
				☐	☐		
				☐	☐		

EMSL LONG ISLAND CITY LAB
RECEIVED
2026 MAY -9 A 8:26

COMMENTS *Analyze using Methods: ELAP 198.1(PLM Bulk) / ELAP 198.6(PLM Bulk) / ELAP 198.4 (TEM Bulk) / ELAP 198.8 (PLM SOF-V) If requested only.*
TAT: 24 hr. for PLM Friable / 48 hr. for PLM NOB or VCM / 48 hr. for TEM NOB
Stop at first positive per homogenous area. Analyze all samples by layer.
Inconclusive results require TEM analysis within 24 hr. TAT of initial analysis. e-mail results to salernor@liro-hill.com, ChuksOkohC@LiRO.com

Relinquished By (Print/Date/Time)	Relinquished By (Print/Date/Time)	Received By (Print/Date/Time)	PLM Analysis (signature/time)
Chuks-Okoh, Chuks 5/8/26		Nathan Caldwell 5/9/26 08:26	
Relinquished By (Signature)	**Relinquished By (Signature)**	**Received By (Signature)**	**TEM Analysis (signature/time)**

pg 292

S3C067-11G
Page 2371 of 2953
Nassau County DPW
OrderID: 032605329

LONG ISLAND ANALYTICAL LABORATORIES INC.
"TOMORROWS ANALYTICAL SOLUTIONS TODAY"

Laboratory Report

NYSDOH ELAP# 11693
USEPA# NY01273
CTDOH# PH-0284
AIHA# 164456
NJDEP# NY012
PADEP# 68-2943

LIAL# 6051109

May 13, 2026

Liro Engineers, Inc.
235 East Jericho Tpk
Mineola, NY 11501

Re: Cedar Creek 3340 Merrick Rd

Dear Liro Engineers, Inc.,

Enclosed please find the laboratory Analysis Report(s) for sample(s) received on May 11, 2026. Long Island Analytical laboratories analyzed the samples on May 12, 2026 for the following:

SAMPLE ID	ANALYSIS
Main Fl (15-50) #1	EPA 8082 A
2 Sub Basement (-28)	EPA 8082 A
3 Sub Basement (-28)	EPA 8082 A
4 Sub Basement (-28)	EPA 8082 A
5 Sub Basement (-28)	EPA 8082 A
6 Confined Space Area	EPA 8082 A
7 Confined Space Area	EPA 8082 A

If you have any questions or require further information, please call at your convenience. Long Island Analytical Laboratories Inc. is a NELAP accredited laboratory. All reported results meet the requirements of the NELAP standards unless noted. Report shall not be reproduced except in full without the written approval of the laboratory. Results related only to items tested. Long Island Analytical Laboratories would like to thank you for the opportunity to be of service to you.

Best Regards,

Long Island Analytical Laboratories, Inc.

Michael D. Veraldi
Laboratory Technical Director

Client: Liro Engineers, Inc.	Client ID: Cedar Creek 3340 Merrick Rd
Date (Time) Collected: 05/08/2026 11:00	Sample ID: Main Fl (15-50) #1
Date (Time) Received: 05/11/2026 08:38	Laboratory ID: 6051109-01
Matrix: Wipe	ELAP: #11693

PCB/Aroclor Analysis

Parameter	CAS No.	LOQ	Result	Units	Flag
Aroclor-1016	12674-11-2	50.0	<50.0	ug/kg	
Aroclor-1221	11104-28-2	50.0	<50.0	ug/kg	
Aroclor-1232	11141-16-5	50.0	<50.0	ug/kg	
Aroclor-1242	53469-21-9	50.0	<50.0	ug/kg	
Aroclor-1248	12672-29-6	50.0	<50.0	ug/kg	
Aroclor-1254	11097-69-1	50.0	<50.0	ug/kg	
Aroclor-1260	11096-82-5	50.0	<50.0	ug/kg	
Aroclor-1262	37324-23-5	50.0	<50.0	ug/kg	
Aroclor-1268	11100-14-4	50.0	<50.0	ug/kg	

Surrogate	CAS No.	% Recovery	Rec. Limits	Flag
Decachlorobiphenyl	2051-24-3	26	47.4-148	4.D
Tetrachloro-m-xylene	877-09-8	89	51.4-150	

Date Prepared: 05/11/2026

Preparation Method: EPA 3546

Date Analyzed: 05/12/2026

Analytical Method: EPA 8082A

LONG ISLAND ANALYTICAL LABORATORIES INC.
"TOMORROWS ANALYTICAL SOLUTIONS TODAY"
110 Colin Drive • Holbrook, New York 11741
Phone (631) 472-3400 • Fax (631) 472-8505 • Email: LIAL@lialinc.com

Client: Liro Engineers, Inc.	Client ID: Cedar Creek 3340 Merrick Rd
Date (Time) Collected: 05/08/2026 11:20	Sample ID: 2 Sub Basement (-28)
Date (Time) Received: 05/11/2026 08:38	Laboratory ID: 6051109-02
Matrix: Wipe	ELAP: #11693

PCB/Aroclor Analysis

Parameter	CAS No.	LOQ	Result	Units	Flag
Aroclor-1016	12674-11-2	50.0	<50.0	ug/kg	
Aroclor-1221	11104-28-2	50.0	<50.0	ug/kg	
Aroclor-1232	11141-16-5	50.0	<50.0	ug/kg	
Aroclor-1242	53469-21-9	50.0	<50.0	ug/kg	
Aroclor-1248	12672-29-6	50.0	<50.0	ug/kg	
Aroclor-1254	11097-69-1	50.0	<50.0	ug/kg	
Aroclor-1260	11096-82-5	50.0	<50.0	ug/kg	
Aroclor-1262	37324-23-5	50.0	<50.0	ug/kg	
Aroclor-1268	11100-14-4	50.0	<50.0	ug/kg	

Surrogate	CAS No.	% Recovery	Rec. Limits	Flag
Decachlorobiphenyl	2051-24-3	70	47.4-148	
Tetrachloro-m-xylene	877-09-8	71	51.4-150	

Date Prepared: 05/11/2026

Preparation Method: EPA 3546

Date Analyzed: 05/12/2026

Analytical Method: EPA 8082A

LONG ISLAND ANALYTICAL LABORATORIES INC.
"TOMORROWS ANALYTICAL SOLUTIONS TODAY"
110 Colin Drive • Holbrook, New York 11741
Phone (631) 472-3400 • Fax (631) 472-8505 • Email: LIAL@lialinc.com

Client: Liro Engineers, Inc.	Client ID: Cedar Creek 3340 Merrick Rd
Date (Time) Collected: 05/08/2026 11:21	Sample ID: 3 Sub Basement (-28)
Date (Time) Received: 05/11/2026 08:38	Laboratory ID: 6051109-03
Matrix: Wipe	ELAP: #11693

PCB/Aroclor Analysis

Parameter	CAS No.	LOQ	Result	Units	Flag
Aroclor-1016	12674-11-2	50.0	<50.0	ug/kg	
Aroclor-1221	11104-28-2	50.0	<50.0	ug/kg	
Aroclor-1232	11141-16-5	50.0	<50.0	ug/kg	
Aroclor-1242	53469-21-9	50.0	<50.0	ug/kg	
Aroclor-1248	12672-29-6	50.0	<50.0	ug/kg	
Aroclor-1254	11097-69-1	50.0	<50.0	ug/kg	
Aroclor-1260	11096-82-5	50.0	<50.0	ug/kg	
Aroclor-1262	37324-23-5	50.0	<50.0	ug/kg	
Aroclor-1268	11100-14-4	50.0	<50.0	ug/kg	

Surrogate	CAS No.	% Recovery	Rec. Limits	Flag
Decachlorobiphenyl	2051-24-3	80	47.4-148	
Tetrachloro-m-xylene	877-09-8	83	51.4-150	

Date Prepared: 05/11/2026

Preparation Method: EPA 3546

Date Analyzed: 05/12/2026

Analytical Method: EPA 8082A

LONG ISLAND ANALYTICAL LABORATORIES INC.
"TOMORROWS ANALYTICAL SOLUTIONS TODAY"
110 Colin Drive • Holbrook, New York 11741
Phone (631) 472-3400 • Fax (631) 472-8505 • Email: LIAL@lialinc.com

Client: Liro Engineers, Inc.	Client ID: Cedar Creek 3340 Merrick Rd
Date (Time) Collected: 05/08/2026 11:22	Sample ID: 4 Sub Basement (-28)
Date (Time) Received: 05/11/2026 08:38	Laboratory ID: 6051109-04
Matrix: Wipe	ELAP: #11693

PCB/Aroclor Analysis

Parameter	CAS No.	LOQ	Result	Units	Flag
Aroclor-1016	12674-11-2	50.0	<50.0	ug/kg	
Aroclor-1221	11104-28-2	50.0	<50.0	ug/kg	
Aroclor-1232	11141-16-5	50.0	<50.0	ug/kg	
Aroclor-1242	53469-21-9	50.0	<50.0	ug/kg	
Aroclor-1248	12672-29-6	50.0	<50.0	ug/kg	
Aroclor-1254	11097-69-1	50.0	<50.0	ug/kg	
Aroclor-1260	11096-82-5	50.0	<50.0	ug/kg	
Aroclor-1262	37324-23-5	50.0	<50.0	ug/kg	
Aroclor-1268	11100-14-4	50.0	<50.0	ug/kg	

Surrogate	CAS No.	% Recovery	Rec. Limits	Flag
Decachlorobiphenyl	2051-24-3	75	47.4-148	
Tetrachloro-m-xylene	877-09-8	77	51.4-150	

Date Prepared: 05/11/2026

Preparation Method: EPA 3546

Date Analyzed: 05/12/2026

Analytical Method: EPA 8082A

LONG ISLAND ANALYTICAL LABORATORIES INC.
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Client: Liro Engineers, Inc.	Client ID: Cedar Creek 3340 Merrick Rd
Date (Time) Collected: 05/08/2026 11:23	Sample ID: 5 Sub Basement (-28)
Date (Time) Received: 05/11/2026 08:38	Laboratory ID: 6051109-05
Matrix: Wipe	ELAP: #11693

PCB/Aroclor Analysis

Parameter	CAS No.	LOQ	Result	Units	Flag
Aroclor-1016	12674-11-2	50.0	<50.0	ug/kg	
Aroclor-1221	11104-28-2	50.0	<50.0	ug/kg	
Aroclor-1232	11141-16-5	50.0	<50.0	ug/kg	
Aroclor-1242	53469-21-9	50.0	<50.0	ug/kg	
Aroclor-1248	12672-29-6	50.0	<50.0	ug/kg	
Aroclor-1254	11097-69-1	50.0	<50.0	ug/kg	
Aroclor-1260	11096-82-5	50.0	<50.0	ug/kg	
Aroclor-1262	37324-23-5	50.0	<50.0	ug/kg	
Aroclor-1268	11100-14-4	50.0	<50.0	ug/kg	

Surrogate	CAS No.	% Recovery	Rec. Limits	Flag
Decachlorobiphenyl	2051-24-3	76	47.4-148	
Tetrachloro-m-xylene	877-09-8	78	51.4-150	

Date Prepared: 05/11/2026

Preparation Method: EPA 3546

Date Analyzed: 05/12/2026

Analytical Method: EPA 8082A

LONG ISLAND ANALYTICAL LABORATORIES INC.
"TOMORROWS ANALYTICAL SOLUTIONS TODAY"
110 Colin Drive • Holbrook, New York 11741
Phone (631) 472-3400 • Fax (631) 472-8505 • Email: LIAL@lialinc.com

Client: Liro Engineers, Inc.	Client ID: Cedar Creek 3340 Merrick Rd
Date (Time) Collected: 05/08/2026 12:15	Sample ID: 6 Confined Space Area
Date (Time) Received: 05/11/2026 08:38	Laboratory ID: 6051109-06
Matrix: Wipe	ELAP: #11693

PCB/Aroclor Analysis

Parameter	CAS No.	LOQ	Result	Units	Flag
Aroclor-1016	12674-11-2	50.0	<50.0	ug/kg	
Aroclor-1221	11104-28-2	50.0	<50.0	ug/kg	
Aroclor-1232	11141-16-5	50.0	<50.0	ug/kg	
Aroclor-1242	53469-21-9	50.0	<50.0	ug/kg	
Aroclor-1248	12672-29-6	50.0	<50.0	ug/kg	
Aroclor-1254	11097-69-1	50.0	<50.0	ug/kg	
Aroclor-1260	11096-82-5	50.0	<50.0	ug/kg	
Aroclor-1262	37324-23-5	50.0	<50.0	ug/kg	
Aroclor-1268	11100-14-4	50.0	<50.0	ug/kg	

Surrogate	CAS No.	% Recovery	Rec. Limits	Flag
Decachlorobiphenyl	2051-24-3	76	47.4-148	
Tetrachloro-m-xylene	877-09-8	78	51.4-150	

Date Prepared: 05/11/2026

Preparation Method: EPA 3546

Date Analyzed: 05/12/2026

Analytical Method: EPA 8082A

LONG ISLAND ANALYTICAL LABORATORIES INC.
"TOMORROWS ANALYTICAL SOLUTIONS TODAY"
110 Colin Drive • Holbrook, New York 11741
Phone (631) 472-3400 • Fax (631) 472-8505 • Email: LIAL@lialinc.com

Client: Liro Engineers, Inc.	Client ID: Cedar Creek 3340 Merrick Rd
Date (Time) Collected: 05/08/2026 12:16	Sample ID: 7 Confined Space Area
Date (Time) Received: 05/11/2026 08:38	Laboratory ID: 6051109-07
Matrix: Wipe	ELAP: #11693

PCB/Aroclor Analysis

Parameter	CAS No.	LOQ	Result	Units	Flag
Aroclor-1016	12674-11-2	50.0	<50.0	ug/kg	
Aroclor-1221	11104-28-2	50.0	<50.0	ug/kg	
Aroclor-1232	11141-16-5	50.0	<50.0	ug/kg	
Aroclor-1242	53469-21-9	50.0	<50.0	ug/kg	
Aroclor-1248	12672-29-6	50.0	<50.0	ug/kg	
Aroclor-1254	11097-69-1	50.0	<50.0	ug/kg	
Aroclor-1260	11096-82-5	50.0	314	ug/kg	
Aroclor-1262	37324-23-5	50.0	<50.0	ug/kg	
Aroclor-1268	11100-14-4	50.0	<50.0	ug/kg	

Surrogate	CAS No.	% Recovery	Rec. Limits	Flag
Decachlorobiphenyl	2051-24-3	70	47.4-148	
Tetrachloro-m-xylene	877-09-8	72	51.4-150	

Date Prepared: 05/11/2026

Preparation Method: EPA 3546

Date Analyzed: 05/12/2026

Analytical Method: EPA 8082A

Data Qualifiers Key Reference:

4.D	Surrogate recovery has failed low.
MDL	Minimum Detection Limit
LOQ	Limit of Quantitation
H	Holding Time Exceeded
	Analyte Non-certified by ELAP.

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CHAIN OF CUSTODY / REQUEST FOR ANALYSIS DOCUMENT

CLIENTS NAME/ADDRESS: L.Ro Engineers 235 E Jericho Tnpk Mineola

CONTACT: Rosemarie Salerno

PHONE: 516 595 2900

SAMPLER (SIGNATURE)

SAMPLER NAME (PRINT): Rosemarie Salerno

SAMPLES RECEIVED AT °C

6051109 (FOR LAB USE ONLY)

PROJECT LOCATION: Cedar Creek 3340 Merrick Rd.

REPORTS EMAIL:

INVOICE EMAIL: Salerno@l.ro-hill.com

COMMENTS/INSTRUCTIONS: PCB wipes — 5-Day

MATRCIES: A=AIR BM=BULK MATERIAL O=OIL S=SOIL NPW=NON-POTABLE WATER PW=POTABLE WATER SD=SOLDER SW=SWAB W=WIPE PC=PAINT CHIPS

SAMPLING TYPE: G=GRAB C=COMPOSITE

TURN AROUND TIME REQUIRED (DAYS) (please circle)

ASAP 1 2 3 4 (5) NORMAL

ANALYSIS REQUIRED

LABORATORY ID # (For Laboratory Use Only)	MATRIX	TYPE	pH	Residual Cl (mg/L)	DATE	TIME	SAMPLE # LOCATION	PCBs	# OF CONTAINERS
1. 01		W			5/8/26	11 Am	Main Fl (15.50) # 1		
2. 02		W				1120	2 Sub Basement (-28.0)		
3. 03		W				1121	3		
4. 04		W				1122	4		
5. 05		W				1123	5		
6. 06		W				1215	6 Confined space area		
7. 07		W				1216	7		
8.									
9.									
10.									

RUSH!

RELINQUISHED BY (SIGNATURE)	DATE / TIME	PRINTED NAME	RECEIVED BY (SIGNATURE)	DATE / TIME	PRINTED NAME
Bill Quinn	5/11/26 8:31				
RELINQUISHED BY (SIGNATURE)	DATE / TIME	PRINTED NAME	RECEIVED BY SAMPLE CUSTODIAN	DATE 5-11-26 TIME 8:38	PRINTED NAME Ilvan Lobbero

WHITE - OFFICE / CANARY - CLIENT

NYSDOH ELAP# 11693 USEPA# NY01273 CTDOH# PH-0284 NJDEP# NY012 PADEP# 68-2943

Company Heuresis Corp.
Model Pb200i
Type XRF Lead Paint Analyzer
Serial Num. 2083
App Version Pb200i-REL-4.0-29

Location: Cedar Creek WPCP-IPS - HBM Scope
Address: 3340 Merrick Road, Wantagh, NY 11793
Building: Various Locations
LiRo Job #: **26-091-1307**

Job Id	Reading #	Concentration	Units	3 SD	Result	Calibration Reading	Action Level	RTA Present	Read Through	NomSecs	Date	Inspector	Floor #	Name	Component	Substrate	Wall Side	Color	Replicant
571055	1	0.5	mg/cm2	0.2		TRUE	1	FALSE	FALSE	5	5/7/2026								
571055	2	0.5	mg/cm2	0.2		TRUE	1	FALSE	FALSE	5	5/7/2026								
571055	3	0.5	mg/cm2	0.2		TRUE	1	FALSE	FALSE	5	5/7/2026								
571055	4	-0.1	mg/cm2	0.3		TRUE	1	FALSE	FALSE	2	5/7/2026								
571055	5	-0.2	mg/cm2	0.3		TRUE	1	FALSE	FALSE	2	5/7/2026								
571055	6	-0.1	mg/cm2	0.3		TRUE	1	FALSE	FALSE	2	5/7/2026								
571055	7	0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Door	Metal	1	Brown	1
571055	8	1.3	mg/cm2	0.2	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Door Frame	Metal	1	Brown	1
571055	9	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Door	Metal	1	Brown	1
571055	10	1.1	mg/cm2	0.2	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Door Frame	Metal	1	Brown	1
571055	11	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Wall	Plaster	1	White	1
571055	12	0.1	mg/cm2	0.2	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Wall	Plaster	2	White	1
571055	13	0.0	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Wall	Plaster	3	White	1
571055	14	0.2	mg/cm2	0.2	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Wall	Plaster	4	White	1
571055	15	-0.2	mg/cm2	0.2	Negative	FALSE	1	FALSE	FALSE	3	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Elevator Door	Metal	1	Brown	1
571055	16	-0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Elevator Door	Metal	1	Brown	1
571055	17	1.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Elevator Door Frame	Metal	1	Brown	1
571055	18	2.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Elevator Door Frame	Metal	1	Brown	1
571055	19	0.0	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 1	Metal	Other	Yellow	1
571055	20	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 1	Metal	Other	Grey	1
571055	21	3.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 2	Metal	Other	Yellow	1
571055	22	2.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 2	Metal	Other	Grey	1
571055	23	1.8	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 3	Metal	Other	Yellow	1
571055	24	2.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 3	Metal	Other	Grey	1
571055	25	3.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 4	Metal	Other	Yellow	1
571055	26	1.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 4	Metal	Other	Grey	1
571055	27	1.6	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 5	Metal	Other	Yellow	1
571055	28	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 5	Metal	Other	Grey	1
571055	29	1.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 6	Metal	Other	Yellow	1
571055	30	1.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 6	Metal	Other	Grey	1
571055	31	0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 7	Metal	Other	Yellow	1
571055	32	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pumps 7	Metal	Other	Grey	1
571055	33	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Top Big Pipes	Metal	3	Grey	1
571055	34	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Top Big Pipes	Metal	3	Grey	1
571055	35	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Top Big Pipes	Metal	3	Grey	1
571055	36	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Metal	3	Grey	1
571055	37	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Metal	3	Grey	1
571055	38	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Bottom Big Pipes in Trench	Metal	3	Grey	1
571055	39	-0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Platforms/Pads	Concrete	Other	Grey	1
571055	40	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Platforms/Pads	Concrete	Other	Grey	1
571055	41	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Platforms/Pads	Concrete	Other	Grey	1
571055	42	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Platforms/Pads	Metal	Other	Grey	1
571055	43	-0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Platforms/Pads	Metal	Other	Grey	1
571055	44	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Platforms/Pads	Metal	Other	Grey	1
571055	45	2.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Pipes Support	Metal	Other	Grey	1
571055	46	1.7	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Pipes Support	Metal	Other	Grey	1
571055	47	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Pipes Support	Metal	Other	Grey	1
571055	48	3.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pipes	Metal	Other	Red	1
571055	49	1.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pipes	Metal	Other	Red	1
571055	50	2.7	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pipes	Metal	Other	Red	1
571055	51	1.3	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Centrifugal Pipes	Metal	Other	Red	1
571055	52	0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Wall	Plaster	Other	Tan	1
571055	53	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	3	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Wall	Plaster	Other	Tan	1
571055	54	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Wall	Plaster	Other	Tan	1
571055	55	0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Wall	Plaster	Other	Tan	1
571055	56	2.8	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Closed Strigent	Metal	Other	Tan	1
571055	57	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Closed Strigent	Metal	Other	Tan	1
571055	58	1.7	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Open Strigent	Metal	Other	Tan	1
571055	59	1.9	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Open Strigent	Metal	Other	Tan	1
571055	60	2.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Riser	Metal	Other	Tan	1
571055	61	3.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Riser	Metal	Other	Tan	1
571055	62	2.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Underneath Staircase	Metal	Other	Tan	1

Company Heuresis Corp.
Model Pb200i
Type XRF Lead Paint Analyzer
Serial Num. 2083
App Version Pb200i-REL-4.0-29

Location: Cedar Creek WPCP-IPS - HBM Scope
Address: 3340 Merrick Road, Wantagh, NY 11793
Building: Various Locations
LiRo Job #: **26-091-1307**

Job Id	Reading #	Concentration	Units	3 SD	Result	Calibration Reading	Action Level	RTA Present	Read Through	NomSecs	Date	Inspector	Floor #	Name	Component	Substrate	Wall Side	Color	Replicant
571055	63	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Underneath Staircase	Metal	Other	Tan	1
571055	64	0.0	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Open Strigent	Metal	Other	Grey	1
571055	65	-0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Closed Strigent	Metal	Other	Grey	1
571055	66	0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Riser	Metal	Other	Grey	1
571055	67	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Riser	Metal	Other	Grey	1
571055	68	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Wall	Plaster	3	Grey	1
571055	69	0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Wall	Plaster	3	Grey	1
571055	70	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Underneath Staircase	Metal	Other	Grey	1
571055	71	0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-28 Level	Staircase	Underneath Staircase	Metal	Other	Grey	1
571055	72	-0.4	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	3	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Column	Concrete	Other	White	1
571055	73	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Column	Concrete	Other	White	1
571055	74	0.1	mg/cm2	0.2	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Column	Concrete	Other	White	1
571055	75	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Wall	Brick Mortar	1	White	1
571055	76	-0.2	mg/cm2	0.2	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Wall	Brick Mortar	1	White	1
571055	77	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Waste Pipes	Cast Iron	1	Grey	1
571055	78	0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Waste Pipes	Cast Iron	1	Grey	1
571055	79	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-28 Level	Basement Dry Well	Waste Pipes	Cast Iron	1	Beige	1
571055	80	2.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-14 Level	Centrifugal Pipe Perimeter	Staircase Platform Support	Metal	1	Brown	1
571055	81	3.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-14 Level	Centrifugal Pipe Perimeter	Staircase Platform Support	Metal	1	Brown	1
571055	82	-0.4	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-14 Level	Centrifugal Pipe Perimeter	Wall	Concrete	1	White	1
571055	83	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-14 Level	Centrifugal Pipe Perimeter	Wall	Concrete	2	White	1
571055	84	0.3	mg/cm2	0.2	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-14 Level	Centrifugal Pipe Perimeter	Wall	Concrete	4	White	1
571055	85	0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-14 Level	Centrifugal Pipe Perimeter	Handrail	Metal	Other	Grey	1
571055	86	-0.3	mg/cm2	0.2	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-14 Level	Centrifugal Pipe Perimeter	Tread	Metal	Other	Grey	1
571055	87	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-14 Level	Centrifugal Pipe Perimeter	Baluster	Metal	Other	Grey	1
571055	88	2.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Wall	Ceramic	Other	Tan	1
571055	89	1.6	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Wall	Ceramic	Other	Tan	1
571055	90	2.8	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Wall	Ceramic	Other	Tan	1
571055	91	2.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Wall	Ceramic	Other	Tan	1
571055	92	0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Wall	Plaster	Other	White	1
571055	93	0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Wall	Plaster	Other	White	1
571055	94	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Wall	Plaster	Other	White	1
571055	95	3.3	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Wall	Plaster	Other	White	1
571055	96	2.6	mg/cm2	0.2	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Door	Metal	Other	Brown	1
571055	97	1.5	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Door Frame	Metal	Other	Brown	1
571055	98	2.5	mg/cm2	0.2	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Door	Metal	Other	Brown	1
571055	99	1.0	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Door Frame	Metal	Other	Brown	1
571055	100	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Closed Strigent	Metal	Other	Tan	1
571055	101	1.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Closed Strigent	Metal	Other	Tan	1
571055	102	2.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Open Strigent	Metal	Other	Tan	1
571055	103	1.0	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Open Strigent	Metal	Other	Tan	1
571055	104	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Riser	Metal	Other	Tan	1
571055	105	1.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Riser	Metal	Other	Tan	1
571055	106	2.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Underneath Staircase	Metal	Other	Tan	1
571055	107	1.9	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	-6.5 Level	Staircase-Basement Walk Way	Underneath Staircase	Metal	Other	Tan	1
571055	108	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Closed Strigent	Metal	Other	Tan	1
571055	109	1.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Closed Strigent	Metal	Other	Tan	1
571055	110	2.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Open Strigent	Metal	Other	Tan	1
571055	111	1.0	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Open Strigent	Metal	Other	Tan	1
571055	112	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Riser	Metal	Other	Tan	1
571055	113	1.1	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Riser	Metal	Other	Tan	1
571055	114	2.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	3	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Underneath Staircase	Metal	Other	Tan	1
571055	115	1.0	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Underneath Staircase	Metal	Other	Tan	1
571055	116	1.1	mg/cm2	0.2	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Wall	Ceramic	Other	Tan	1
571055	117	1.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Wall	Ceramic	Other	Tan	1
571055	118	1.3	mg/cm2	0.2	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Wall	Ceramic	Other	Tan	1
571055	119	1.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Wall	Ceramic	Other	Tan	1
571055	120	0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	4.5 Level	Stairwell-Bearing Access Platforms	Ceiling	Plaster	Other	Tan	1
571055	121	2.2	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Closed Strigent	Metal	Other	Tan	1
571055	122	2.6	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Closed Strigent	Metal	Other	Tan	1
571055	123	2.4	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Open Strigent	Metal	Other	Tan	1
571055	124	2.3	mg/cm2	0.3	Positive	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Open Strigent	Metal	Other	Tan	1

Company Heuresis Corp.
Model Pb200i
Type XRF Lead Paint Analyzer
Serial Num. 2083
App Version Pb200i-REL-4.0-29

Location: Cedar Creek WPCP-IPS - HBM Scope
Address: 3340 Merrick Road, Wantagh, NY 11793
Building: Various Locations
LiRo Job #: **26-091-1307**

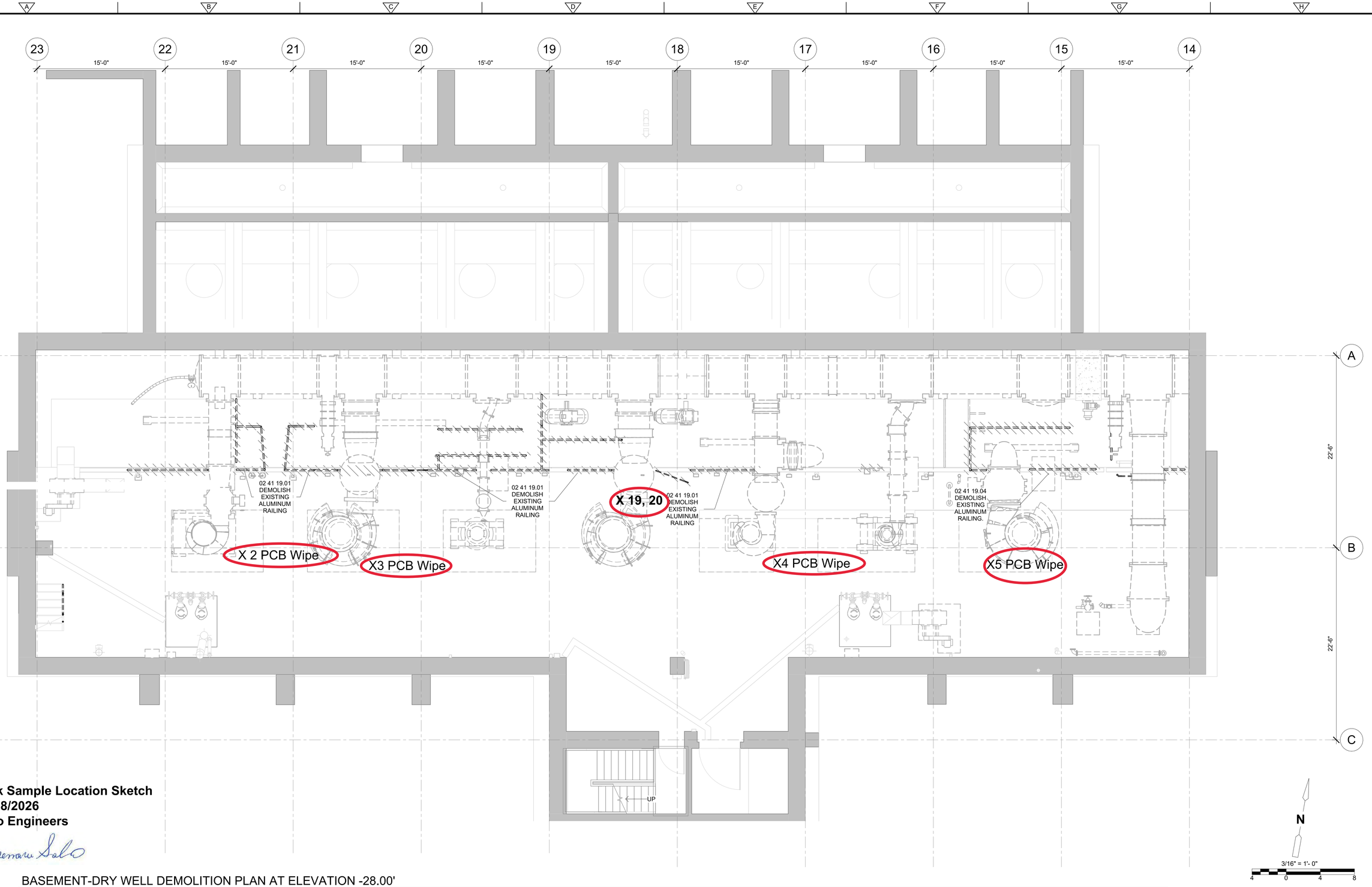
Job Id	Reading #	Concentration	Units	3 SD	Result	Calibration Reading	Action Level	RTA Present	Read Through	NomSecs	Date	Inspector	Floor #	Name	Component	Substrate	Wall Side	Color	Replicant
571055	125	**2.2**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Riser	Metal	Other	Tan	1
571055	126	**1.1**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Riser	Metal	Other	Tan	1
571055	127	**2.4**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Underneath Staircase	Metal	Other	Tan	1
571055	128	**1.8**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Underneath Staircase	Metal	Other	Tan	1
571055	129	**2.3**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Wall	Ceramic	Other	Tan	1
571055	130	**2.2**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Wall	Ceramic	Other	Tan	1
571055	131	**1.6**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Wall	Ceramic	Other	Tan	1
571055	132	**2.1**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Wall	Ceramic	Other	Tan	1
571055	133	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Stairwell-Ground Floor Ref	Ceiling	Plaster	Other	Tan	1
571055	134	0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Metal	Other	Tan	1
571055	135	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Metal	Other	Tan	1
571055	136	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Ground Floor Ref	Suction Line Centrifugal Shaft A-6	Metal	Other	Tan	1
571055	137	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Metal	Other	Green	1
571055	138	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Metal	Other	Green	1
571055	139	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Metal	Other	Green	1
571055	140	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	15.5 Level	Ground Floor Ref	Electrical Equipment Walls	Metal	Other	Green	1
571055	141	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	Wall	Plaster	1	Beige	1
571055	142	-0.1	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	Wall	Plaster	2	Beige	1
571055	143	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	Wall	Plaster	3	Beige	1
571055	144	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	Wall	Plaster	4	Beige	1
571055	145	**1.6**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	Wall	Ceramic	Other	Brown	1
571055	146	**1.1**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	Wall	Ceramic	Other	Brown	1
571055	147	**2.2**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	Wall	Ceramic	Other	Brown	1
571055	148	**1.8**	mg/cm2	0.3	**Positive**	FALSE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	Wall	Ceramic	Other	Brown	1
571055	149	-0.3	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	HVAC/Duct Coating	Canvas	Other	Grey	1
571055	150	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	HVAC/Duct Coating	Canvas	Other	Grey	1
571055	151	0.2	mg/cm2	0.3	Negative	FALSE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh	30.5 Level	HVAC Demolition Overall Plan	HVAC/Duct Coating	Canvas	Other	Grey	1
571055	152	0.5	mg/cm2	0.2		TRUE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh							
571055	153	0.5	mg/cm2	0.2		TRUE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh							
571055	154	0.5	mg/cm2	0.2		TRUE	1	FALSE	FALSE	5	5/7/2026	Chuks-Okoh							
571055	155	-0.1	mg/cm2	0.3		TRUE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh							
571055	156	-0.2	mg/cm2	0.3		TRUE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh							
571055	157	-0.2	mg/cm2	0.3		TRUE	1	FALSE	FALSE	2	5/7/2026	Chuks-Okoh							

LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

APPENDIX B

SAMPLE LOCATION DRAWING(S)

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Bulk Sample Location Sketch
05/08/2026
LiRo Engineers

Rosemary Salo

BASEMENT-DRY WELL DEMOLITION PLAN AT ELEVATION -28.00'
3/16" = 1'-0"

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. Torento-Butkiewicz
DRAWN BY: R. Ruscigno
SHEET CHK'D BY: K. Hlynchuk
CROSS CHK'D BY: M. Torento-Butkiewicz
APPROVED BY: K. Speidel
DATE: JANUARY 2026

CDM Smith
324 S Service Road, Suite 204
Melville, NY 11747
Tel: (516) 496-8400

MACAN DEVE
410 N Broadway
White Plains, NY 10603
Tel: (914) 610-7000

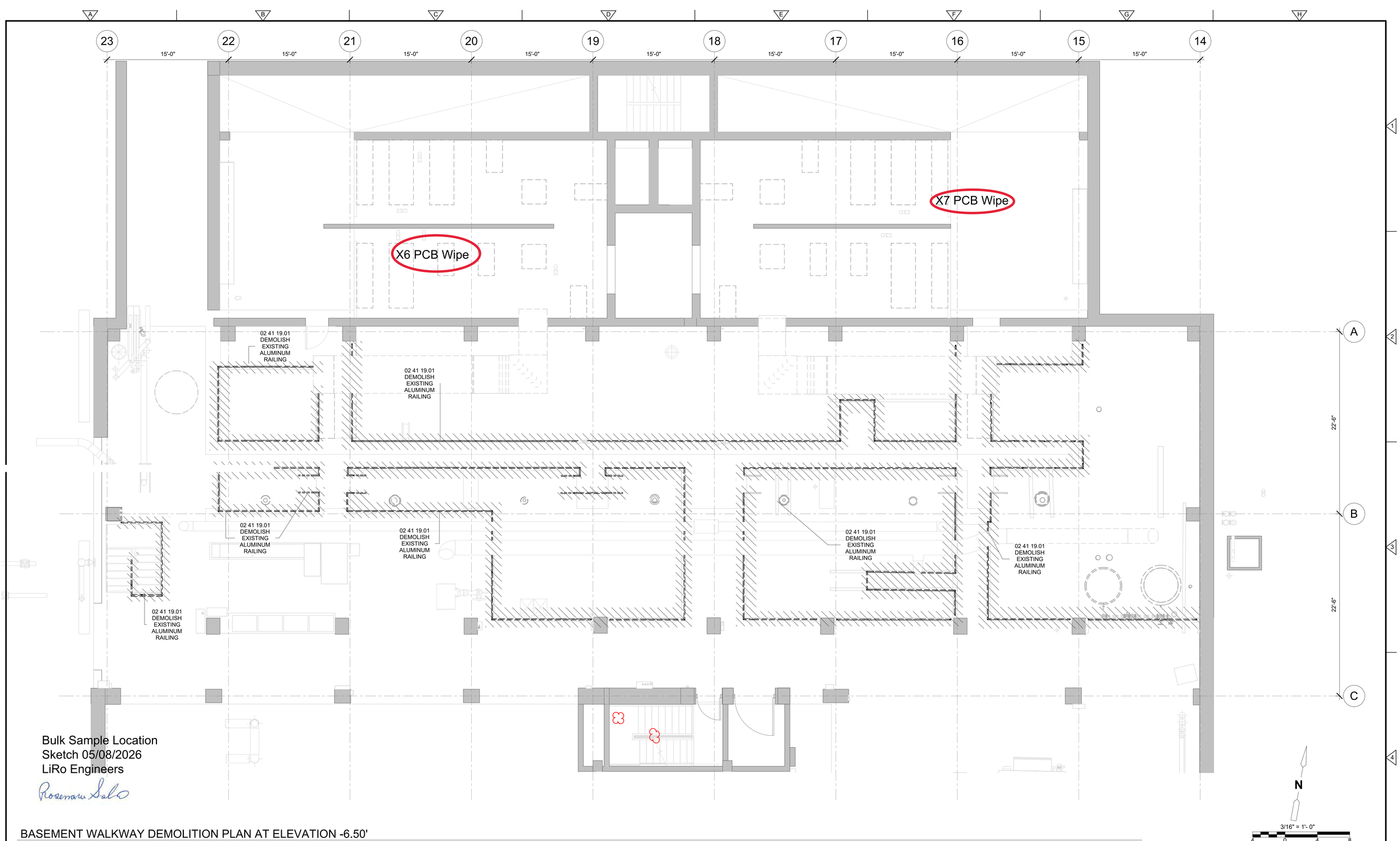
DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK
CEDAR CREEK WATER POLLUTION CONTROL PLANT
INFLUENT PUMP STATION IMPROVEMENTS

ARCHITECTURAL DEMOLITION PLAN
BASEMENT DRY WELL
ELEVATION -28.00'

PROJECT NO. 5044-300615
FILE NAME:
SHEET NO.
AD-010

75% SUBMITTAL - NOT FOR CONSTRUCTION
S3C067-11G

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BASEMENT WALKWAY DEMOLITION PLAN AT ELEVATION -6.50'

3/16" = 1'-0"

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. Torento-Butkiewicz
DRAWN BY: R. Ruscigno
SHEET CHK'D BY: K. Hlynchuk
CROSS CHK'D BY: M. Torento-Butkiewicz
APPROVED BY: K. Speidel
DATE: JANUARY 2026

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Tel: (914) 610-7000

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK
CEDAR CREEK WATER POLLUTION CONTROL PLANT
INFLUENT PUMP STATION IMPROVEMENTS

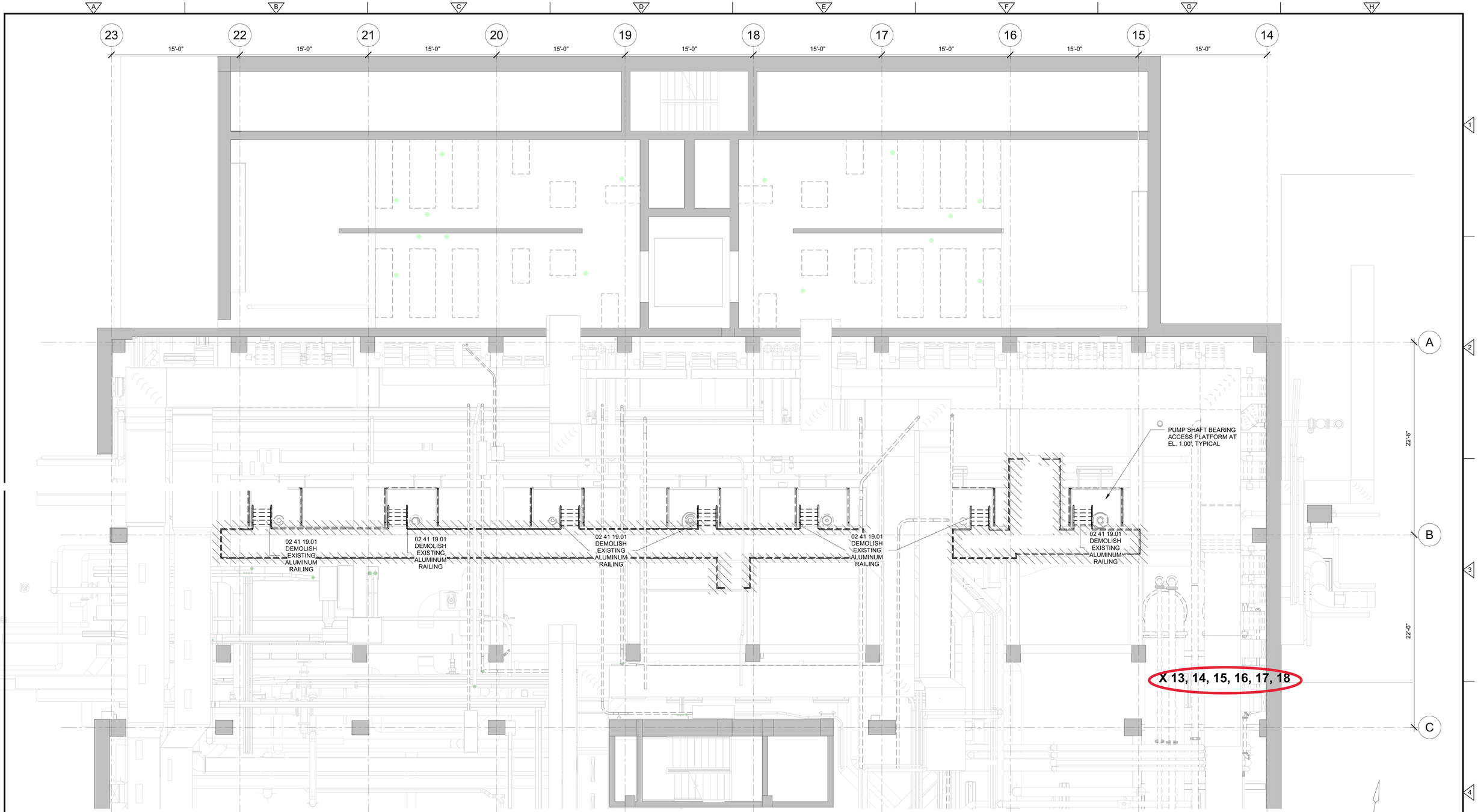
ARCHITECTURAL DEMOLITION PLAN
BASEMENT WALKWAY
ELEVATION -6.50'

PROJECT NO. 5044-300615
FILE NAME:

SHEET NO.
AD-012

75% SUBMITTAL - NOT FOR CONSTRUCTION

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Bulk Sample Location Sketch
05/08/2026
LiRo Engineers Rosemary Salo

1 WALKWAY DEMOLITION PLAN AT ELEVATION 4.50'
3/16" = 1'-0"

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. Torento-Butkiewicz
DRAWN BY: R. Rusciano
SHEET CHK'D BY: K. Hlynchuk
CROSS CHK'D BY: M. Torento-Butkiewicz
APPROVED BY: K. Speidel
DATE: JANUARY 2026

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DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK
CEDAR CREEK WATER POLLUTION CONTROL PLANT
INFLUENT PUMP STATION IMPROVEMENTS

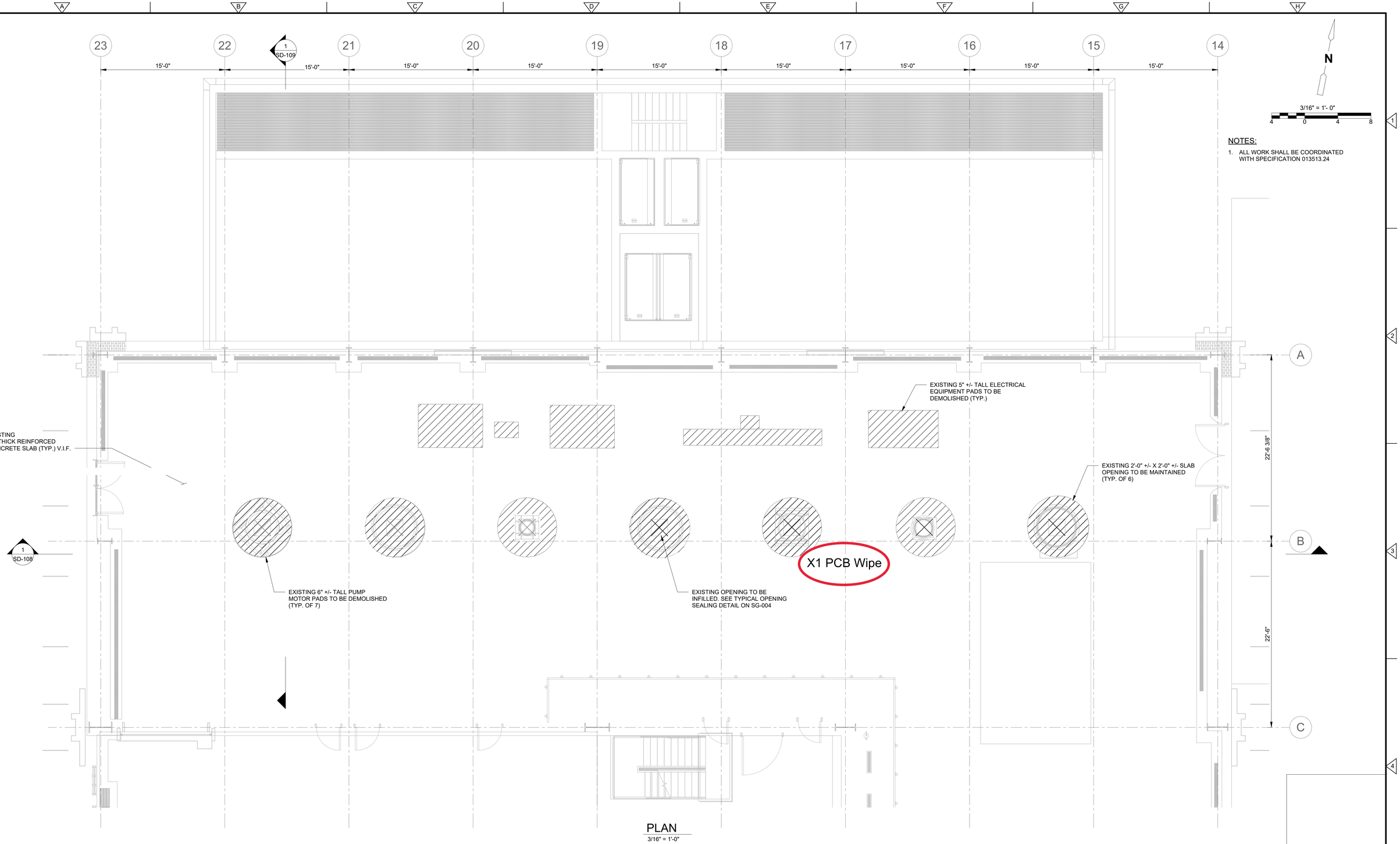
ARCHITECTURAL DEMOLITION PLAN
ACCESS TO BEARING ACCESS PLATFORMS AT ELEVATION 4.50'

PROJECT NO. 5044-300615
FILE NAME:

SHEET NO.
AD-013

75% SUBMITTAL - NOT FOR CONSTRUCTION
S3C067-11G

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PLAN
3/16" = 1'-0"

NOTES:

1. ALL WORK SHALL BE COORDINATED WITH SPECIFICATION 013513.24

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: G. GALASSO
DRAWN BY: J. CASTRO
SHEET CHK'D BY: D. HAN
CROSS CHK'D BY: H. ELZOGHBY
APPROVED BY: H. ELZOGHBY
DATE: JANUARY 2026

CDM Smith
324 S Service Road, Suite 204
Melville, NY 11747
Tel: (516) 496-8400

Savin Engineers, P.C.

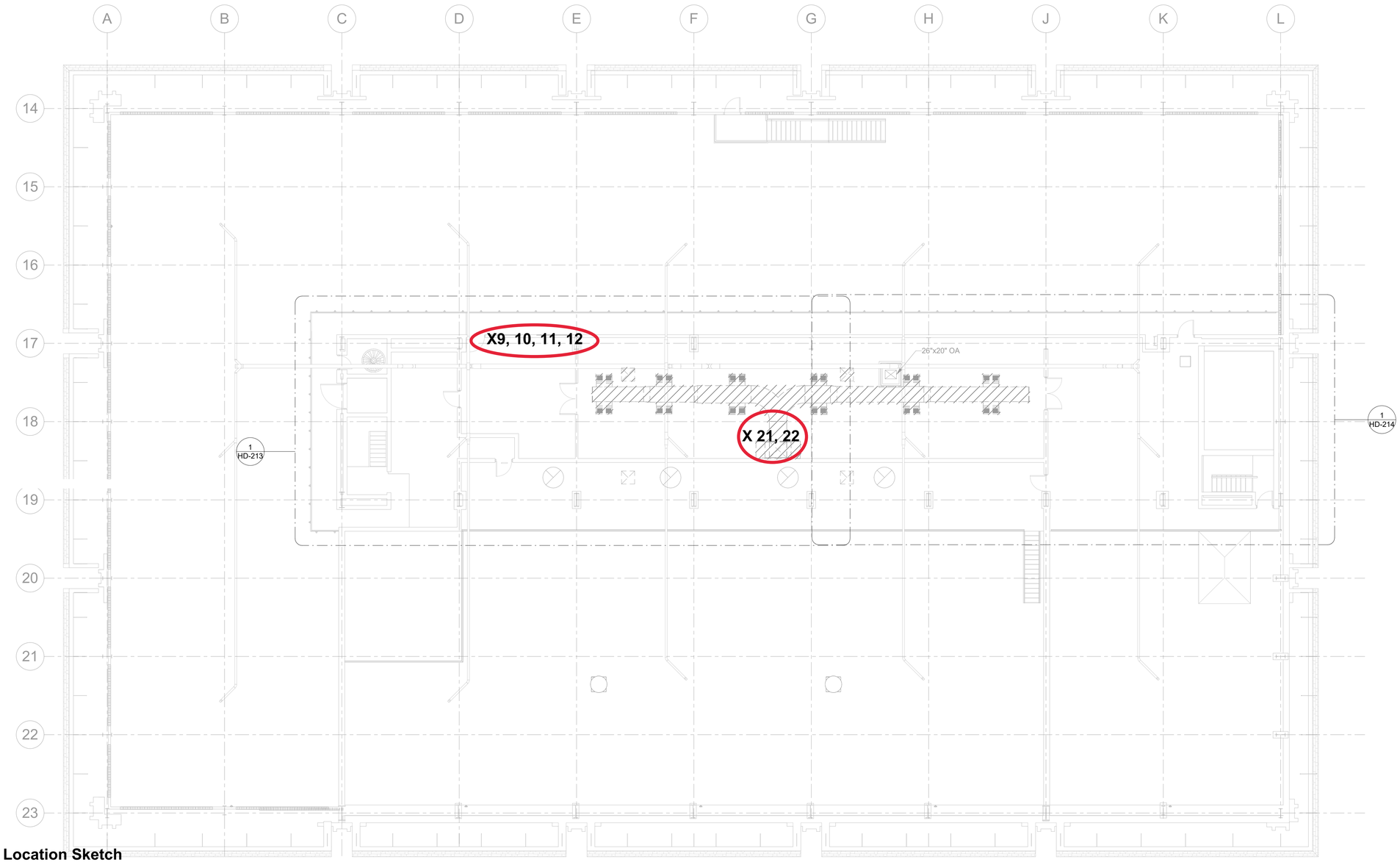
DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK
CEDAR CREEK WATER POLLUTION CONTROL PLANT
INFLUENT PUMP STATION IMPROVEMENTS

STRUCTURAL
DEMOLITION PLAN AT EL. (15.50)

PROJECT NO. 5044-300615
FILE NAME: XWZ000XX
SHEET NO.
SD-106

75% SUBMITTAL - NOT FOR CONSTRUCTION
S3C067-11G

Last Saved by: G. NITHIYAN Time: 1/14/2026 8:34:44 PM
Autodesk Docs://Cedar Creek WPCP IPS/HEZ001PS.rvt
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Bulk Sample Location Sketch
05/08/2026
LiRo Engineers

Rosemary Salo

HVAC DEMOLITION OVERALL PLAN AT ELEVATION 30.50
3/32" = 1'-0"

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: E. MONROE
DRAWN BY: G. NITHIYAN
SHEET CHK'D BY: E. MONROE
CROSS CHK'D BY: D. FLAHERTY
APPROVED BY:
DATE: JANUARY 2026

CDM Smith
324 S Service Road, Suite 204
Melville, NY 11747
Tel: (516) 496-8400

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK
CEDAR CREEK WATER POLLUTION CONTROL PLANT
INFLUENT PUMP STATION IMPROVEMENTS

HVAC DEMOLITION - OVERALL PLAN AT EL. 30.5

PROJECT NO. 5044-300615
FILE NAME: HEZ001PS.rvt
SHEET NO.
HD-104

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TOP / STEEL LEVEL PLAN AT ELEVATION 50.50'

3/32" = 1'-0"

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. Torento-Butkiewicz
DRAWN BY: R. Rusciano
SHEET CHK'D BY: K. Hlynchuk
CROSS CHK'D BY: M. Torento-Butkiewicz
APPROVED BY: K. Speidel
DATE: JANUARY 2026

CDM Smith
324 S Service Road, Suite 204
Melville, NY 11747
Tel: (516) 496-8400

MACAN DEVE
410 N Broadway
White Plains, NY 10603
Tel: (914) 610-7000

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK
CEDAR CREEK WATER POLLUTION CONTROL PLANT
INFLUENT PUMP STATION IMPROVEMENTS

ARCHITECTURAL DEMOLITION PLAN
ROOF
TOP OF STEEL ELEVATION 50.50'

PROJECT NO. 5044-300615
FILE NAME:

SHEET NO.
AD-015

75% SUBMITTAL - NOT FOR CONSTRUCTION
S3C067-11G

LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

APPENDIX C

PHOTOGRAPH(S)

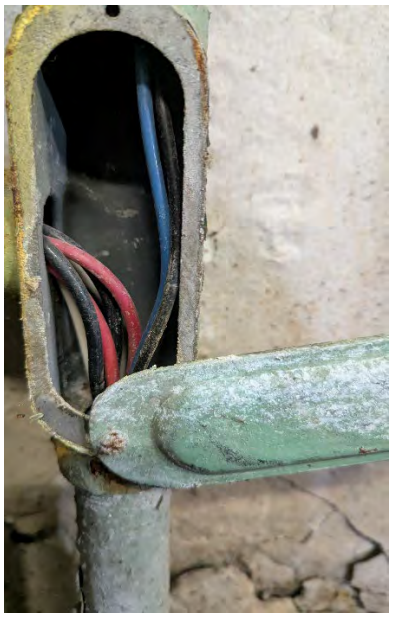
LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

235 East Jericho Turnpike Mineola, NY 11501
Phone: 516-595-2900 • Fax: 516-595-2948

PHOTOGRAPHIC DOCUMENTATION

CLIENT NAME:	LOCATION NAME:	LIRO PROJECT NO.:
CDM Smith	Cedar Creek WPCP	26-091-1307

PHOTO NO.:	
01	
DESCRIPTION: Elevation -28.00 Conditions.	

PHOTO NO.:	
02	
DESCRIPTION: Interior vinyl Wiring	

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235 East Jericho Turnpike Mineola, NY 11501
Phone: 516-595-2900 • Fax: 516-595-2948

PHOTOGRAPHIC DOCUMENTATION

CLIENT NAME:	LOCATION NAME:	LIRO PROJECT NO.:
CDM Smith	Cedar Creek WPCP	26-091-1307

PHOTO NO.:	
03	
DESCRIPTION: Assumed ACM Duct Vibration Cloth Elevation -28.00	

PHOTO NO.:	
04	
DESCRIPTION: Elevation 4.50 Non-ACM Pipe Wrap and Black Foam Insulation	

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235 East Jericho Turnpike Mineola, NY 11501
Phone: 516-595-2900 • Fax: 516-595-2948

PHOTOGRAPHIC DOCUMENTATION

CLIENT NAME:	LOCATION NAME:	LIRO PROJECT NO.:
CDM Smith	Cedar Creek WPCP	26-091-1307

PHOTO NO.:	
05	
DESCRIPTION: Elevation 15.50 Assumed Electrical Panel Backer Boards and Wiring due to live Electric.	

PHOTO NO.:	
06	
DESCRIPTION: Elevation 15.50 Assumed Terrazzo Flooring Underlayment Not Observed.	

LiRo Engineers, Inc.
A LiRo-Hill Company
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235 East Jericho Turnpike Mineola, NY 11501
Phone: 516-595-2900 • Fax: 516-595-2948

PHOTOGRAPHIC DOCUMENTATION

CLIENT NAME:	LOCATION NAME:	LIRO PROJECT NO.:
CDM Smith	Cedar Creek WPCP	26-091-1307

PHOTO NO.:	
07	
DESCRIPTION: Non-ACM Roofing Materials	

LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

APPENDIX D

PERSONNEL CERTIFICATION(S)

United States Environmental Protection Agency

This is to certify that

Liro Engineers, Inc.

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226

In the Jurisdiction of:

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires May 18, 2027

LBP-14409-3

Certification #

May 01, 2024

Issued On

Marc Edmonds, Chief

Risk Assessment Management Branch 2.

WE ARE YOUR DOL

NEW YORK STATE | Department of Labor

DIVISION OF SAFETY & HEALTH LICENSE AND CERTIFICATE UNIT, STATE OFFICE CAMPUS, BLDG. 12, ALBANY, NY 12226

ASBESTOS HANDLING LICENSE

LiRo Engineers, Inc.
690 Delaware Avenue, Buffalo, NY, 14209

License Number: 28866
License Class: RESTRICTED
Date of Issue: 11/20/2025
Expiration Date: 12/31/2026
Duly Authorized Representative: Robert Kreuzer

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.

Amy Phillips, Director
For the Commissioner of Labor

United States Environmental Protection Agency

This is to certify that



Rosemarie Salerno

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226 as:

Risk Assessor

In the Jurisdiction of:

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires April 11, 2027

LBP-R-111498-3

Certification #

November 22, 2023

Issued On

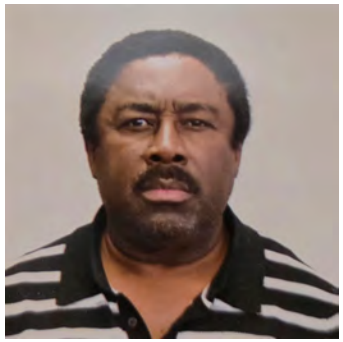
Ben Conetta, Chief

Chemicals and Multimedia Programs Branch


STATE OF NEW YORK - DEPARTMENT OF LABOR
ASBESTOS CERTIFICATE
N.Y.S
ROSEMARIE SALERNO
CLASS(EXPIRES)
C ATEC (10/26) D INSP (10/26)
I PD (10/26) H PM (10/26)
CERT# 25-61V89-SHAB
[redacted]
MUST BE CARRIED ON ASBESTOS PROJECTS

United States Environmental Protection Agency

This is to certify that



Chukwunonyerem Chuks-Okoh

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226 as:

Risk Assessor

In the Jurisdiction of:

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires January 27, 2029

LBP-R-18740-4

Certification #

January 15, 2026

Issued On

Ben Conetta

Ben Conetta, Manager

Chemicals and Multimedia Programs Branch

STATE OF NEW YORK - DEPARTMENT OF LABOR

ASBESTOS CERTIFICATE

N.Y.S



CHUKWUNONYEREM CHUKS-OKOH

CLASS(EXPIRES)

D INSP (12/26) I PD (12/26)

C ATEC (12/25) H PM (12/25)

CERT# 25-6LTSG-SHAB

DMV# [illegible]

MUST BE CARRIED ON ASBESTOS PROJECTS

APPENDIX E

LABORATORY ACCREDITATION

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 101048-9

EMSL Analytical, Inc.

Long Island City, NY

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique on ISO/IEC 17025).

2025-07-01 through 2026-06-30

Effective Dates

For the National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

EMSL Analytical, Inc.
10-39 45th Road
Long Island City, NY 11101
Mr. Charles A. Johnson
Phone: 212-290-0051
Email: cajohnson@emsl.com
http://www.emsl.com

ASBESTOS FIBER ANALYSIS — NVLAP LAB CODE 101048-9

Bulk Asbestos Analysis

Code	*Description*
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

Airborne Asbestos Analysis

Code	*Description*
18/A02	U.S. EPA's "Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Nonmandatory-and Mandatory Section to Determine Completion of Response Actions" as found in 40 CFR, Part 763, Subpart E, Appendix A.

For the National Voluntary Laboratory Accreditation Program

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2027
Issued April 01, 2026

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. CHARLES JOHNSON
EMSL ANALYTICAL, INC
10-39 45TH ROAD
LONG ISLAND CITY, NY 11101

NY Lab Id No: 11506

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:

Miscellaneous

Asbestos in Friable Material	Item 198.1 of Manual
	EPA 600/M4/82/020
Asbestos in Non-Friable Material-PLM	Item 198.6 of Manual (NOB by PLM)
Asbestos in Non-Friable Material-TEM	Item 198.4 of Manual
Asbestos-Vermiculite-Containing Mate	Item 198.8 of Manual
Lead in Dust Wipes	EPA 7000B
Lead in Paint	EPA 7000B

Sample Preparation Methods

	EPA 3050B
	EPA 3051A

Serial No.: 72144

Property of the New York State Department of Health. Certificates are valid only at the address shown and must be conspicuously posted by the laboratory. Continued accreditation depends on the laboratory's successful ongoing participation
at https://apps.health.ny.gov/pubdoh/applinks/wc/elappublicweb/, by phone (518) 485-5570 or by email to elap@health.ny.gov.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2027
Issued April 01, 2026

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. CHARLES JOHNSON
EMSL ANALYTICAL, INC
10-39 45TH ROAD
LONG ISLAND CITY, NY 11101

NY Lab Id No: 11506

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Metals I

Lead, Total	EPA 7000B

Sample Preparation Methods

EPA 3050B
EPA 3051A

Serial No.: 72143

Property of the New York State Department of Health. Certificates are valid only at the address shown and must be conspicuously posted by the laboratory. Continued accreditation depends on the laboratory's successful ongoing participation at https://apps.health.ny.gov/pubdoh/applinks/wc/elappublicweb/, by phone (518) 485-5570 or by email to elap@health.ny.gov.

Page 1 of 1

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2027
Issued April 01, 2026

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MICHAEL VERALDI
LONG ISLAND ANALYTICAL LABORATORIES, INC
110 COLIN DRIVE
HOLBROOK, NY 11741

NY Lab Id No: 11693

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Perfluorinated Alkyl Acids

Perfluorotetradecanoic Acid (PFTeDA)	EPA 1633A
Perfluoroundecanoic Acid (PFUnA)	EPA 1633A
PFEESA	EPA 1633A

Petroleum Hydrocarbons

Diesel Range Organics	EPA 8015D
Gasoline Range Organics	EPA 8015D

Phthalate Esters

Benzyl butyl phthalate	EPA 8270E
Bis(2-ethylhexyl) phthalate	EPA 8270E
Diethyl phthalate	EPA 8270E
Dimethyl phthalate	EPA 8270E
Di-n-butyl phthalate	EPA 8270E
Di-n-octyl phthalate	EPA 8270E

Polychlorinated Biphenyls

Aroclor 1016 (PCB-1016)	EPA 8082A
Aroclor 1016 (PCB-1016) in Oil	ASTM D4059-91,00, e05
Aroclor 1221 (PCB-1221)	EPA 8082A
Aroclor 1221 (PCB-1221) in Oil	ASTM D4059-91,00, e05
Aroclor 1232 (PCB-1232)	EPA 8082A
Aroclor 1232 (PCB-1232) in Oil	ASTM D4059-91,00, e05
Aroclor 1242 (PCB-1242)	EPA 8082A
Aroclor 1242 (PCB-1242) in Oil	ASTM D4059-91,00, e05
Aroclor 1248 (PCB-1248)	EPA 8082A
Aroclor 1248 (PCB-1248) in Oil	ASTM D4059-91,00, e05
Aroclor 1254 (PCB-1254)	EPA 8082A
Aroclor 1254 (PCB-1254) in Oil	ASTM D4059-91,00, e05

Serial No.: 72220

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at https://apps.health.ny.gov/pubdoh/applinks/wc/elappublicweb/, by phone (518) 485-5570 or by email to elap@health.ny.gov.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2027
Issued April 01, 2026

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MICHAEL VERALDI
LONG ISLAND ANALYTICAL LABORATORIES, INC
110 COLIN DRIVE
HOLBROOK, NY 11741

NY Lab Id No: 11693

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Polychlorinated Biphenyls

Aroclor 1260 (PCB-1260)	EPA 8082A
Aroclor 1260 (PCB-1260) in Oil	ASTM D4059-91,00, e05
Aroclor 1262 (PCB-1262)	EPA 8082A
Aroclor 1262 (PCB-1262) in Oil	ASTM D4059-91,00, e05
Aroclor 1268 (PCB-1268)	EPA 8082A
Aroclor 1268 (PCB-1268) in Oil	ASTM D4059-91,00, e05

Polynuclear Aromatic Hydrocarbons

Acenaphthene	EPA 8270E
Acenaphthylene	EPA 8270E
Anthracene	EPA 8270E
Benzo(a)anthracene	EPA 8270E
Benzo(a)pyrene	EPA 8270E
Benzo(b)fluoranthene	EPA 8270E
Benzo(g,h,i)perylene	EPA 8270E
Benzo(k)fluoranthene	EPA 8270E
Chrysene	EPA 8270E
Dibenzo(a,h)anthracene	EPA 8270E
Fluoranthene	EPA 8270E
Fluorene	EPA 8270E
Indeno(1,2,3-cd)pyrene	EPA 8270E
Naphthalene	EPA 8270E
Phenanthrene	EPA 8270E
Pyrene	EPA 8270E

Priority Pollutant Phenols

2,4,5-Trichlorophenol	EPA 8270E
2,4,6-Trichlorophenol	EPA 8270E

Serial No.: 72220

Property of the New York State Department of Health. Certificates are valid only at the address shown and must be conspicuously posted by the laboratory. Continued accreditation depends on the laboratory's successful ongoing participation
at https://apps.health.ny.gov/pubdoh/applinks/wc/elappublicweb/, by phone (518) 485-5570 or by email to elap@health.ny.gov.

LiRo Engineers, Inc.
A LiRo-Hill Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

APPENDIX F

FILE HISTORY

County of Nassau
Department of Public Works

Limited Hazardous Material Assessment Report

Cedar Creek Water Pollution Control Plant

Wantagh, New York

March 2017

D&B Engineers and Architects, P.C.

LIMITED HAZARDOUS MATERIALS ASSESSMENT REPORT

CEDAR CREEK WATER POLLUTION CONTROL PLANT
WANTAGH, NEW YORK

Prepared for:

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
WESTBURY, NEW YORK

Prepared by:

D&B ENGINEERS AND ARCHITECTS, P.C.
WOODBURY, NEW YORK

MARCH 2017

LIMITED HAZARDOUS MATERIALS ASSESSMENT REPORT
CEDAR CREEK WATER POLLUTION CONTROL PLANT
WANTAGH, NEW YORK

TABLE OF CONTENTS

Section		Title	Page
1.0	**INTRODUCTION**		1-1
	1.1	Limitations	1-2
	1.2	Qualifications	1-2
2.0	**FACILITY DESCRIPTION**		2-1
3.0	**METHODOLOGY**		3-1
	3.1	Asbestos-Containing Materials	3-1
	3.2	Lead-Based Paint	3-2
	3.3	Polychlorinated Biphenyls	3-3
	3.4	Universal Waste	3-5
	3.5	Refrigerant-Containing Equipment	3-5
	3.6	Chemical and Petroleum Products	3-6
	3.7	Miscellaneous Items, Materials and Equipment	3-7
4.0	**FINDINGS**		4-1
	4.1	Asbestos-Containing Materials	4-1
	4.2	Lead-Based Paint	4-2
	4.3	Polychlorinated Biphenyls	4-3
	4.4	Universal Waste	4-4
	4.5	Refrigerant-Containing Equipment	4-4
	4.6	Chemical and Petroleum Products	4-4
	4.7	Miscellaneous Items, Materials and Equipment	4-4
5.0	**CONCLUSIONS**		5-1
6.0	**RECOMMENDATIONS**		6-1
	6.1	Asbestos-Containing Materials	6-1
	6.2	Lead-Based Paint	6-1
	6.3	Petroleum Products	6-2
	6.4	Miscellaneous Items, Materials and Equipment	6-3

List of Appendices

Asbestos Licenses .....A

Sample Summary Tables .....B

Laboratory Results and Chain of Custody Records C

Sample Location Plans.....D

Asbestos-Containing Material Location Plans.....E

List of Figures

2-1 Site Location Map.....2-2

1.0 INTRODUCTION

D&B Engineers and Architects, P.C. (D&B) was retained by the Nassau County Department of Public Works (DPW) to perform a limited hazardous materials assessment of the Cedar Creek Water Pollution Control Plant (WPCP) located at 3340 Merrick Road in Wantagh, New York. It is D&B's understanding that Nassau County DPW is planning to remove and replace pumps A-1 through A-7, electrical cabinets on the main floor, associated piping, duct work, wet wells and other associated equipment located within the Main Building at the Cedar Creek WPCP. The proposed plant upgrade will affect portions of the Main Building's main floor, basement, sub-basement and pit level in vicinity of Pumps A-1 through A-7. The objective of this limited hazardous materials assessment is to determine the presence, extent and condition of any hazardous materials that may be present within the area of work within the Main Building, as defined in Section 2.0 of this report, at the time of the field inspection.

The field activities associated with this limited hazardous materials assessment were performed on January 27, 2017.

The findings contained within this report are consistent with accepted principles and practices established and prescribed by the United States Environmental Protection Agency (USEPA) and the New York State Department of Labor (NYSDOL) with respect to asbestos and lead-based paint surveys and reporting. In addition, the waste management procedures outlined herein are consistent with the regulations established by the USEPA and the New York State Department of Environmental Conservation (NYSDEC).

Section 2.0 of this report contains a physical description of the property and buildings located on-site. Section 3.0 of this report contains the methodology employed during the performance of this limited hazardous materials assessment. The findings of the assessment are presented in Section 4.0, and the conclusions and recommendations of the assessment are presented in Sections 5.0 and 6.0, respectively.

1.1 Limitations

D&B assumes no responsibility, liability, or risk for the use of this report for any purpose other than as a limited assessment to be used for informational purposes only. The contents of this report, including the findings, results, conclusions and recommendations presented herein, are based on information available at the time of the actual on-site survey. The assessment was limited to the area of work contained within the Main Building on the main floor, basement, sub-basement and pit level present at the time of the inspection. Destructive activities to identify concealed asbestos-containing material (ACM) were not performed in order to avoid compromising the weather-tight condition of the building. In addition, certain materials were not sampled due to safety and operational concerns (see Section 4.0). Furthermore, due to the potential for concealed ACM to be present, this report should not be construed to represent all ACM located at the site; all quantities of ACM identified and all dimensions referenced in this report shall be considered approximate and shall be verified on-site.

1.2 Qualifications

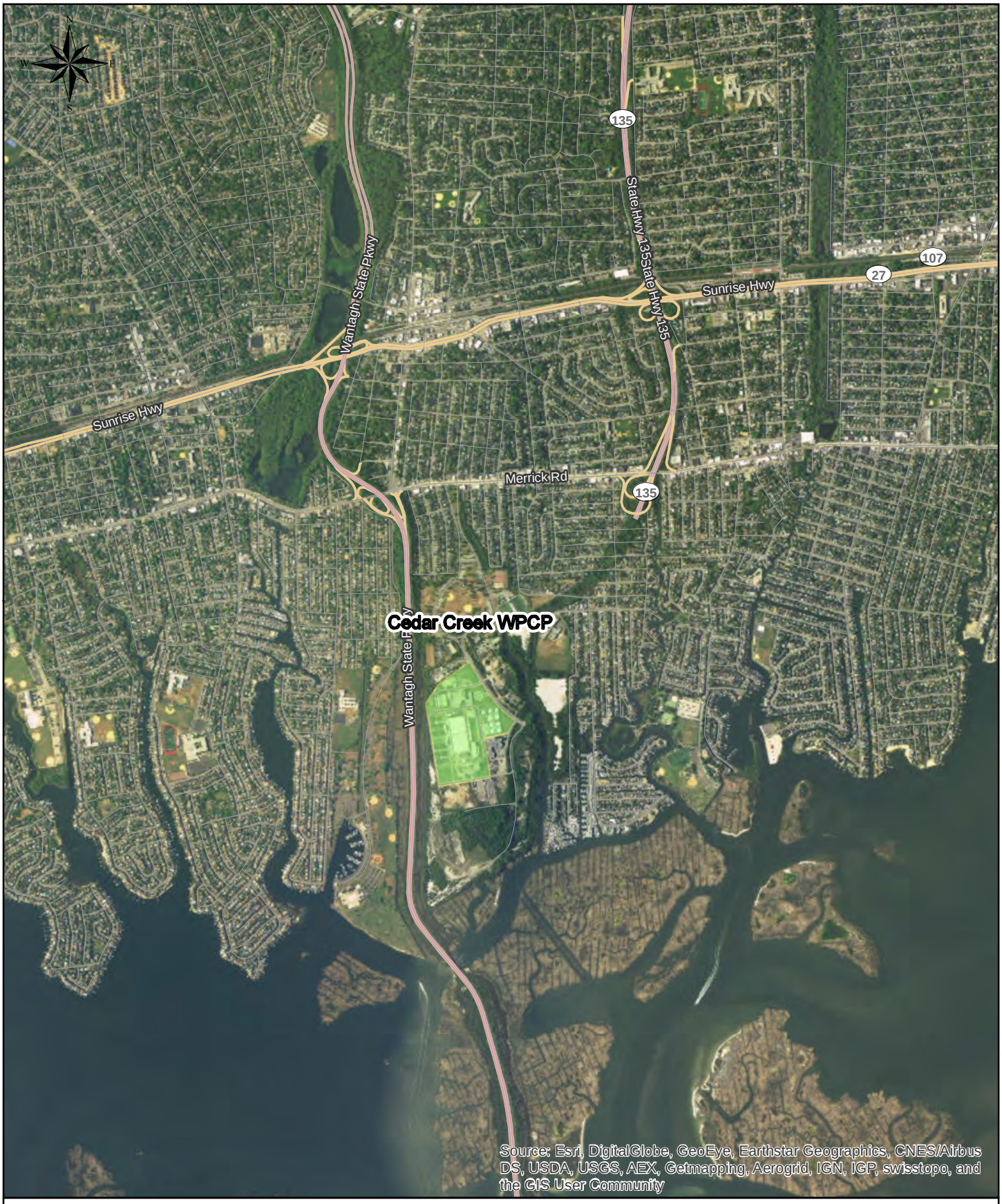
D&B Engineers and Architects, P.C. has the experience and certifications necessary to perform a hazardous materials survey for the area of work located in Main Building on the subject property. Specifically, D&B is in possession of a New York State Department of Labor (NYSDOL) Asbestos Handling License (License No. 28587), as well as a lead-based paint certification issued by the United States Environmental Protection Agency (USEPA) (Certification No. NY-I-17775-2). In addition, the individuals performing the survey are certified inspectors under the NYSDOL asbestos inspection program and the USEPA lead assessment program. Lastly, the inspectors have the training and experience necessary to identify waste materials that require special handling under the USEPA and NYSDEC environmental regulations. Copies of the applicable asbestos licenses are presented in Appendix A of this report.

2.0 FACILITY DESCRIPTION

The Cedar Creek WPCP is located at 3340 Merrick Road in Wantagh, New York (see Figure 2-1). The Cedar Creek WPCP was originally constructed in 1974 and is a secondary activated sludge facility capable of biochemical oxygen demand reduction. The facility is designed for an average daily flow of 72 million gallons per day (MGD) of wastewater, with actual daily average flows of 50 MGD. The plant serves Nassau County's Sewage Disposal District No. 3, which serves a population of approximately 600,000, treating domestic, commercial and industrial wastewater. The Cedar Creek WPCP property is approximately 76 acres and is comprised of 22 buildings.

The limits of work for this assessment included portions of the main floor, basement, sub-basement and pit level in the vicinity of Pumps A-1 through A-7 within the Main Building. The ceilings in the area of work are constructed of concrete (both painted and unpainted). The floors are constructed of concrete (both painted and unpainted) and terrazzo. The walls are constructed of concrete (both painted and unpainted), cinder block, painted plaster and ceramic tiles with mortar. A service elevator and staircase are located along the south side of the area of work. The limits of the area of work are shown on Figures D-1 through D-5 in Appendix D.

The area of work on the main floor includes pump motors A-1 through A-7, associated energized electrical cabinets and a suspect dismantled chemical feeder system located on the main floor north and southwest of Pump A-6 (a label on the unit indicates "T-5 Bldg. H Grade Floor"). The basement level includes the catwalk level, the rotating shafts associated with Pumps A-1 through A-7 (running down to the sub-basement level), fan exhausts, duct work, insulated potable and non-potable water piping, sewer piping, and heating piping. A 500-gallon insulated single-walled steel aboveground storage tank (AST) located on the basement level of the Main Building is used to store hydraulic oil for Pumps A-1 through A-7. The sub-basement level includes Pumps A-1 through A-7, two sump pits and associated piping. The pit level consists of the wet wells, associated piping and suction valves for Pumps A-1 through A-7. The extents of this hazardous materials survey are limited to only those areas where work is proposed under the plant upgrade project.



L:\3676_UnitedWater\Cedar Creek Asbestos Survey\Figure 1-1 Site Location Map V2.mxd (1/30/2017)

D&B ENGINEERS AND ARCHITECTS, P.C.

CEDAR CREEK
WATER POLLUTION CONTROL PLANT
3340 MERRICK ROAD
WANTAGH, NEW YORK

SITE LOCATION MAP

FIGURE 2-1

3.0 METHODOLOGY

The following provides a brief description of the methodology used in performing the limited hazardous materials survey for the area of work described in Section 2.0 of this report.

3.1 Asbestos-Containing Materials

An asbestos survey was performed for the area of work in order to determine the locations, quantities, friability and condition of any asbestos-containing materials (ACM) present. The survey was performed in accordance with the asbestos bulk sampling protocols for multi-layered building systems and materials as specified in the applicable provisions of the following standards:

- United States Environmental Protection Agency (USEPA) Asbestos Hazard Emergency Response Act (AHERA) (40 CFR Part 763, Subpart E)
- USEPA Asbestos School Hazard Abatement Reauthorization Act (ASHARA) (40 CFR Part 763, Subpart E)
- New York State Department of Labor (NYSDOL) Industrial Code Rule 56 (12 NYCRR Part 56)

The purpose of the assessment was to identify whether any suspect ACM is present within the area of work and to sample and determine whether the material is ACM prior to any demolition or renovation activities. NYSDOL's Industrial Code Rule 56 (ICR 56) defines ACM as any material that contains greater than 1% asbestos by weight and requires all ACM to be removed by a licensed asbestos abatement contractor prior to building renovation or demolition. Those materials containing asbestos at concentrations less than or equal to 1% asbestos by weight are classified as non-regulated ACM.

During the assessment, all accessible portions of the area of work were visually assessed to identify any suspect ACM. All suspect ACM observed was grouped into homogenous areas for sampling (i.e., items composed of the same material with the same color and texture).

Samples were collected of each homogenous area for laboratory analysis utilizing the prescribed sample collection methodology outlined by USEPA and NYSDOL as follows: three to nine samples were collected of each surfacing material depending upon the square footage of the material present; three samples were collected of each thermal system insulation (TSI); and two to three samples were collected of each miscellaneous material depending on the square footage of the material present. The samples of each homogenous area were collected from well distributed locations of the material and all layers of the material present were collected. The samples were collected in accordance with the procedures described in the NYSDOL's ICR 56. During sample collection, the suspect ACM was physically handled to determine friability. Only observed suspect ACM was sampled during the assessment. Following collection of each sample, the inspector noted the location from where each sample was collected on a sample location plan and added the sample identification to a Chain of Custody form.

The samples were sent to the laboratory for analysis by Polarized Light Microscopy (PLM) utilizing NYSDOH ELAP Method 198.1 for friable suspect materials, and Non-friable Organically Bound (NOB) PLM utilizing NYSDOH ELAP Method 198.6 for non-friable suspect materials. Confirmation analysis of NOB materials utilizing Transmission Electron Microscopy (TEM) was performed, where necessary, utilizing NYSDOH ELAP Method 198.4. TEM is required by the New York State Department of Health (NYSDOH) to prove that a NOB material is non-ACM, when the material is initially determined to be non-ACM by PLM and the sample has an acid insoluble inorganic phase of greater than 1.0%.

All samples were submitted to EMSL Analytical Inc. (EMSL) of Carle Place, New York for analysis. EMSL participates in the NYSDOH Environmental Laboratory Approval Program (ELAP).

3.2 Lead-Based Paint

A lead-based paint (LBP) survey was performed for the area of work in order to determine the locations, components, extent, substrate materials and condition of any LBP present. The survey was performed utilizing the applicable provisions of the USEPA and United States Department of Housing and Urban Development (HUD) standards.

According to HUD and USEPA, LBP is defined as a coating with a lead concentration greater than or equal to 0.5% or 5,000 parts per million (ppm) (also equivalent to milligrams per kilogram [mg/kg]) in a paint chip sample analyzed by a laboratory.

During the survey, accessible portions of the area of work were visually assessed to identify coated building components. The coated components were grouped by the same color, texture and substrate material. For the purposes of this assessment, the survey was performed utilizing paint chip sampling. One sample was collected of each coated building component for laboratory analysis. During sample collection, layers of the coating present were collected with the substrate material excluded. Following collection of each sample, the inspector noted the location from where each sample was collected on a sample location plan and added the sample identification to a Chain of Custody form.

The samples were sent to the laboratory for lead analysis by atomic absorption spectroscopy utilizing USEPA SW-846 Method 3050B/7000B.

All samples were submitted to EMSL Analytical Inc. (EMSL) of Carle Place, New York for analysis. EMSL participates in the NYSDOH Environmental Laboratory Approval Program (ELAP).

3.3 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are a group synthetic chemical compounds known for their non-flammability, chemical stability, low volatility and electrical insulating properties. Due to these properties, PCBs were widely used in electrical, heat transfer and hydraulic equipment; as plasticizers in paints, plastics, caulks and rubber products; as pigments in dyes; as well as many other applications. PCBs were first synthesized in 1881 and, due to their toxicity and environmental persistence, their manufacture was prohibited by USEPA in 1977.

The Toxic Substances Control Act (TSCA) (40 CFR Part 761) regulates the management of PCBs at concentrations greater than or equal to 50 parts per million (ppm). Under TSCA, any equipment or material containing ≥50 ppm PCBs has specific handling, transportation, record

keeping and disposal requirements. Electrical equipment has specific requirements depending on the type of equipment and its PCB concentration. Other equipment and materials containing ≥50 ppm PCBs is generally termed "PCB Bulk Product Waste." However, if the electrical equipment or PCB Bulk Product Waste contaminates any other material via a spill, leaching, contact, etc., the impacted material is termed a "PCB Remediation Waste" and is regulated under TSCA if its PCB concentration is greater than or equal to 2 ppm.

In New York State, the NYSDEC regulates equipment and materials containing PCBs at concentrations of greater than or equal to 50 ppm as hazardous waste. The NYSDEC's regulations governing the identification of PCB hazardous waste are codified at 6 NYCRR Part 371.4(e), and the NYSDEC's regulations governing the management of PCB hazardous waste are codified at 6 NYCRR Parts 372 and 373.

It should be noted that an exemption for "small capacitors" is contained in both TSCA (40 CFR 761.60(b)(2)(ii)) and the New York State hazardous waste management regulations (6 NYCRR Part 371.4(e)(1)), which is applicable to fluorescent light ballasts. All fluorescent light ballasts contain small capacitors. If manufactured prior to 1978, these small capacitors typically contain PCBs at concentrations exceeding 50 ppm. As a result, based on this exemption, the regulations allow non-leaking ballasts to be managed as municipal solid waste. However, USEPA has determined that the ballast's potting material, the insulation that fills the space between the ballast and the outer metal shell, also contains PCBs at concentrations that can exceed 50 ppm in pre-1978 ballasts. Therefore, USEPA recommends that either the ballast be sampled to determine that its PCB concentration is less than 50 ppm allowing it to be managed as municipal solid waste, or assume the ballast contains ≥50 ppm PCBs and manage the ballast as PCB Bulk Product Waste. Since sampling can be costly, often the most cost-effective option is to simply manage ballasts as PCB Bulk Product Waste.

During the survey, all PCB and suspect PCB items observed were quantified and their locations noted on a floor plan. If it was determined that the item should be sampled for PCBs, the sample was sent to EMSL Analytical Inc. (EMSL) of Carle Place, New York for analysis utilizing USEPA SW-846 Method 8082.

3.4 Universal Waste

Due primarily to the presence of mercury and other metals in some commonplace building materials that would render them hazardous waste, the USEPA has created a category of waste referred to as "universal waste" to streamline the hazardous waste management standards and prevent generators of these materials from becoming traditional hazardous waste generators. The goal of this program is to ensure that these materials are properly managed and prevented from entering the environment without imposing the onerous requirements of the hazardous waste management regulations.

As a result, USEPA has specified, and NYSDEC has adopted, the identification of four categories of ubiquitous wastes for management as universal waste. These wastes include certain lamps (i.e., fluorescent, neon, high-intensity discharge, metal halide, sodium vapor and mercury vapor), batteries, mercury-containing equipment and certain pesticides. The regulations specifying the proper identification and management of universal waste are codified in the federal regulations at 40 CFR Part 273 and in the New York State regulations at 6 NYCRR Part 274-3.

During the survey, all universal waste observed was quantified and its location noted on a floor plan. Samples were not collected of universal waste during the survey for laboratory analysis.

3.5 Refrigerant-Containing Equipment

Many different chemical compounds used as refrigerants in commercial and industrial refrigerant containing equipment are classified as chlorofluorocarbons (CFCs). CFCs gained notoriety due their persistence in the environment coupled with their ability to efficiently destroy ozone in the upper atmosphere, which has led to the depletion of the ozone layer. As a result of the depletion of the ozone layer, USEPA established the refrigerant recycling rule under Section 608 of the Clean Air Act.

The USEPA's regulations describing the requirements for refrigerant recycling are codified at 40 CFR Part 82. These regulations require that CFCs be recovered and recycled from all equipment in which they are present during any maintenance activities and prior to any disposal activities.

In addition, USEPA has identified some refrigerants as hazardous waste in the event the refrigerants are disposed rather than recycled. The regulations specifying the proper identification and management of certain refrigerants as hazardous waste are codified in the federal regulations at 40 CFR Parts 260 through 268 and in the New York State regulations at 6 NYCRR Parts 370 through 376.

During the survey, all refrigerant-containing equipment observed was quantified and its location noted on a floor plan. In addition, an attempt was made during the survey to identify the type of refrigerant present in the equipment by reading the equipment nameplate and other information provided on the equipment itself. Samples were not collected of refrigerant during the survey for laboratory analysis.

3.6 Chemical and Petroleum Products

Chemical and petroleum products have the ability to adversely impact human health and/or the environment if not properly managed. As a result, unwanted chemical and petroleum products present in containers and/or tanks should be properly managed prior to any renovation or demolition activities.

Certain chemical and petroleum products can be considered hazardous waste at the time of disposal. The regulations specifying the proper identification and management of hazardous waste are codified in the federal regulations at 40 CFR Parts 260 through 268 and in the New York State regulations at 6 NYCRR Parts 370 through 376.

Many petroleum products are considered used oil by the USEPA and NYSDEC. The regulations specifying the proper identification and management of used oil are codified in the

federal regulations at 40 CFR Part 279 and in the New York State regulations at 6 NYCRR Part 374-2.

Even if a chemical or petroleum product is not identified as either hazardous waste or used oil, certain management procedures should be employed to prevent contaminating the environment or triggering a reportable quantity (RQ) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Emergency Planning and Community Right-to-Know Act (EPCRA) or the Chemical Bulk Storage (CBS) regulations. As a result, these materials should be managed as hazardous materials and properly disposed or recycled at an appropriate off-site facility.

During the survey, the chemical and petroleum products observed were quantified and their locations noted on a floor plan. In addition, an attempt was made during the audit to identify the type of product present in the container by reading the label provided on the equipment itself. Also, if the container was observed to be leaking, the approximate area of floor impacted by the spill was noted during the audit. Samples were not collected of any chemical or petroleum product during the survey for laboratory analysis.

3.7 Miscellaneous Items, Materials and Equipment

Although not included in any of the categories identified above, some miscellaneous items, materials and equipment commonplace in construction require special handling at the time of disposal, rather than management as construction and demolition debris (C&D). These materials should be removed prior to any planned demolition activities and properly managed. Since the waste management requirements for these items will depend on the specific item, recommendations for the proper management of these items, if identified on-site, is included in the recommendations section of this report (see Section 6.0).

During the survey, all miscellaneous items, materials and equipment observed were quantified and their locations noted on a floor plan. In addition, an attempt was made during the audit to identify the type of item, material or equipment observed by reading the equipment nameplate and other information provided on the equipment itself. The nameplate was also

consulted to determine whether the item, material or equipment contains any chemical or any other material that may be harmful to human health or the environment. Samples were not collected of any item, material or equipment during the survey for laboratory analysis.

4.0 FINDINGS

The sections that follow present the findings of the limited hazardous materials survey based on the field inspection and laboratory analytical results. The extents of this hazardous materials survey are limited to only those areas where work is proposed under the plant upgrade project, as described in Section 2.0 of this report.

It should be noted that certain materials were not sampled during this assessment due to safety and operational concerns. These materials include: the suspect underlayment beneath the terrazzo flooring on the main floor; the live electrical wiring throughout the area of work; the backer board/transite panel suspected in the electrical cabinets on the main floor; the vibration dampening cloth observed on the exhaust units on the sub-basement level; and, the gasket material associated with the pumps, motors and piping observed on the main floor, basement, sub-basement and pit level of the Main Building.

4.1 Asbestos-Containing Materials

A total of 30 bulk samples were collected of 10 homogeneous areas from the area of work. The bulk samples were analyzed via PLM or NOB PLM for asbestos content and, if the results of the NOB PLM analysis were inconclusive, were further analyzed by TEM. A table summarizing the asbestos bulk sample results is provided as Table B-1 in Appendix B. The laboratory data packages and Chain of Custody records for the samples are provided in Appendix C. Asbestos bulk sample location plans are provided as Figures D-1 through D-4 in Appendix D.

Based on the analyses, one homogeneous area was identified as ACM (i.e., the sample's analytical results indicated asbestos at a concentration greater than 1% by weight). In addition, the following materials not sampled due to safety and operational concerns were assumed to be ACM: the suspect underlayment beneath the terrazzo flooring on the main floor; the live electrical wiring throughout the area of work; the backer board/transite panel suspected in the electrical cabinets on the main floor; the vibration dampening cloth observed on the exhaust units on the sub-basement level; and, the gasket material associated with the pumps, motors and piping

observed on the main floor, basement, sub-basement and pit level of the Main Building. ACM location plans are provided as Figures E-1 through E-5 in Appendix E. The following table summarizes the materials identified as ACM:

SUMMARY OF REGULATED ASBESTOS-CONTAINING MATERIALS			
Homogenous Area	**Location**	**Asbestos content (%)**	**Approximate Quantity***
Cementitious Pipe Insulation Fitting/ Elbow	Basement - 2-inch Diameter Green Pipe	2.15% Chrysotile	Field Verify
Suspect Underlayment beneath the Terrazzo Flooring	Main Floor	Assumed	6,000 SF
Vibration Dampening Cloth on Exhaust Units	Sub-Basement	Assumed	Field Verify
Gasket Material associated with the Pumps, Motors and Piping	Main Floor, Basement, Sub-Basement and Pit Level	Assumed	Field Verify
Backer Board/Transite Panel Suspected in the Electrical Cabinets	Main Floor	Assumed	Field Verify
Live Electrical Wiring	Main Floor, Basement, Sub-Basement and Pit Level	Assumed	Field Verify

* Quantities are estimated and should be verified by the contractor prior to bidding or abatement.
SF = square feet, LF = linear feet.

4.2 Lead-Based Paint

Paint chip samples were collected of 21 different building components from the area of work. A table summarizing the paint chip sample lead results is provided as Table B-2 in Appendix B. The laboratory data packages and Chain of Custody records for the samples are

provided in Appendix C. Paint chip sample location plans are provided as Figures D-1, D-2, D-4 and D-5 in Appendix D.

Based on the analyses, five components were identified as lead-based paint (i.e., the sample's analytical results indicated lead at a concentration greater than 0.5% by weight). The following table summarizes the building component identified as lead-based paint:

SUMMARY OF LEAD-BASED PAINT				
Building Component	**Location**	**Color**	**Substrate**	**Lead Content**
Pump	Main Floor - Exterior of Pump A-3	Light Beige	Metal	0.743%
Staircase	Basement - Underside of the Staircase	Beige	Metal	4.66%
Pump	Sub-basement - Exterior of Pump A-3	Grey	Metal	0.988%
Rotating Shaft	Sub-Basement - Rotating Shaft for Pump A-4	Red	Metal	7.232%
Pipe	Pit Level - 48" Diameter Pipe	Grey	Metal	0.554%

4.3 Polychlorinated Biphenyls

The only potential polychlorinated biphenyl (PCB) containing material observed within the area of work was the hydraulic oil contained in the 500-gallon steel aboveground storage tank located on the basement level of the Main Building. In order to determine whether the oil contains PCBs at a concentration in excess of the regulatory level of 50 ppm, a sample was collected of the oil for PCB analysis to ensure that the oil is properly managed once removed. A table summarizing the PCB sample result is provided as Table B-3 in Appendix B. The laboratory data package and Chain of Custody record for the sample are provided in Appendix C. A PCB sample location plan for the basement level of the Main Building is provided as Figure D-2 in Appendix D.

As indicated in Table B-3, PCBs were detected in the hydraulic oil sample at a concentration below the USEPA Toxic Substances Control Act (TSCA) and New York State Department of Environmental Conservation (NYSDEC) PCB regulatory level of 50 ppm.

4.4 Universal Waste

Based on the on-site survey, universal waste was not identified within the area of work.

4.5 Refrigerant-Containing Equipment

Based on the on-site survey, refrigerant-containing equipment was not identified within the area of work.

4.6 Chemical and Petroleum Products

Based on the on-site survey, chemical products were not identified within the area of work. However, the following petroleum product was identified within the area of work:

SUMMARY OF PETROLEUM PRODUCTS		
Description	**Location**	**Quantity**
Hydraulic Oil System and Tank	Basement Level of the Main Building	500 gallons

* Quantities are estimated and should be verified by the contractor prior to bidding.

4.7 Miscellaneous Items, Materials and Equipment

Based on the on-site survey, the following miscellaneous items, materials and equipment that are of concern from a hazardous materials perspective were identified within the area of work within the Main Building:

SUMMARY OF MISCELLANEOUS ITEMS, MATERIALS AND EQUIPMENT		
Description	**Location**	**Quantity**
Suspect Dismantled Chemical Feeder System (a label on the unit indicated "T-5 Bldg. H Grade Floor")	Main Floor North and Southwest of Pump A-6	1

5.0 CONCLUSIONS

D&B completed a limited hazardous material assessment for the area of work (as defined in Section 2.0 of this report) located within the Main Building of the Nassau County Cedar Creek WPCP at 3340 Merrick Road in Wantagh, New York. The results of the survey are provided below.

Asbestos-Containing Materials

The results of the samples collected indicate that the following material is considered to be ACM:

- The cementitious pipe insulation fitting/elbow on the 2-inch diameter green pipe located on the basement level within the Main Building.

In addition, the following materials were assumed to be ACM since they could not be sampled during the survey due to the aforementioned limitations:

- Suspect underlayment beneath the terrazzo flooring on the main floor of the Main Building.
- The backer board/transite panel suspected in the electrical cabinets on the main floor of the Main Building.
- The live electrical wiring on the main floor, basement, sub-basement and pit level of the Main Building.
- The vibration dampening cloth observed on the exhaust units on the sub-basement level of the Main Building.
- Gasket material associated with the pumps, motors and piping observed on the main floor, basement, sub-basement and pit level of the Main Building.

Lead-Based Paint

The result of the paint chip samples collected indicate that the following coatings are considered to be lead-based paint:

- The light beige paint on the exterior of Pump A-3 on the main floor.
- The beige paint on the underside of the staircase on the basement level.
- The grey paint on the exterior of Pump A-3 on the sub-basement level.
- The red paint on the rotating shaft for Pump A-4 on the sub-basement level.
- The grey paint on the 48-inch diameter pipe on the pit level of the Main Building.

Polychlorinated Biphenyls

PCBs were detected in the hydraulic oil sample collected from the hydraulic oil tank on the basement level of the Main Building at a concentration below the USEPA TSCA and NYSDEC PCB regulatory level of 50 ppm. As a result, this oil does not require special management under the TSCA or NYSDEC hazardous waste management regulations.

Universal Waste

Universal waste was not identified within the area of work.

Refrigerant-Containing Equipment

Refrigerant-containing equipment was not identified within the area of work.

Chemical and Petroleum Products

Chemical products were not identified within the area of work. However, the following petroleum product was identified within the area of work:

- The approximate 500 gallons of hydraulic oil contained in the hydraulic oil system and tank located in the basement level of the Main Building.

Miscellaneous Items, Materials and Equipment

The following miscellaneous items, materials and equipment were observed within the area of work:

- A suspect dismantled chemical feeder system located on the main floor north and southwest of Pump A-6 (a label on the unit indicated “T-5 Bldg. H Grade Floor”).

6.0 RECOMMENDATIONS

The following recommendations are presented based on the conclusions of the limited hazardous materials survey as presented in Section 5.0 of this report.

6.1 Asbestos-Containing Materials

Prior to performing any future demolition or renovation activities in the area of work, all ACM affected by the planned activities should be removed and managed in accordance with the USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61), New York State Department of Labor (NYSDOL) Industrial Code Rule 56 (ICR 56) and any applicable local regulations. A licensed and accredited asbestos abatement contractor must be utilized to perform the removal of all ACM identified within the area of work. Suspect ACM not sampled during this survey should be considered ACM until sampled and proven by laboratory analysis to be non-ACM. The USEPA and NYSDOL must be notified of this project prior to performing any asbestos removal activities.

During performance of the asbestos removal activities, the owner must retain an independent third-party contractor to conduct project monitoring and work area air sampling and analysis to ensure that the asbestos removal work is performed in accordance with Industrial Code Rule 56 and all other applicable regulations. The owner must obtain copies of the analytical results for all air samples collected for each specific project in order to document the airborne asbestos concentrations before, during and after the asbestos abatement activities. In addition, copies of all clearance asbestos air sampling analytical results must be submitted to the NYSDOL Division of Safety & Health, Asbestos Control Bureau, as required by Industrial Code Rule 56.

6.2 Lead-Based Paint

In the event that the materials identified as lead-based paint are demolished in the future, the demolition debris must be tested for lead, at a minimum, utilizing the Toxicity Characteristic Leaching Procedure (TCLP). If the TCLP analysis indicates lead at a concentration of 5 mg/L or

greater, then the debris must be managed as a hazardous waste in accordance with the USEPA Resource Conservation and Recovery Act (RCRA) regulations (40 CFR Parts 260 through 268) and the New York State Department of Environmental Conservation's (NYSDEC's) hazardous waste management regulations (6 NYCRR Parts 370 through 376). However, if the lead-based paint coated component is composed of metal, then the scrap metal exemption may be used and the component can be recycled in lieu of management as hazardous waste (records of the transportation and proper management of these items must be maintained).

In the event that the on-site building is renovated in the future and will be used as a "child-occupied facility," then the requirements of USEPA's Lead-Based Paint Renovation, Repair and Painting Program Rule must be followed. In addition, if the building will be voluntarily abated and used as a "child-occupied facility," then the abatement work must be conducted in accordance with USEPA and HUD requirements. Also, if the building is sold or leased for housing, then the owner must notify the buyer or lessee of the hazards of lead-based paint in accordance with USEPA's requirements. Lastly, if the building will be used for HUD housing, then a certified lead Risk Assessor should be consulted to determine whether the lead-based paint identified in this report must be abated in accordance with USEPA and HUD requirements.

Whenever work is performed that disturbs lead-based paint, workers must be protected in accordance with the United States Department of Labor Occupational Safety and Health Administration's (OSHA's) "Lead in Construction" Rule (29 CFR 1926.62).

6.3 Petroleum Products

The petroleum product (hydraulic oil) identified during this survey should be properly managed in the event that it is affected by any future renovation or demolition activities and will not be reused. The first step in disposal is to perform a waste determination for the oil in accordance with 40 CFR 261 and 6 NYCRR 371. A sample of the oil should be collected and analyzed for total halogens. If the oil has not been mixed with any other material, then additional testing should not be required unless requested by the disposal facility. If the total halogens content is less than 1,000 ppm, then the oil may be managed as used oil in accordance

with 40 CFR Part 279 and 6 NYCRR Part 374-2. If the total halogens content is greater than 1,000 ppm, then the oil must be managed as hazardous waste in accordance with 40 CFR 264 and 6 NYCRR 373. This oil should not be mixed with any other material or waste prior to disposal.

6.4 Miscellaneous Items, Materials and Equipment

All of the miscellaneous items, materials and equipment identified during this survey should be properly managed in the event that they are affected by any future renovation or demolition activities and will not be reused. The first step in disposal is to perform a waste determination on each item in accordance with 40 CFR 261 and 6 NYCRR 371. If a Safety Data Sheet (SDS) cannot be located for the item, a sample of the material should be collected and analyzed for flash point, pH, reactive sulfide, reactive cyanide and RCRA constituents by the Toxicity Characteristic Leaching Procedure (TCLP), as well as any additional parameters specified by the selected disposal facility. If determined to be hazardous waste, the waste should be managed at a facility authorized to manage hazardous waste in accordance with 40 CFR 264 and 6 NYCRR 373. If determined to be nonhazardous waste, the waste should be managed as nonhazardous waste at a facility approved to manage such waste.

APPENDIX A

ASBESTOS LICENSES

New York State – Department of Labor
Division of Safety and Health
License and Certificate Unit
State Campus, Building 12
Albany, NY 12240

ASBESTOS HANDLING LICENSE

D & B Engineers and Architects, P.C. (a/k/a Dvirka and Bartilucci Consulting Engineers)

330 Crossways Park Drive

Woodbury, NY 11797

FILE NUMBER: 07-0207
LICENSE NUMBER: 28587
LICENSE CLASS: RESTRICTED
DATE OF ISSUE: 06/30/2016
EXPIRATION DATE: 07/31/2017

Duly Authorized Representative – Richard M Walka:

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.

Eileen M. Franko, Director
For the Commissioner of Labor

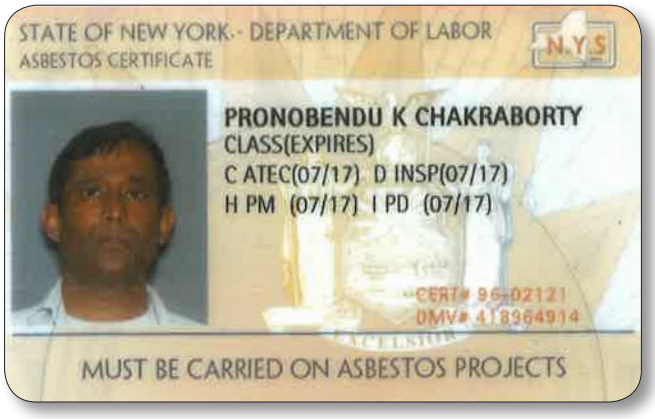
SH 432 (8/12)

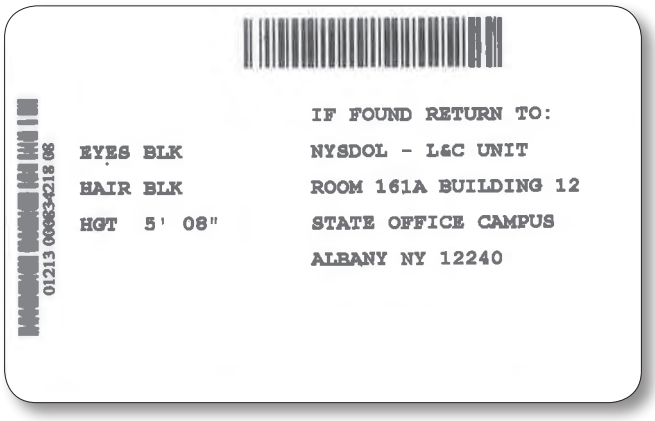
D&B Engineers and Architects, P.C.

P. KUMAR CHAKRABORTY

New York State Department of Labor (NYSDOL)
Certificate # 96-02121
Expiration Date: 07/17

New York State Department of Labor (NYSDOL) - Licenses
Project Designer
Inspector
Project Monitor
Air Sampling Technician





APPENDIX B

SAMPLE SUMMARY TABLES

TABLE B-1
CEDAR CREEK WATER POLLUTION CONTROL PLANT
WANTAGH, NEW YORK
ASBESTOS BULK SAMPLE RESULTS

Sample ID	Material Description	Sample Location			Sample Information			Sample Result	
		Floor	Area	Interior/ Exterior	Condition	Friable/ Non-Friable	Date Sample Collected	PLM or PLM-NOB	TEM-NOB
KC-ACM-TF-1-01	Terrazzo Flooring	Main Floor	Pump Motor Room	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-TF-1-02	Terrazzo Flooring	Main Floor	Pump Motor Room	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-TF-1-03	Terrazzo Flooring	Main Floor	Pump Motor Room	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-PIE-2-01	Pipe Insulation Elbow	Main Floor	North Wall Behind Electrical Cabinet A-2	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-PIE-2-02	Pipe Insulation Elbow	Main Floor	North Wall Behind Electrical Cabinet A-2	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-PIE-2-03	Pipe Insulation Elbow	Main Floor	North Wall Behind Electrical Cabinet A-2	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-FGIW-3-01	Fiberglass Insulation Wrap	Main Floor	Northwest Corner - T 5 Bldg. H Grade Floor Unit	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-FGIW-3-02	Fiberglass Insulation Wrap	Main Floor	Northwest Corner - T 5 Bldg. H Grade Floor Unit	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-FGIW-3-03	Fiberglass Insulation Wrap	Main Floor	West Wall - Panel Insulation	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-PW-4-01	Plaster Wall	Main Floor	Staircase Wall/Over Concrete Wall	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-PW-4-02	Plaster Wall	Basement	Staircase Wall/Over Concrete Wall	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-PW-4-03	Plaster Wall	Sub-basement	Staircase Wall/Over Concrete Wall	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA

TABLE B-1
CEDAR CREEK WATER POLLUTION CONTROL PLANT
WANTAGH, NEW YORK
ASBESTOS BULK SAMPLE RESULTS

Sample ID	Material Description	Sample Location			Sample Information			Sample Result	
		Floor	Area	Interior/ Exterior	Condition	Friable/ Non-Friable	Date Sample Collected	PLM or PLM-NOB	TEM-NOB
KC-ACM-FIW-5-01	Fan Insulation Wrap/Cloth	Basement	East Fan Adjacent to Walkway	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-FIW-5-02	Fan Insulation Wrap/Cloth	Basement	West Fan Adjacent to Walkway	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-FIW-5-03	Fan Insulation Wrap/Cloth	Basement	Northeast Fan Adjacent to Walkway	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-PI-6-01	**Cementitious Pipe Insulation Fitting/Elbow**	**Basement**	**Basement 2-inch Dia. Pipe - Green**	**Interior**	**Significantly Damaged**	**Friable**	**Jan-26-2017**	**2.15% Chrysotile**	**NA**
KC-ACM-PI-6-02	**Cementitious Pipe Insulation Fitting/Elbow**	**Basement**	**Basement 2-inch Dia. Pipe - Green**	**Interior**	**Significantly Damaged**	**Friable**	**Jan-26-2017**	**NA/PS**	**NA**
KC-ACM-PI-6-03	**Cementitious Pipe Insulation Fitting/Elbow**	**Basement**	**Basement 2-inch Dia. Pipe - Green**	**Interior**	**Significantly Damaged**	**Friable**	**Jan-26-2017**	**NA/PS**	**NA**
KC-ACM-CIW-7-01	12-inch Dia. Pipe Cloth Insulation Wrap	Basement-Catwalk	Catwalk Green Wrap	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-CIW-7-02	12-inch Dia. Pipe Cloth Insulation Wrap	Basement-Catwalk	Catwalk Green Wrap	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-CIW-7-03	12-inch Dia. Pipe Cloth Insulation Wrap	Basement-Catwalk	Catwalk Green Wrap	Interior	Good	Friable	Jan-26-2017	ND	NA
KC-ACM-PIW-8-01	1/4-inch Dia. Pipe Insulation Wrap	Basement-Catwalk	Catwalk Beige Wrap	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-PIW-8-02	1/4-inch Dia. Pipe Insulation Wrap	Basement-Catwalk	Catwalk Beige Wrap	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-PIW-8-03	1/4-inch Dia. Pipe Insulation Wrap	Basement-Catwalk	Catwalk Beige Wrap	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA

TABLE B-1
CEDAR CREEK WATER POLLUTION CONTROL PLANT
WANTAGH, NEW YORK
ASBESTOS BULK SAMPLE RESULTS

Sample ID	Material Description	Sample Location			Sample Information			Sample Result	
		Floor	Area	Interior/ Exterior	Condition	Friable/ Non-Friable	Date Sample Collected	PLM or PLM-NOB	TEM-NOB
KC-ACM-FGIW-9-01	Fiberglass Insulation Wrap - Light Green	Sub-basement	West Horizontal Pipe Under 48-inch Dia. Pipe	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-FGIW-9-02	Fiberglass Insulation Wrap - Light Green	Sub-basement	West Horizontal Pipe Above 48-inch Dia. Pipe	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-FGIW-9-03	Fiberglass Insulation Wrap - Light Green	Sub-basement	East Horizontal Pipe Under 48-inch Dia. Pipe	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-FGIW-10-01	Fiberglass Insulation Wrap - Dark Green	Sub-basement	1/4-inch Dia. Water Pipe Under 48-inch Dia. Pipe	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-FGIW-10-02	Fiberglass Insulation Wrap - Dark Green	Sub-basement	1/4-inch Dia. Water Pipe Under 48-inch Dia. Pipe	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA
KC-ACM-FGIW-10-03	Fiberglass Insulation Wrap - Dark Green	Sub-basement	1/4-inch Dia. Water Pipe Under 48-inch Dia. Pipe	Interior	Significantly Damaged	Friable	Jan-26-2017	ND	NA

Notes:
ND: Asbestos not detected
NA: Not analyzed.
PLM: Polarized light microscopy
TEM: Transmission Electron Microscopy
NA/PS: Not analyzed. Analysis stopped after first positive result.
ACM materials highlighted in orange.

TABLE B-2
CEDAR CREEK WATER POLLUTION CONTROL PLANT
WANTAGH, NEW YORK
PAINT CHIP LEAD SAMPLE RESULTS

Sample ID	Location	Floor	Color	Interior/ Exterior	Condition	Substrate Material	Date Sample Collected	Lead Concentration (% by weight)
KC-LBP-01	On Pump A-4	Main Floor	Beige	Interior	Good	Metal	Jan-26-2017	0.316%
KC-LBP-02	**On Pump A-3**	**Main Floor**	**Light Beige**	**Interior**	**Good**	**Metal**	**Jan-26-2017**	**0.743%**
KC-LBP-03	By Pump A-4 on Red Metal Post	Main Floor	Red	Interior	Significantly Damaged	Metal	Jan-26-2017	0.081%
KC-LBP-04	Staircase Wall	Basement	White	Interior	Significantly Damaged	Concrete	Jan-26-2017	0.062%
KC-LBP-05	**Underside of the Staircase**	**Basement**	**Beige**	**Interior**	**Significantly Damaged**	**Metal**	**Jan-26-2017**	**4.66%**
KC-LBP-06	48-inch Dia. Vertical Pipe	Basement	Grey	Interior	Significantly Damaged	Metal	Jan-26-2017	0.217%
KC-LBP-07	Floor	Basement	Grey	Interior	Good	Concrete	Jan-26-2017	0.006%
KC-LBP-08	Vertical Duct	Basement	Beige	Interior	Significantly Damaged	Metal	Jan-26-2017	0.101%
KC-LBP-09	**On Pump A-3**	**Sub-basement**	**Grey**	**Interior**	**Significantly Damaged**	**Metal**	**Jan-26-2017**	**0.988%**
KC-LBP-10	On Pump A-7	Sub-basement	Beige	Interior	Significantly Damaged	Metal	Jan-26-2017	0.018%
KC-LBP-11	East Wall	Sub-basement	Off White	Interior	Significantly Damaged	Concrete	Jan-26-2017	0.017%
KC-LBP-12	12-inch Dia. Drain Pipe Adjacent to Pump Pit	Sub-basement	Beige	Interior	Significantly Damaged	Metal	Jan-26-2017	0.013%
KC-LBP-13	48-inch Dia. Pipe Adjacent to North Wall	Sub-basement	Grey	Interior	Significantly Damaged	Metal	Jan-26-2017	0.142%
KC-LBP-14	**Rotating Shaft Associated with Pump A-4**	**Sub-basement**	**Red**	**Interior**	**Significantly Damaged**	**Metal**	**Jan-26-2017**	**7.232%**
KC-LBP-15	North Wall Upper 48-inch Dia. Pipe	Sub-basement	Grey	Interior	Significantly Damaged	Metal	Jan-26-2017	0.01%

TABLE B-2
CEDAR CREEK WATER POLLUTION CONTROL PLANT
WANTAGH, NEW YORK
PAINT CHIP LEAD SAMPLE RESULTS

Sample ID	Location	Floor	Color	Interior/ Exterior	Condition	Substrate Material	Date Sample Collected	Lead Concentration (% by weight)
KC-LBP-16	On Pump A-1 Concrete Pad	Sub-basement	Grey	Interior	Significantly Damaged	Concrete	Jan-26-2017	0.019%
KC-LBP-17	Northwest Wall	Sub-basement	White	Interior	Significantly Damaged	Concrete	Jan-26-2017	0.015%
KC-LBP-18	Exhaust Fan	Sub-basement	Beige	Interior	Significantly Damaged	Metal	Jan-26-2017	0.105%
KC-LBP-19	Large Suction Valve	Pit Level	Grey	Interior	Significantly Damaged	Metal	Jan-26-2017	0.007%
KC-LBP-20	**48-inch Dia. Pipe**	**Pit Level**	**Grey**	**Interior**	**Significantly Damaged**	**Metal**	**Jan-26-2017**	**0.554%**
KC-LBP-21	A-2 Pump Suction Valve West	Pit Level	Blue	Interior	Good	Metal	Jan-26-2017	0.007%

Notes:
Lead-based paint coated materials highlighted in green.

TABLE B-3
CEDAR CREEK WATER POLLUTION CONTROL PLANT
WANTAGH NEW YORK
POLYCHLORINATED BIPHENYL SAMPLE RESULTS

Sample ID	Materials Description	Location	Interior/ Exterior	Condition	Date Sample Collected	Total PCB Concentration (ppm)
HYD-TK-1	Hydraulic Oil from AST	Basement	Interior	Good	Jan-26-2017	0.98

APPENDIX C

LABORATORY RESULTS AND CHAIN OF CUSTODY RECORDS

OrderID: 0617010 39

0617 01039

D&B ENGINEERS AND ARCHITECTS, P.C.

ASBESTOS BULK SAMPLE DATA AND CHAIN OF CUSTODY FORM

Client Name: Cedar Creek WPCP	Project Name and Address: Cedar Creek WPCP - Main Building 3340 Merrick Road, Wantagh, NY	Inspector/Investigator: Kumar Chakraborty	Page: 1 of 4
Date: 1-26-2017	Requested Turnaround Time: ☐ 2 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour 72 Hour ☐ Other ____ HR 1 Week	Project Manager: Garrett Byrnes	Project Number: 3894-01A

BULK SAMPLE INFORMATION

Bulk Sample ID No.	Material Description	Floor ID	Room/Area Description	Condition / Friability	Photo ID/ Time
KC-ACM-TF-1-01	Terrazzo Flooring	Main Fl	Pump Motor Rm | Beige	G/NF	
" " 1-02	Terrazzo Flooring	"	" "	↓	
" " 1-03	" "	"	" "		
KC-ACM-PIE-2-01	Pipe Insulation Elbow	Main Fl	North Wall Behind Elect Cab A-2	G/F	
" " 2-02	" "	↓	" " "	↓	
2-03	" "		" " "		
KC-ACM-FGIW-3-01	Fiberglass Insulation Wrap	Main Fl	NW Corner T-5 Bldg H Grade Floor Unit	P/NF	
" " 3-02	" "	↓	" " "	↓	
" " 3-03	" "		West Wall - Panel Insulation		

Condition: G- Good, D –Damage, SD – Significant Damage

Friability: F – Friable, NF – Not Friable

Special Instruction to Laboratory:
☐ Analyze All Samples ☒ Stop at First Positive in Each Homogeneous Group ☒ Perform TEM-NOB Analysis if Necessary
☒ Email Results to: kchakraborty@db-eng.com

CHAIN OF CUSTODY INFORMATION AND LABORATORY INFORMATION

Relinquished By:	Date	Time	Received By:	Date	Time	Method Of Submittal	
I. (Print): Kumar Chakraborty	1-26-2017		P.E. CTL	1/26/17	3:48p	Field	
(Sign):						Walk In	
II. (Print):	1-26-17	348 PM				Fed-Ex	
(Sign):						Others	
III. (Print):						Fed-Ex	
(Sign):						Others	

D&B Comments:

Lab Comments:

Analyzed By: Date & Time:
Print Name:
Sign:

2017 JAN 26 P 3:48

Ellen Russell 2/2/17

Nassau County DPW Page 2449 of 2953 S3C067-11G

Nassau County DPW
Page 2450 of 2953
S3C067-11G
OrderID: 061701039

0617 01039

D&B ENGINEERS AND ARCHITECTS, P.C.

ASBESTOS BULK SAMPLE DATA AND CHAIN OF CUSTODY FORM

Client Name: Cedar Creek WPCP	Project Name and Address: Cedar Creek WPCP, 3340 Merrick Road, Wantagh, NY	Inspector/Investigator: Kumar Chakraborty	Page: 3 of 4
Date:	Requested Turnaround Time: ☐ 2 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour 72 Hour ☐ Other ___ HR___	Project Manager: Garrett Byrnes	Project Number: 3894-01A

BULK SAMPLE INFORMATION

Bulk Sample ID No.	Material Description	Floor ID	Room/Area Description	Condition / Friability	Photo ID/ Time
KC-ACM-CIW-7-01	12"ϕ Pipe Cloth Insulation Wrap	Basement-CW	Catwalk Green Wrap	G/F	
" " 7-02	" "	BSMT-CW	" " "	↓	
" " 7-03	" "	BSMT-CW	" " "	↓	
KC-ACM-PIW-8-01	1/4"ϕ Pipe Insulation Wrap	BSMT-CW	Catwalk Beige Wrap	P/F	
" PIW-8-02	" " "	↓	" "	↓	
" PIW-8-03	" " "	↓	" "	↓	
KC-ACM-FGIW-9-01	Fiberglass Insulation Wrap	Subbasement	West Horizontal Pipe Under 48"ϕ Pipe	P/NF	
" " 9-02	Light Green " "		West Horizontal Pipe Above 48"ϕ Pipe	P/NF	
" " 9-03	" " "		East Horizontal Pipe Under 48"ϕ Pipe	P/NF	

Condition: G- Good, D –Damage, SD – Significant Damage

Friability: F – Friable, NF – Not Friable

Special Instruction to Laboratory:
☐ Analyze All Samples ☒ Stop at First Positive in Each Homogeneous Group ☐ Perform TEM-NOB Analysis if Necessary
☒ Email Results to: kchakraborty@db-eng.com

CHAIN OF CUSTODY INFORMATION AND LABORATORY INFORMATION

Relinquished By:	Date	Time	Received By:	Date	Time	Method Of Submittal	
I. (Print): Kumar Chakraborty	1-26-17		Pat Cal	1/26/17	3:45pm	Field	
(Sign):						Walk In	
II. (Print):						Fed-Ex	
(Sign):	1-26-17	345 PM				Others	
III. (Print):						Fed-Ex	
(Sign):						Others	

D&B Comments:

Lab Comments:

Analyzed By: Date & Time:
Print Name:
Sign:

Ellen Russell 2/2/17

Nassau County DPW

Page 2451 of 2953

S3C067-11G

OrderID: 061701039

0617 01039

D&B ENGINEERS AND ARCHITECTS, P.C.

ASBESTOS BULK SAMPLE DATA AND CHAIN OF CUSTODY FORM

Client Name:	Project Name and Address:	Inspector/Investigator: Kumar Chakraborty	Page:
Cedar Creek WPCP	Cedar Creek WPCP 3340 Merrick Road, Wantagh, NY		2 of 4

Date:	Requested Turnaround Time:	Project Manager	Project Number:
	☐ 2 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour 72 Hour ☐ Other ____ HR___	Garrett Byrnes	3894-01A

BULK SAMPLE INFORMATION

Bulk Sample ID No.	Material Description	Floor ID	Room/Area Description	Condition / Friability	Photo ID/ Time
KC-ACM-PW-4-01	Plaster Wall	Main Fl.	Staircase Wall/Over Concrete Wall	P/F	
" " 4-02	" "	Basement	" " "	↓	
" " 4-03	" "	Sub-basement	" " "	↓	
KC-ACM-FIW-5-01	Fan Insulation Wrap/Cloth	Basement	East Fan Adjacent to Walkway	G/F	
" " 5-02	" " "	↓	West Fan Adjacent to Walkway	G/F	
" " 5-03	" " "	↓	Northeast Fan Adjacent to Walkway	G/F	
KC-ACM-PI-6-01	~~Pipe~~ Cementitious Pipe Insulation	Basement	Basement 2" ϕ Pipe - Green	P/F	
" " 6-02	Cementitious Pipe Insulation	↓	" "	↓	
" " 6-03	" "	↓	" "	↓	

Condition:
G- Good, D –Damage,
SD – Significant Damage

Friability:
F – Friable
NF – Not Friable

Special Instruction to Laboratory:
☐ Analyze All Samples ☒ Stop at First Positive in Each Homogeneous Group ☐ Perform TEM-NOB Analysis if Necessary
☒ Email Results to: kchakraborty@db-eng.com

CHAIN OF CUSTODY INFORMATION AND LABORATORY INFORMATION

Relinquished By:	Date	Time	Received By:	Date	Time	Method Of Submittal	
I. (Print):						Field	
(Sign):	1-26-17		Pat Ellis	1/26/17	3:48p	Walk In	
II. (Print):						Fed-Ex	
(Sign):	1-26-17	3:48p				Others	
III. (Print):						Fed-Ex	
(Sign):						Others	

D&B Comments:	Lab Comments:	Analyzed By:	Date & Time:
		Print Name:	
		Sign:	

Ellen Russell 2/2/17

JAN 26 2017

Nassau County DPW
Page 2452 of 2953
S3C067-11G
OrderID: 061701039

0617 01039

D&B ENGINEERS AND ARCHITECTS, P.C.

ASBESTOS BULK SAMPLE DATA AND CHAIN OF CUSTODY FORM

Client Name: Cedar Creek WPCP	Project Name and Address: Cedar Creek WPCP 3340 Merrick Road, Wantagh, NY	Inspector/Investigator: Kumar Chakraborty	Page: 4 of 4
Date:	Requested Turnaround Time: ☐ 2 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour 72 Hour ☐ Other ____ HR___	Project Manager Garrett Byrnes	Project Number: 3894-01A

BULK SAMPLE INFORMATION

Bulk Sample ID No.	Material Description	Floor ID	Room/Area Description	Condition / Friability	Photo ID/ Time
KC-ACM-FGIW-10-01	Fiberglass Insulation Wrap	Sub BSMT	Dark Green 1/4"ϕ water pipe	P/NF	
" " 10-02	"	↓	under 48" ϕ Pipe "	↓	
" " 10-03	"		" " "		

EPSL ASBESTOS LABORATORY
CARLE PLACE, NY
2017 JAN 26 P 3:48

Condition: G- Good, D –Damage, SD – Significant Damage	Friability: F – Friable NF – Not Friable	Special Instruction to Laboratory: ☐ Analyze All Samples ☒ Stop at First Positive In Each Homogeneous Group ☐ Perform TEM-NOB Analysis if Necessary ☒ Email Results to: kchakraborty@db-eng.com

CHAIN OF CUSTODY INFORMATION AND LABORATORY INFORMATION

Relinquished By:	Date	Time	Received By:	Date	Time	Method Of Submittal	
I. (Print): Kumar Chakraborty	1-26-2017			1/26/17	7:48pm	Field	
(Sign):						Walk In	
II. (Print):						Fed-Ex	
(Sign):	1-26-17	3:48PM				Others	
III. (Print):						Fed-Ex	
(Sign):						Others	

D&B Comments:	Lab Comments:	Analyzed By:	Date & Time:
Call Kumar @ 516-637-1474 with Question.		Print Name:	
		Sign:	

Ellen Russell 2/2/17

EMSL Analytical, Inc.
528 Mineola Avenue, Carle Place, NY 11514
Phone/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	061701039
CustomerID:	DVBI69
CustomerPO:	3894-01A
ProjectID:	

Attn: **Kumar Chakroborty**
Dvirka & Bartilucci
330 Crossway Park Drive
Woodbury, NY 11797

Phone:	(516) 364-9890
Fax:	(516) 364-9045
Received:	01/26/17 3:48 PM
Analysis Date:	2/2/2017
Collected:	1/26/2017

Project: **Cedar Creek WPCP, Cedar Creek WPCP-Main Building, 3340 Merrick Road, Wantagh, NY, Project Number: 3894-01A**

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non Asbestos Fibrous	Non Asbestos Non-Fibrous	Asbestos
Sample ID KC-ACM-TF-1-01 *061701039-0001*		**Description** Main FL, Pump Motor Rm/Beige - Terrazzo Flooring **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	White/Variou		30.00% Ca Carbonate 70.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-TF-1-02 *061701039-0002*		**Description** Main FL, Pump Motor Rm/Beige - Terrazzo Flooring **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	White/Variou		27.00% Ca Carbonate 73.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-TF-1-03 *061701039-0003*		**Description** Main FL, Pump Motor Rm/Beige - Terrazzo Flooring **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	White/Variou		35.00% Ca Carbonate 65.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-PIE-2-01 *061701039-0004*		**Description** Main FL, North Wall Behind Elect Cab A-2 - Pipe Insulation Elbow **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan	10.00% Min. Wool 5.00% Cellulose	16.00% Ca Carbonate 69.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-PIE-2-02 *061701039-0005*		**Description** Main FL, North Wall Behind Elect Cab A-2 - Pipe Insulation Elbow **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Gray	16.00% Min. Wool 3.00% Cellulose	17.00% Ca Carbonate 64.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial Report From 02/02/2017 13:59:11

EMSL Analytical, Inc.
528 Mineola Avenue, Carle Place, NY 11514
Phone/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	061701039
CustomerID:	DVBI69
CustomerPO:	3894-01A
ProjectID:	

Test Report:Asbestos Analysis of Bulk Material

Test		Color	Non Asbestos Fibrous	Non-Fibrous	Asbestos
Sample ID KC-ACM-PIE-2-03 *061701039-0006*		**Description** Main FL, North Wall Behind Elect Cab A-2 - Pipe Insulation Elbow **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan	16.00% Min. Wool	18.00% Ca Carbonate 66.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FGIW-3-01 *061701039-0007*		**Description** Main FL-NW Corner T-5 Bldg H Grade Floor - Fiberglass Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Various/Yello	94.00% Glass 2.00% Cellulose	4.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FGIW-3-02 *061701039-0008*		**Description** Main FL-NW Corner T-5 Bldg H Grade Floor - Fiberglass Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Brown/Variou	95.00% Glass 3.00% Cellulose	2.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FGIW-3-03 *061701039-0009*		**Description** Main FL-West Wall-Panel Insulation - Fiberglass Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Brown/Variou	96.00% Glass 1.00% Cellulose	3.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-PW-4-01 *061701039-0010*		**Description** Main FL-Staircase Wall/Over Concrete Wall - Plaster Wall **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Gray		5.00% Quartz 23.00% Ca Carbonate 72.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial Report From 02/02/2017 13:59:11

EMSL Analytical, Inc.
528 Mineola Avenue, Carle Place, NY 11514
Phone/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	061701039
CustomerID:	DVBI69
CustomerPO:	3894-01A
ProjectID:	

Test Report:Asbestos Analysis of Bulk Material

Test		Color	Non Asbestos Fibrous	Non-Fibrous	Asbestos
Sample ID KC-ACM-PW-4-02 *061701039-0011*		**Description** Basement-Staircase Wall/Over Concrete Wall - Plaster Wall **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Gray		22.00% Ca Carbonate 78.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-PW-4-03 *061701039-0012*		**Description** Sub-Basement-Staircase Wall/Over Concrete Wall - Plaster Wall **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Gray		4.00% Quartz 25.00% Ca Carbonate 71.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FIW-5-01 *061701039-0013*		**Description** Basement-East Fan Adjacent to Walkway - Fan Insulation Wrap/Cloth **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan	64.00% Cellulose	36.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FIW-5-02 *061701039-0014*		**Description** Basement-West Fan Adjacent to Walkway - Fan Insulation Wrap/Cloth **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan	75.00% Cellulose	25.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FIW-5-03 *061701039-0015*		**Description** Basement-North East Fan Adjacen to Walkway - Fan Insulation Wrap/Cloth **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan	70.00% Cellulose	30.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-PI-6-01 *061701039-0016*		**Description** Basement 2" Pipe-Green - Cementitous Pipe Insulation **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Gray/Green		97.85% Non-fibrous (other)	**2.15% Chrysotile**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial Report From 02/02/2017 13:59:11

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EMSL Order:	061701039
CustomerID:	DVBI69
CustomerPO:	3894-01A
ProjectID:	

Test Report:Asbestos Analysis of Bulk Material

Test		Color	Non Asbestos Fibrous	Non-Fibrous	Asbestos
Sample ID KC-ACM-PI-6-02 *061701039-0017*		**Description** Basement 2" Pipe-Green - Cementitous Pipe Insulation **Homogeneity**			
PLM NYS 198.1 Friable	2/2/2017				**Positive Stop (Not Analyzed)**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-PI-6-03 *061701039-0018*		**Description** Basement 2" Pipe-Green - Cementitous Pipe Insulation **Homogeneity**			
PLM NYS 198.1 Friable	2/2/2017				**Positive Stop (Not Analyzed)**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-CIW-7-01 *061701039-0019*		**Description** Basement-CW-Catwalk Green Wrap - 12" Pipe Cloth Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan/Green	76.00% Cellulose 3.00% Glass	21.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-CIW-7-02 *061701039-0020*		**Description** Basement-CW-Catwalk Green Wrap - 12" Pipe Cloth Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Gray/Green	64.00% Cellulose 1.00% Glass	35.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-CIW-7-03 *061701039-0021*		**Description** Basement-CW-Catwalk Green Wrap - 12" Pipe Cloth Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan/Green	72.00% Cellulose 4.00% Glass	24.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-PIW-8-01 *061701039-0022*		**Description** Bsmt-CW-Catwalk Beige Wrap - 1/4" Pipe Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan/Yellow	5.00% Cellulose 79.00% Glass	16.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial Report From 02/02/2017 13:59:11

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http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	061701039
CustomerID:	DVBI69
CustomerPO:	3894-01A
ProjectID:	

Test Report:Asbestos Analysis of Bulk Material

Test		Color	Non Asbestos Fibrous	Non-Fibrous	Asbestos
Sample ID KC-ACM-PIW-8-02 *061701039-0023*		**Description** Bsmt-CW-Catwalk Beige Wrap - 1/4" Pipe Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan/Yellow	6.00% Cellulose 77.00% Glass	17.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-PIW-8-03 *061701039-0024*		**Description** Bsmt-CW-Catwalk Beige Wrap - 1/4" Pipe Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Tan/Yellow	10.00% Cellulose 67.00% Glass	23.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FGIW-9-01 *061701039-0025*		**Description** Sub Basement-West Horizontal Pipe under 48" Pipe - Fiberglass Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	White/Yellow	6.00% Cellulose 85.00% Glass	9.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FGIW-9-02 *061701039-0026*		**Description** Sub Basement-West Horizontal Pipe under 48" Pipe - Light Green Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	White/Yellow	4.00% Cellulose 82.00% Glass	14.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID KC-ACM-FGIW-9-03 *061701039-0027*		**Description** Sub Basement-East Horizontal Pipe under 48" Pipe - Light Green Insulation Wrap **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	2/2/2017	Various/Yello	2.00% Cellulose 83.00% Glass	15.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial Report From 02/02/2017 13:59:11

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http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	061701039
CustomerID:	DVBI69
CustomerPO:	3894-01A
ProjectID:	

Test Report:Asbestos Analysis of Bulk Material

Test			Color	Fibrous	Non Asbestos Non-Fibrous	Asbestos
Sample ID	KC-ACM-FGIW-10-01 *061701039-0028*		**Description** **Homogeneity**	Sub Bsmt-Dark Green 1/4" Water Pipe under 48" Pipe - Fiberglass Insulation Wrap Homogeneous		
PLM NYS 198.1 Friable		2/2/2017	Gray	16.00% Glass	17.00% Ca Carbonate 67.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID	KC-ACM-FGIW-10-02 *061701039-0029*		**Description** **Homogeneity**	Sub Bsmt-Dark Green 1/4" Water Pipe under 48" Pipe - Fiberglass Insulation Wrap Homogeneous		
PLM NYS 198.1 Friable		2/2/2017	Gray/Tan	20.00% Glass 2.00% Cellulose	17.00% Ca Carbonate 61.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**
Sample ID	KC-ACM-FGIW-10-03 *061701039-0030*		**Description** **Homogeneity**	Sub Bsmt-Dark Green 1/4" Water Pipe under 48" Pipe - Fiberglass Insulation Wrap Homogeneous		
PLM NYS 198.1 Friable		2/2/2017	Gray	20.00% Glass	15.00% Ca Carbonate 65.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM						**Not Analyzed**
PLM NYS 198.6 NOB						**Not Analyzed**
TEM NYS 198.4 NOB						**Not Analyzed**

Analyst(s)
Ellen Russell



Michelle McGowan, Laboratory Manager
or other approved signatory

NOB = Non Friable Organically Bound N/A = Not Applicable VCM = Vermiculite Containing Material

-In New York State, TEM is currently the only method that can be used to determine if NOB materials can be considered or treated as non-asbestos containing.
All samples examined for the presence of vermiculite when analyzed via NYS 198.1.
-NYS Guidelines for Vermiculite containing samples are available at http://www.wadsworth.org/labcert/elapcert/forms/VermiculiteInterimGuidance_Rev070913.pdf
EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples were received in good condition unless otherwise noted.
This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. This report may contain data that is not covered by the NVLAP accreditation.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY NYS ELAP 11469

Initial Report From 02/02/2017 13:59:11

Lead (Pb) Chain of Custody

EMSL Order ID *(Lab Use Only)*

061701077

PHONE:
FAX:

Company: D&B Engineers and Architects, P.C.	**EMSL-Bill to:** ☐ Different ☐ Same If Bill to is Different note instructions in Comments**
Street: 330 Crossways Park Drive	*Third Party Billing requires written authonzation from third party*
City: Woodbury **State/Province:** NY	**Zip/Postal Code:** 11797 **Country:** USA
Report To (Name): Kumar Chakraborty	**Telephone #:** 516-364-9890
Email Address: kchakraborty@db-eng.com	**Fax #:** 516-364-9045 **Purchase Order:**
Project Name/Number: Cedar Creek WPCP/ 3894-01A	**Please Provide Results:** ☐ FAX ☒ E-mail ☐ Mail
U.S. State Samples Taken: New York	**CT Samples:** ☐ Commercial/Taxable ☐ Residential/Tax Exempt

Turnaround Time (TAT) Options* - Please Check

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour ☐ 72 Hour ☐ 96 Hour ☒ 1 Week ☐ 2 Week

**Analysis completed in accordance with EMSL's Terms and Conditions located in the Price Guide*

Matrix	Method	Instrument	Reporting Limit	Check
Chips ☐ % by wt. ☐ mg/cm² ☒ ppm	SW846-7000B	Flame Atomic Absorption	0.01%	☑
Air	NIOSH 7082	Flame Atomic Absorption	4 µg/filter	☐
	NIOSH 7105	Graphite Furnace AA	0.03 µg/filter	☐
	NIOSH 7300 modified	ICP-AES/ICP-MS	0.5 µg/filter	☐
Wipe* ASTM ☐ non ASTM ☐ *if no box is checked, non-ASTM Wipe is assumed	SW846-7000B	Flame Atomic Absorption	10 µg/wipe	☐
	SW846-6010B or C	ICP-AES	1.0 µg/wipe	☐
	SW846-7000B/7010	Graphite Furnace AA	0.075 µg/wipe	☐
TCLP	SW846-1311/7000B/SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW846-1131/SW846-6010B or C	ICP-AES	0.1 mg/L (ppm)	☐
Soil	SW846-7000B	Flame Atomic Absorption	40 mg/kg (ppm)	☐
	SW846-7010	Graphite Furnace AA	0.3 mg/kg (ppm)	☐
	SW846-6010B or C	ICP-AES	2 mg/kg (ppm)	☐
Wastewater Unpreserved ☐ Preserved with HNO_3 pH < 2 ☐	SM3111B/SW846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	EPA 200.9	Graphite Furnace AA	0.003 mg/L (ppm)	☐
	EPA 200.7	ICP-AES	0.020 mg/L (ppm)	☐
Drinking Water Unpreserved ☐ Preserved with HNO_3 pH < 2 ☐	EPA 200.9	Graphite Furnace AA	0.003 mg/L (ppm)	☐
	EPA 200 8	ICP-MS	0.001 mg/L (ppm)	☐
TSP/SPM Filter	40 CFR Part 50	ICP-AES	12 µg/filter	☐
	40 CFR Part 50	Graphite Furnace AA	3.6 µg/filter	☐
Other:				☐

Name of Sampler: **Signature of Sampler:**

Sample #	Location	Volume/Area	Date/Time Sampled
			JAN 26

Client Sample #'s 1 to 21 **Total # of Samples:** 21

Relinquished (Client):		**Date:**	1-26-2017	**Time:**	
Received (Lab):		**Date:**	1/26/17	**Time:**	3:50pm

Comments:

Pb-DL 2/2/17

Page 1 of 3 pages

LEAD (Pb) CHAIN OF CUSTODY

EMSL ORDER ID *(Lab Use Only)*:

061701077

PHONE:
FAX:

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Sample #	Location	Volume/Area	Date/Time Sampled
KC-LBP-01	Cedar Creek Main Building — Main Floor Pump A-4 Beige Metal		
KC-LBP-02	Main Floor Pump A-3 Light Beige Metal		
KC-LBP-03	Main Floor By Pump A-4 Red Post Metal		
KC-LBP-04	Basement Staircase Wall White Concrete		
KC-LBP-05	Basement Underneath Staircase Beige Metal		
KC-LBP-06	Basement 48"ø Vertical Grey Pipe Metal		
KC-LBP-07	Basement Floor Grey Concrete		
KC-LBP-08	Basement Vertical Duct Beige Metal		
KC-LBP-09	Sub basement Pump A-3 Grey Pipe Metal		
KC-LBP-10	Sub Basement Pump A-7 Beige Metal		
KC-LBP-11	Sub basement East Wall Off White Concrete		
KC-LBP-12	Sub basement Drain Pipe 12"ø Adjacent to Pump Pit Beige Metal		2017 JAN 26 P 3:51
KC-LBP-13	Sub basement 48"ø Pipe Adjacent to North Wall Grey Metal		
KC-LBP-14	Sub basement Pump A4 Red Rotating Pipe Metal		
~~KC-LBP-~~KC-LBP-15	Sub basement Upper North Wall Pipe 48"ø Grey Metal		

Comments/Special Instructions:

PH

Pb-D 2/2/17

Page 2 of 3 pages

LEAD (Pb) CHAIN OF CUSTODY

EMSL ORDER ID *(Lab Use Only)*

061701077

PHONE:
FAX:

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Sample #	Location	Volume/Area	Date/Time Sampled
KC-LBP-16	Cedar Creek Main Building: Sub basement Pump A-1 Concrete Pad Grey Concrete		
KC-LBP-17	Subbasement Northwest Wall White Concrete		
KC-LBP-18	Subbasement Exhanst Fan Beige Metal		
KC-LBP-19	Pit Large Valve Sncton Grey Metal		
KC-LBP-20	Pit 48" Dia Pipe Grey Metal		
KC-LBP-21	Pit A-2 Pump Blue Suction Valve West		

2017 JAN 26 P 3:51

Comments/Special Instructions:

PH

Page 3 of 3 pages

Pb-DL 2/2/17

EMSL Analytical, Inc.
528 Mineola Avenue, Carle Place, NY 11514
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http://www.EMSL.com carleplacelab@emsl.com

EMSL Order: 061701077
CustomerID: DVBI69
CustomerPO:
ProjectID:

Attn: **Kumar Chakroborty**
Dvirka & Bartilucci
330 Crossway Park Drive
Woodbury, NY 11797

Phone: (516) 364-9890
Fax: (516) 364-9045
Received: 01/26/17 3:50 PM
Collected: 1/26/2017

Project: **Cedar Creek WPCP/3894-01A**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3051A/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
KC-LBP-01	*061701077-0001*	1/26/2017	2/2/2017	0.316 % wt
	Site: Cedar Creek Main Building - Main Floor Pump A-4 Beige Metal			
KC-LBP-02	*061701077-0002*	1/26/2017	2/2/2017	0.743 % wt
	Site: Cedar Creek Main Building - Main Floor Pump A-3 Light Beige Metal			
KC-LBP-03	*061701077-0003*	1/26/2017	2/2/2017	0.081 % wt
	Site: Cedar Creek Main Building - Main Floor by Pump A-4 Red Post Metal			
KC-LBP-04	*061701077-0004*	1/26/2017	2/2/2017	0.062 % wt
	Site: Cedar Creek Main Building - Basement Staircase Wall White Concrete			
KC-LBP-05	*061701077-0005*	1/26/2017	2/2/2017	4.66 % wt
	Site: Cedar Creek Main Building - Basement Staircase Wall Beige Metal			
KC-LBP-06	*061701077-0006*	1/26/2017	2/2/2017	0.217 % wt
	Site: Cedar Creek Main Building - Basement 48" Vertical Grey Pipe Metal			
KC-LBP-07	*061701077-0007*	1/26/2017	2/2/2017	0.006 % wt
	Site: Cedar Creek Main Building - Basement Floor Grey Concrete			
KC-LBP-08	*061701077-0008*	1/26/2017	2/2/2017	0.101 % wt
	Site: Cedar Creek Main Building - Basement Vertical Duct Beige Metal			
KC-LBP-09	*061701077-0009*	1/26/2017	2/2/2017	0.988 % wt
	Site: Cedar Creek Main Building - Sub Basement Pump A-3 Grey Pipe Metal			
KC-LBP-10	*061701077-0010*	1/26/2017	2/2/2017	0.018 % wt
	Site: Cedar Creek Main Building - Sub Basement Pump A-7 Beige Metal			
KC-LBP-11	*061701077-0011*	1/26/2017	2/2/2017	0.017 % wt
	Site: Cedar Creek Main Building - Sub Basement East Wall Off White Concrete			

Michelle McGowan, Laboratory Manager
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010% wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies the analyte was not detected at or above the warning limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY Lab ID 102344 is accredited by the AIHA LAP, LLC in the Environmental Lead accred. program for Lead in Dust, CT PH-0249, NYS ELAP 11469, CA 2339.

Initial report from 02/02/2017 19:31:29

EMSL Analytical, Inc.
528 Mineola Avenue, Carle Place, NY 11514
Phone/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	061701077
CustomerID:	DVBI69
CustomerPO:	
ProjectID:	

Attn: **Kumar Chakroborty**
Dvirka & Bartilucci
330 Crossway Park Drive
Woodbury, NY 11797

Phone:	(516) 364-9890
Fax:	(516) 364-9045
Received:	01/26/17 3:50 PM
Collected:	1/26/2017

Project: **Cedar Creek WPCP/3894-01A**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3051A/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
KC-LBP-12	*061701077-0012*	1/26/2017	2/2/2017	0.013 % wt
	Site: Cedar Creek Main Building - Sub Basement Drain Pipe 12" Adjacent to Pump Pit Beige Metal			
KC-LBP-13	*061701077-0013*	1/26/2017	2/2/2017	0.142 % wt
	Site: Cedar Creek Main Building - Sub Basement 48" Pipe Adjacent to North Wall Grey Metal			
KC-LBP-14	*061701077-0014*	1/26/2017	2/2/2017	7.232 % wt
	Site: Cedar Creek Main Building - Sub Basement Pump A-4 Red Rotating Pipe Metal			
KC-LBP-15	*061701077-0015*	1/26/2017	2/2/2017	0.01 % wt
	Site: Cedar Creek Main Building - Sub Basement Upper North Wall Pipe 48" Grey Metal			
KC-LBP-16	*061701077-0016*	1/26/2017	2/2/2017	0.019 % wt
	Site: Cedar Creek Main Building - Sub Basement Pump A-1 Concrete Pad Grey Concrete			
KC-LBP-17	*061701077-0017*	1/26/2017	2/2/2017	0.015 % wt
	Site: Cedar Creek Main Building - Sub Basement Northwest Wall White Concrete			
KC-LBP-18	*061701077-0018*	1/26/2017	2/2/2017	0.105 % wt
	Site: Cedar Creek Main Building - Sub Basement Exhaust Fan Beige Metal			
KC-LBP-19	*061701077-0019*	1/26/2017	2/2/2017	0.007 % wt
	Site: Cedar Creek Main Building - Pit Large Valve Suction Grey Metal			
KC-LBP-20	*061701077-0020*	1/26/2017	2/2/2017	0.554 % wt
	Site: Cedar Creek Main Building - Pit 48" Dia Pipe Grey Metal			
KC-LBP-21	*061701077-0021*	1/26/2017	2/2/2017	0.007 % wt
	Site: Cedar Creek Main Building - Pit A-2 Pimp Blue Suction Valve West			

Michelle McGowan, Laboratory Manager
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010% wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies the analyte was not detected at or above the warning limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY Lab ID 102344 is accredited by the AIHA LAP, LLC in the Environmental Lead accred. program for Lead in Dust, CT PH-0249, NYS ELAP 11469, CA 2339.

Initial report from 02/02/2017 19:31:29

OrderID: 011700742

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Chain of Custody

EMSL Order Number (*Lab Use Only*): 011700742

PHONE:
FAX:

Company: D&B Engineers and Architects, P.C.		**EMSL-Bill to:** ☐ Same ☐ Different If Bill to is Different note instructions in Comments**	
Street: 330 Crossway Park Drive		Third Party Billing requires written authorization from third party	
City: Woodbury	**State/Province:** NY	**Zip/Postal Code:** 11797	**Country:**
Report To (Name): Kumar Chakraborty		**Telephone #:** 516-364-9890	
Email Address: KChakraborty@db-eng.com		**Fax #:**	**Purchase Order:**
Project Name/Number: 3894-01A		**Please Provide Results:** ☐ Fax ☒ Email ☐ Mail	
U.S. State Samples Taken: NY		**Connecticut Samples:** ☐ Commercial ☐ Residential	

Turnaround Time (TAT) Options* - Please Check

☐ 3 Hour | ☐ 6 Hour | ☐ 24 Hour | ☐ 48 Hour | ☐ 72 Hour | ☐ 96 Hour | ☒ 1 Week | ☐ 2 Week

**For RUSH TAT's Please Call Ahead to Confirm Lab Hours and Availability. Not all TAT options are valid for every test. Materials Science and IAQ TATs are in Business Days rather than Hours (i.e. 24 Hour = End of Next Business Day)*

Asbestos

PCM - Air
☐ NIOSH 7400 w/ 8hr. TWA

TEM– Air ☐ 4-4.5hr TAT(AHERA ONLY)
☐ AHERA 40 CFR, Part 763
☐ NIOSH 7402
☐ EPA Level II
☐ ISO 10312

TEM - Water
Fibers ≥10µm ☐ Waste ☐ Drinking
All Fiber Sizes ☐ Waste ☐ Drinking

PLM - Bulk
☐ PLM EPA 600/R-93/116
☐ PLM EPA NOB (<1%)
☐ NYS 198.1 (friable-NY)
☐ NYS 198.6 (non-friable-NY)
Point Count ☐ 400 (<0.25%) ☐ 1000 (<0.1%)
Point Count w/ Gravimetric ☐ 400 (<0.25%) ☐ 1000 (<0.1%)

TEM - Dust
☐ Microvac – ASTM D 5755
☐ Wipe-ASTM D6480

TEM - Bulk
☐ TEM EPA NOB
☐ NYS NOB 198.4 (non-friable-NY)
☐ Chatfield SOP

Soil/Rock/Vermiculite
☐ PLM CARB 435 – A (0.25% sensitivity)
☐ PLM CARB 435 – B (0.1% sensitivity)
☐ TEM CARB 435 – B (0.1% sensitivity)
☐ EPA Reg. 1 Screening Protocol (Qualitative)

Other:

Lead (Pb)

Flame Atomic Absorption
☐ Chips SW846-7000B or AOAC 974.02
☐ Soil SW846-7000B/7420
☐ Air NIOSH 7082
☐ Wastewater SM3111B or SW846-7000B/7420
☐ ASTM Wipe SW846-7000B/7420
☐ non ASTM Wipe SW846-7000B/7420
☐ TCLP SW846-1311/7420/SM 3111B

ICP
☐ Air NIOSH 7300 Modified
☐ non ASTM Wipe SW846-6010B or C
☐ ASTM Wipe SW846-6010B or C
☐ Soil SW846-6010 B or C
☐ Waste Water SW846-6010B or C
☐ TCLP SW846-6010B or C

Graphite Furnace Atomic Absorption
☐ Soil SW846-7421 ☐ Wastewater EPA 200.9
☐ Air NIOSH 7105 ☐ Drinking Water EPA 200.9

Other: ☐

Microbiology

Wipe and Bulk Samples
☐ Mold & Fungi – Direct Examination
☐ Mold & Fungi Culture (Genus Only)
☐ Mold & Fungi Culture (Genus & Species)
☐ Bacterial Count & ID (Up to Three Types)
☐ Bacterial Count & ID (Up to Five Types)
☐ MRSA
☐ *Pseudomonas aeruginosa*

Water Samples
☐ Total Coliform & E.coli (P/A)
☐ Fecal Coliform (SM 9222D)
☐ Sewage Screen
☐ Heterotrophic Plate Count (SM 9215)

Air Samples
☐ Mold & Fungi (Spore Trap)
☐ Mold & Fungi Culture (Genus Only)
☐ Mold & Fungi (Genus & Species)
☐ Bacterial Culture & ID (Up to Three Types)
☐ Bacterial Culture & ID (Up to Five Types)
☐ Endotoxin Testing

Real Time Q-PCR (See Analytical Guide for Code)
Code:

Legionella
☐ Level 1 ☐ Level 2 ☐ Level 3 ☐ Level 4

Other: ☐

Materials Science

☐ Common Particle ID (large particles)
☐ Full Particle ID (environmental dust)
☐ Basic Material ID (solids)
☐ Advanced Material ID
☐ Physical Testing (Tensile, Compression)
☐ Combustion-by-products (soot, char, etc.)
☐ X-Ray Fluorescence (elem. analysis)
☐ X-Ray Diffraction (Crystalline Part.)
☐ MMVF's (Fibrous glass, RCF's)
☐ Particle Size (sieve/microscopy/laser)
☐ Combustible Dust
☐ Petrographic Examination
Other: ☒ PCB in Oil

IAQ

Nuisance Dust NIOSH ☐ 0500 ☐ 0600
Airborne Dust ☐ PM10 ☐ TSP
Silica Analysis: ☐ All Species
Silica Analysis – Single Species
☐ Alpha Quartz ☐ Cristobalite ☐ Tridymite
☐ HVAC Efficiency
☐ Carbon Black
☐ Airborne Oil Mist
Radon Testing: Call for Kit and COC
Other: ☐

****Comments/Special Instructions:**

Client Sample #'s			**Total # of Samples:** 1
Relinquished (Client):		**Date:** 1/26-2017	**Time:**
Received (Lab):		**Date:** 11/26/17	**Time:** 3:44pm

Analysis Completed in Accordance with EMSL's Terms and Conditions located in the Analytical Price Guide

Controlled Document-OneChain-R3-11/8/2011

Rec'd Room/Box 4° 1/27/17 09.30

OrderID: 011700742

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Chain of Custody

EMSL Order Number *(Lab Use Only)*: 011700742

PHONE:
FAX:

Sample #	Sample Description	Volume/Area (Air) HA # (Bulk)	Date/Time Sampled
1 HYD-TK-1	Cedar Creek Basement Hydraulic Oil Tank		1/26/17

2017 JAN 26 P 3:49

EMSL ANALYTICAL CARLE PLACE

*Comments/Special Instructions:

PH

Analysis Completed in Accordance with EMSL's Terms and Conditions located in the Analytical Price Guide

OrderID: 011700742

[redacted]

011700742

GEN-FM-10-1: Sample Transfer-One Time
Revision 4.2
Revision Date: 1/05/2016
Effective Date: 1/05/2016

EMSL Analytical, Inc.

Sample Transfer Form

8111 7249 6498

Receiving Lab:	EMSL- Carle Place	**Phone Number:**	516-997-7251
		Fax Number:	516-997-7528
Relinquished to:	EMSL- Cinnaminson	**Phone Number:**	
		Fax Number:	
Does new lab hold equivalent or additional accreditation? *		☐ Yes ☐ No	

EMSL Customer ID # (if known):	DBEA25
Client Name:	D and B Engineers and Architects
Client Project:	3894-01A
Tests to be Performed:	PCB
Date Received:	1/26/17
Date Relinquished:	1/26/17
Date Due:	1 week TAT
Special Instructions: (e.g. Work Order # , required qualifications, project specific procedures/modifications)	PCB's

Relinquished by (Signature):	**Date:** 1/26/17	**Received by (Signature):**	**Date:** 1/27/17
Relinquished by (Signature):	**Date:**	**Received by (Signature):**	**Date:**

Customer Agreement- Please sign form and send to the receiving laboratory. By signing below, you agree to permit the above named receiving lab to transfer samples to a separate EMSL lab with equivalent qualifications* for analysis. The final report will be issued from the analyzing laboratory. Ensure any requirements are listed in special instructions.

Name (please print): P. Kumar Chakraborty	**Signature:**	**Agent of:** D&B Engineers & Architects	**Date:** 1-26-2017

If this is a recurring project or sample type that may require samples to be relinquished on a regular basis, a Standing Agreement form must be completed.

* Receiving and analyzing labs shall be aware of required qualifications of project prior to transfer of samples.

Note: If customer has been notified and approved this transfer verbally or by e-mail, the receiving lab must sign for the customer above. EMSL employee filling out form on behalf of customer shall print name of person to whom they spoke, date agreement was received, and then sign under Signature.

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone: (856) 303-2500 Fax: (856) 858-4571 Email: EnvChemistry2@emsl.com

Attn: **Kumar Chakroborty**
Dvirka & Bartilucci
330 Crossway Park Drive
Woodbury, NY 11797
Phone: (516) 364-9890
Fax: (516) 364-9045

2/3/2017

The following analytical report covers the analysis performed on samples submitted to EMSL Analytical, Inc. on 1/27/2017. The results are tabulated on the attached data pages for the following client designated project:

3894-01A

The reference number for these samples is EMSL Order #011700742. Please use this reference when calling about these samples. If you have any questions, please do not hesitate to contact me at (856) 303-2500.

Approved By:

Phillip Worby, Chemistry Laboratory Manager

The test results contained within this report meet the requirements of NELAP and/or the specific certification program that is applicable, unless otherwise noted.
NELAP Certifications: NJ 03036, NY 10872, PA 68-00367, CA ELAP 187

The samples associated with this report were received in good condition unless otherwise noted. This report relates only to those items tested as received by the laboratory. The QC data associated with the sample results meet the recovery and precision requirements established by the NELAP, unless specifically indicated. All results for soil samples are reported on a dry weight basis, unless otherwise noted. This report may not be reproduced except in full and without written approval by EMSL Analytical, Inc.

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone/Fax: (856) 303-2500 / (856) 858-4571
http://www.EMSL.com EnvChemistry2@emsl.com

EMSL Order: 011700742
CustomerID: DVBI69
CustomerPO:
ProjectID:

Attn: **Kumar Chakroborty**
Dvirka & Bartilucci
330 Crossway Park Drive
Woodbury, NY 11797

Phone: (516) 364-9890
Fax: (516) 364-9045
Received: 01/27/17 9:30 AM

Project: **3894-01A**

Analytical Results

Client Sample Description HYD-TK-1
Cedar Creek Basement Hydraulic Oil Tank

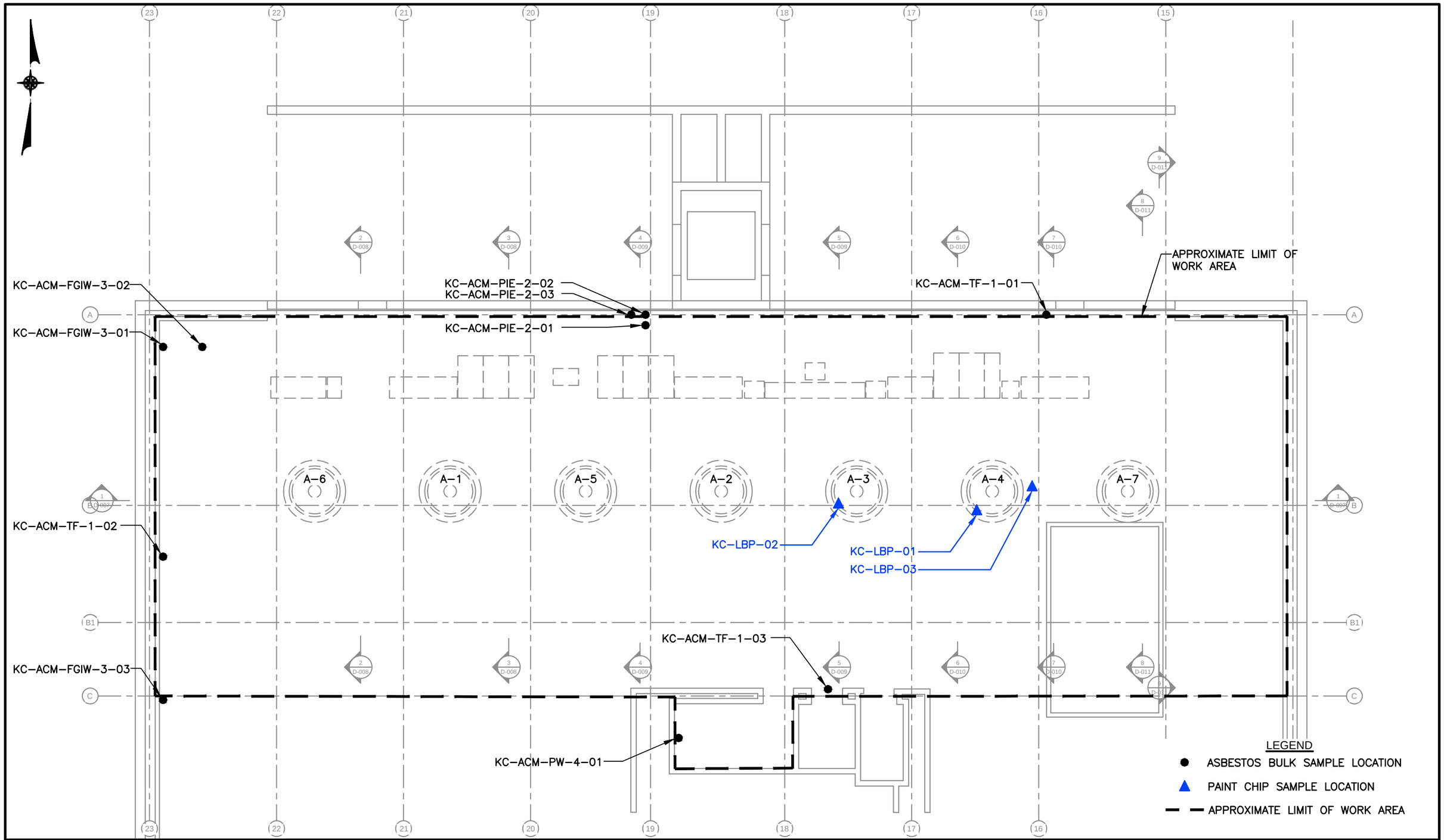
Collected: 1/26/2017 ***Lab ID:*** *0001*

Method	*Parameter*	*Result*	*RL*	*Units*	*Prep Date*	*Analyst*	*Analysis Date*	*Analyst*
3580A/8082	Aroclor-1016	ND	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL
3580A/8082	Aroclor-1221	ND	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL
3580A/8082	Aroclor-1232	ND	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL
3580A/8082	Aroclor-1242	ND	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL
3580A/8082	Aroclor-1248	0.98	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL
3580A/8082	Aroclor-1254	ND	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL
3580A/8082	Aroclor-1260	ND	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL
3580A/8082	Aroclor-1262	ND	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL
3580A/8082	Aroclor-1268	ND	0.49	mg/Kg	1/30/2017	SD	2/1/2017	TL

Definitions:
ND - indicates that the analyte was not detected at the reporting limit
RL - Reporting Limit (Analytical)

APPENDIX D

SAMPLE LOCATION PLANS



F:\3894\Figures\3894-A-MAIN FLOOR.dwg, 3894-A-MAIN FLOOR - C1-MAIN FLOOR, 3/9/2017 6:41:32 PM, DBCadd

D&B ENGINEERS AND ARCHITECTS, P.C.

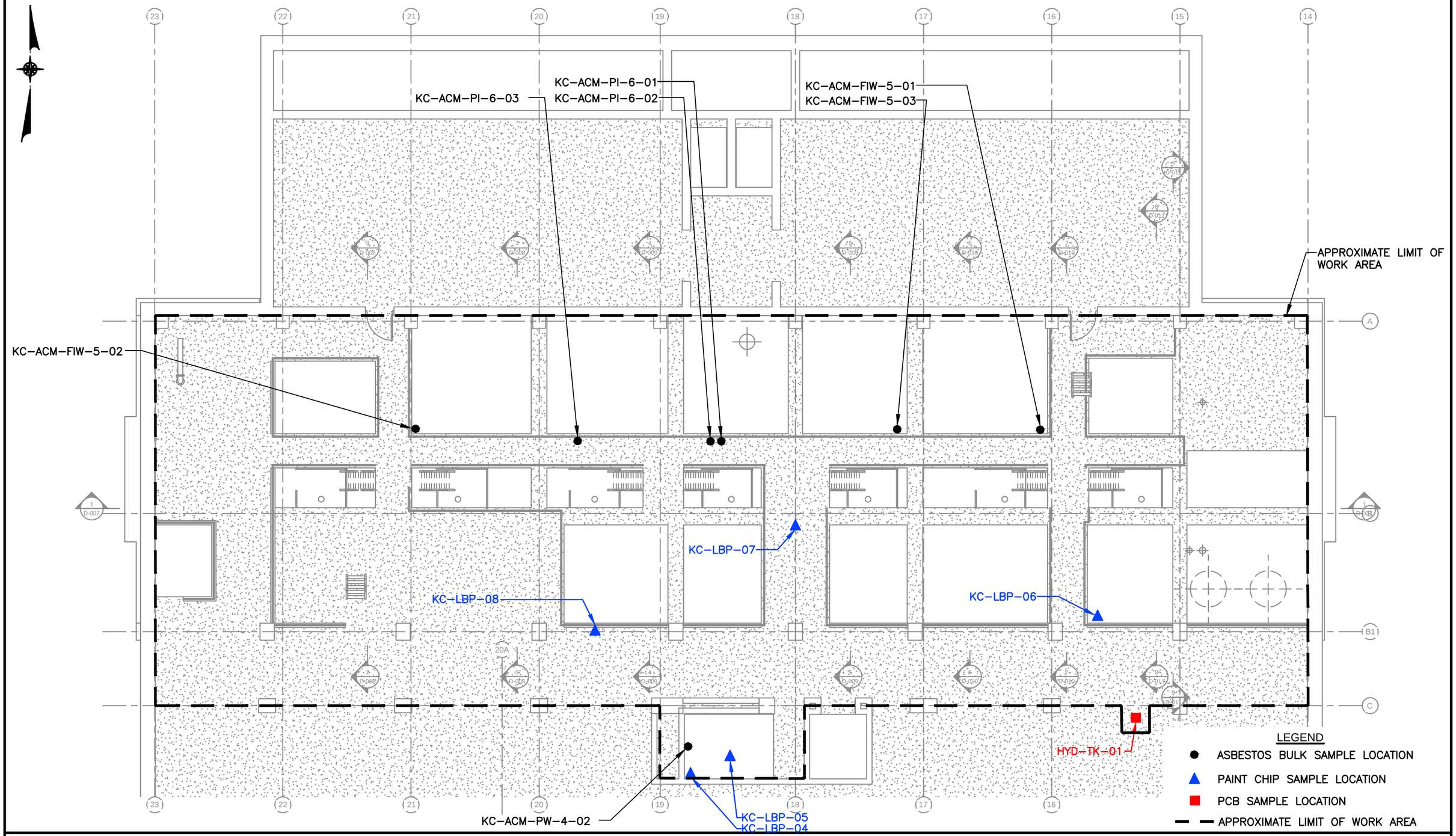
NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

MAIN BUILDING - MAIN FLOOR

SCALE: N.T.S.

FIGURE D-1

F:\3894\Figures\3894-A-MAIN BLDG_BASEMENT.dwg, 3894-A-MAIN BLDG_BASEMENT - C-2 MAIN BLDG_BASEMENT, 3/8/2017 6:43:01 PM, DBCadd



D&B ENGINEERS AND ARCHITECTS, P.C.

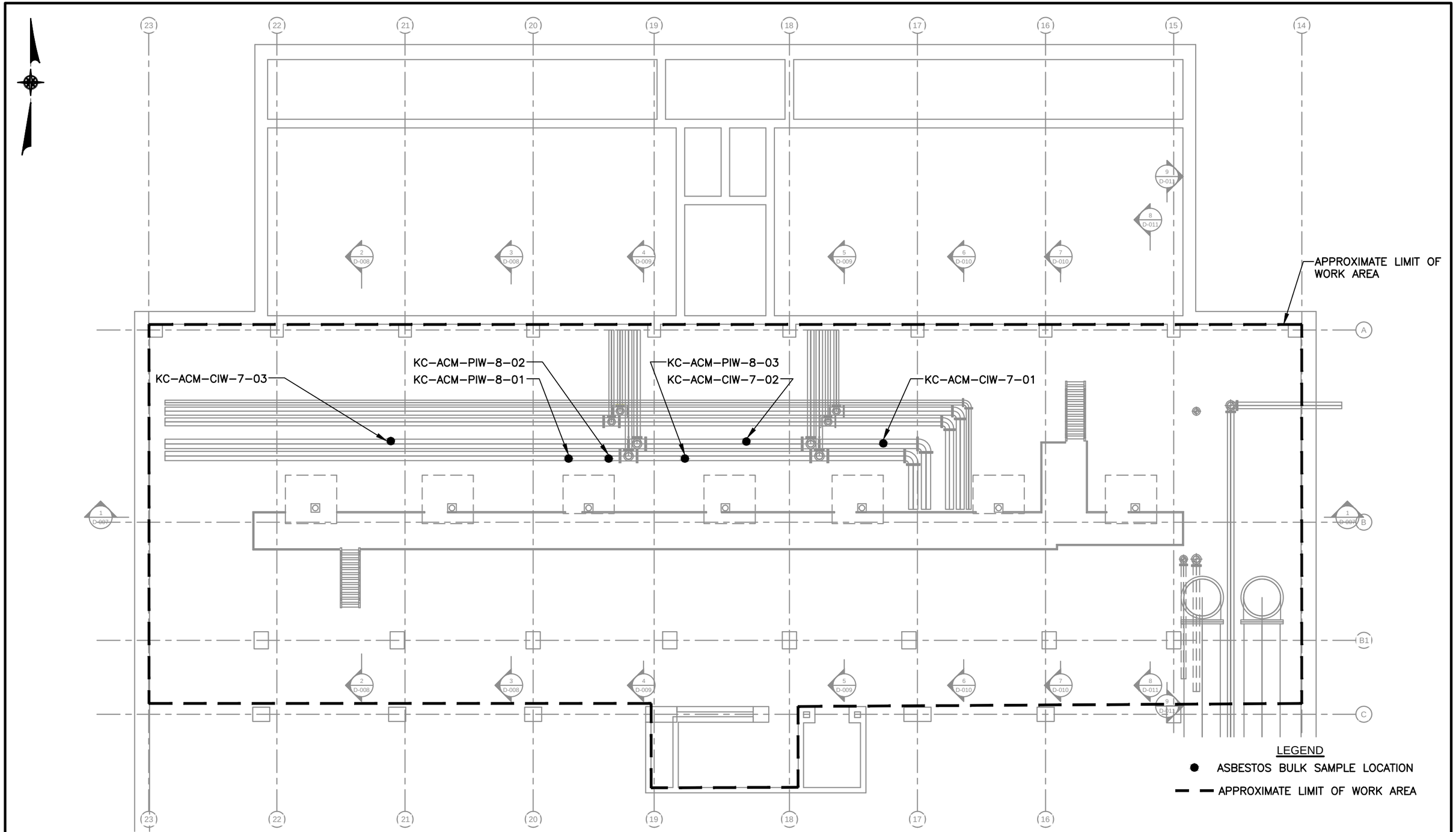
NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

SCALE: N.T.S.

MAIN BUILDING - BASEMENT

FIGURE D-2

F:\3894\Figures\3894-A-MAIN BLDG_BASEMENT CAT WALK.dwg, 3894-A-MAIN BLDG_BASEMENT CAT WALK, 3/8/2017 6:44:16 PM, DBCadd



D&B ENGINEERS AND ARCHITECTS, P.C.

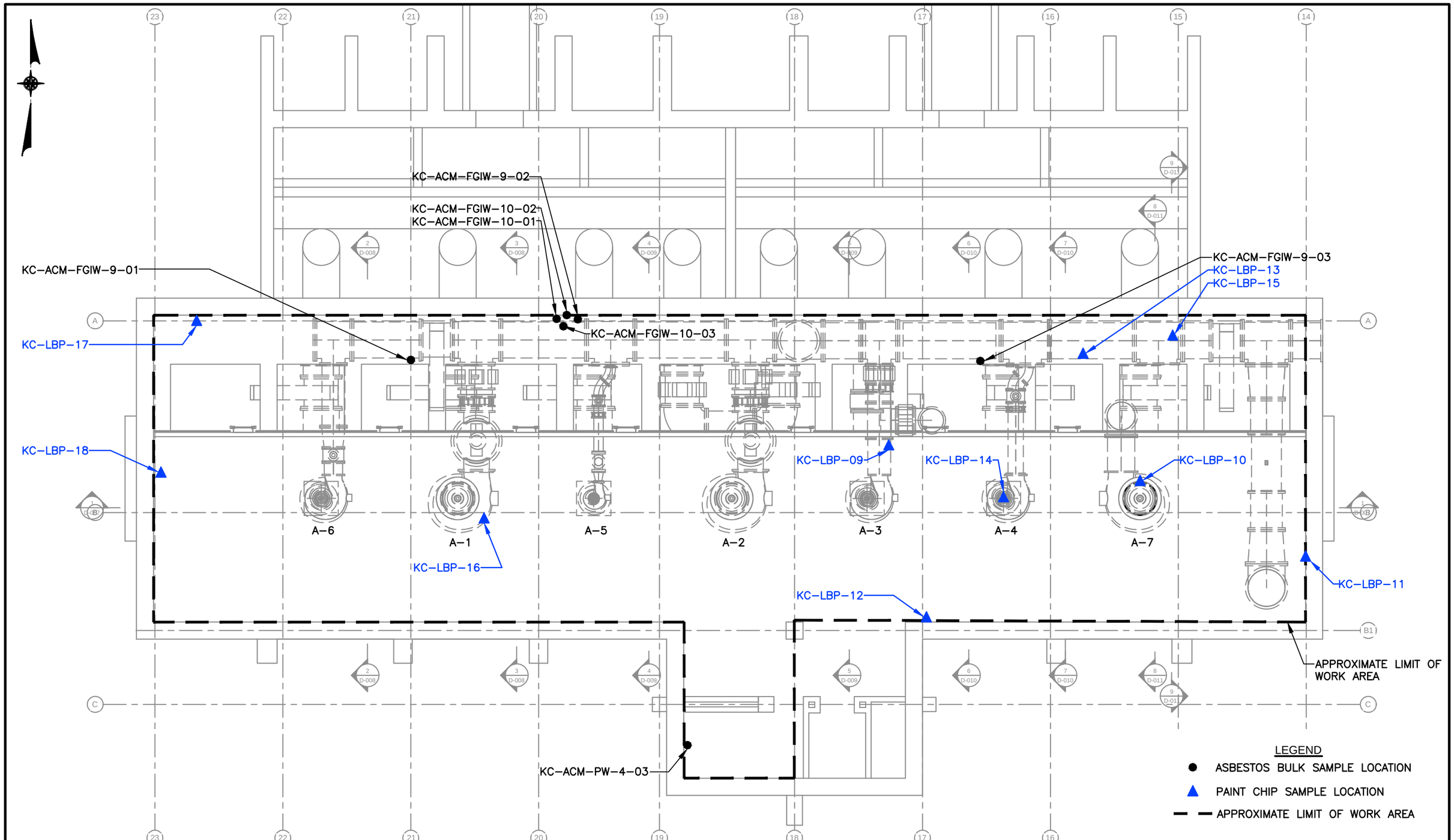
NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

SCALE: N.T.S.

MAIN BUILDING - BASEMENT CATWALK

FIGURE D-3

F:\3894\Figures\3894-A-MAIN BLDG_SUB BASEMENT.dwg, 3894-A-MAIN BLDG_SUB BASEMENT - C-4 MAIN BLDG_SUB BASEMENT, 3/8/2017 6:02:50 PM, DBCadd



D&B ENGINEERS AND ARCHITECTS, P.C.

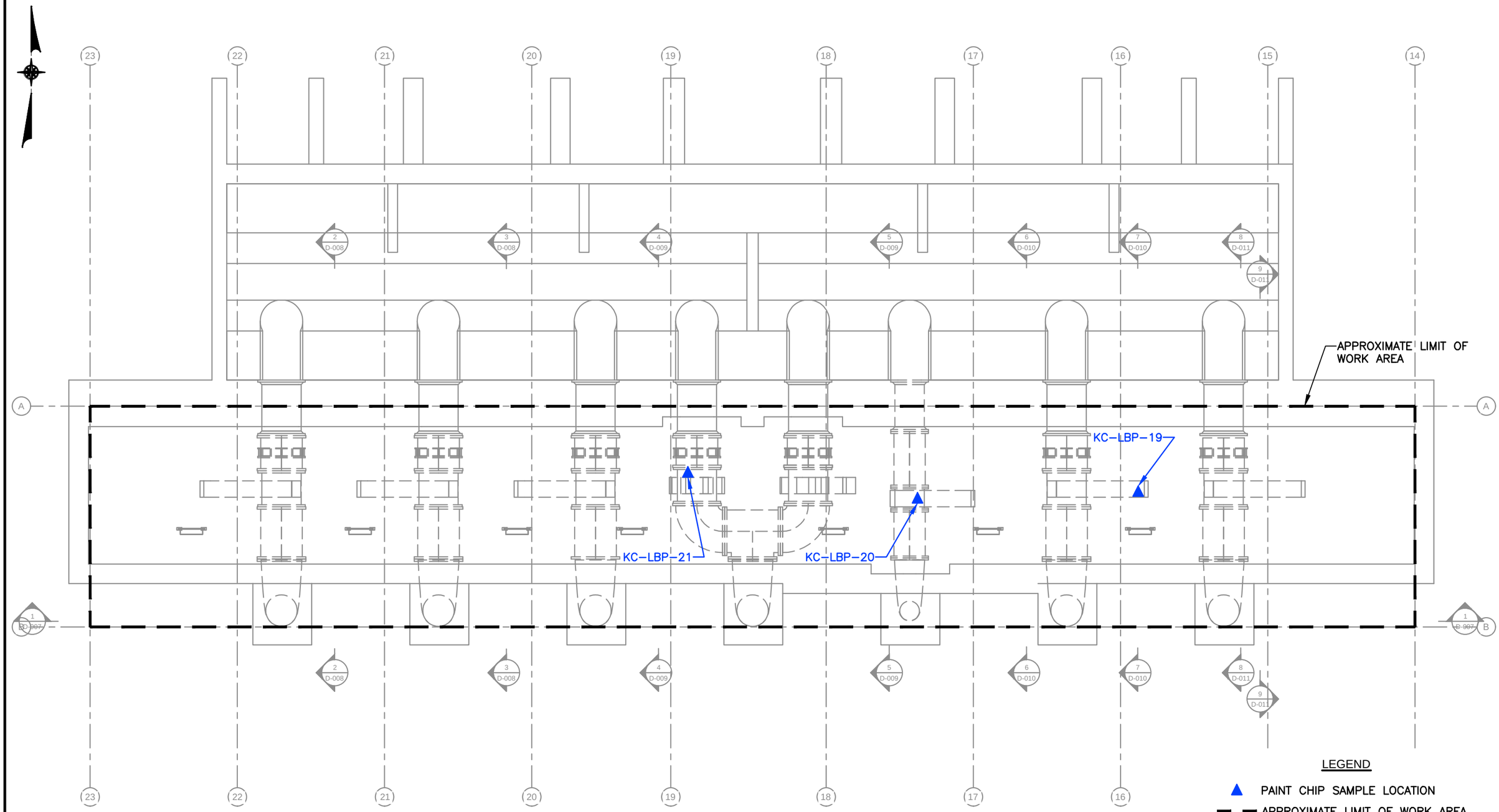
NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

MAIN BUILDING - SUB-BASEMENT

SCALE: N.T.S.

FIGURE D-4

F:\3894\Figures\3894-A-MAIN BLDG_PIT LEVEL.dwg, 3894-A-MAIN BLDG_PIT LEVEL - C-5 MAIN BLDG_PIT LEVEL, 3/8/2017 6:04:04 PM, DBCadd



D&B ENGINEERS AND ARCHITECTS, P.C.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

MAIN BUILDING - PIT LEVEL

SCALE: N.T.S.

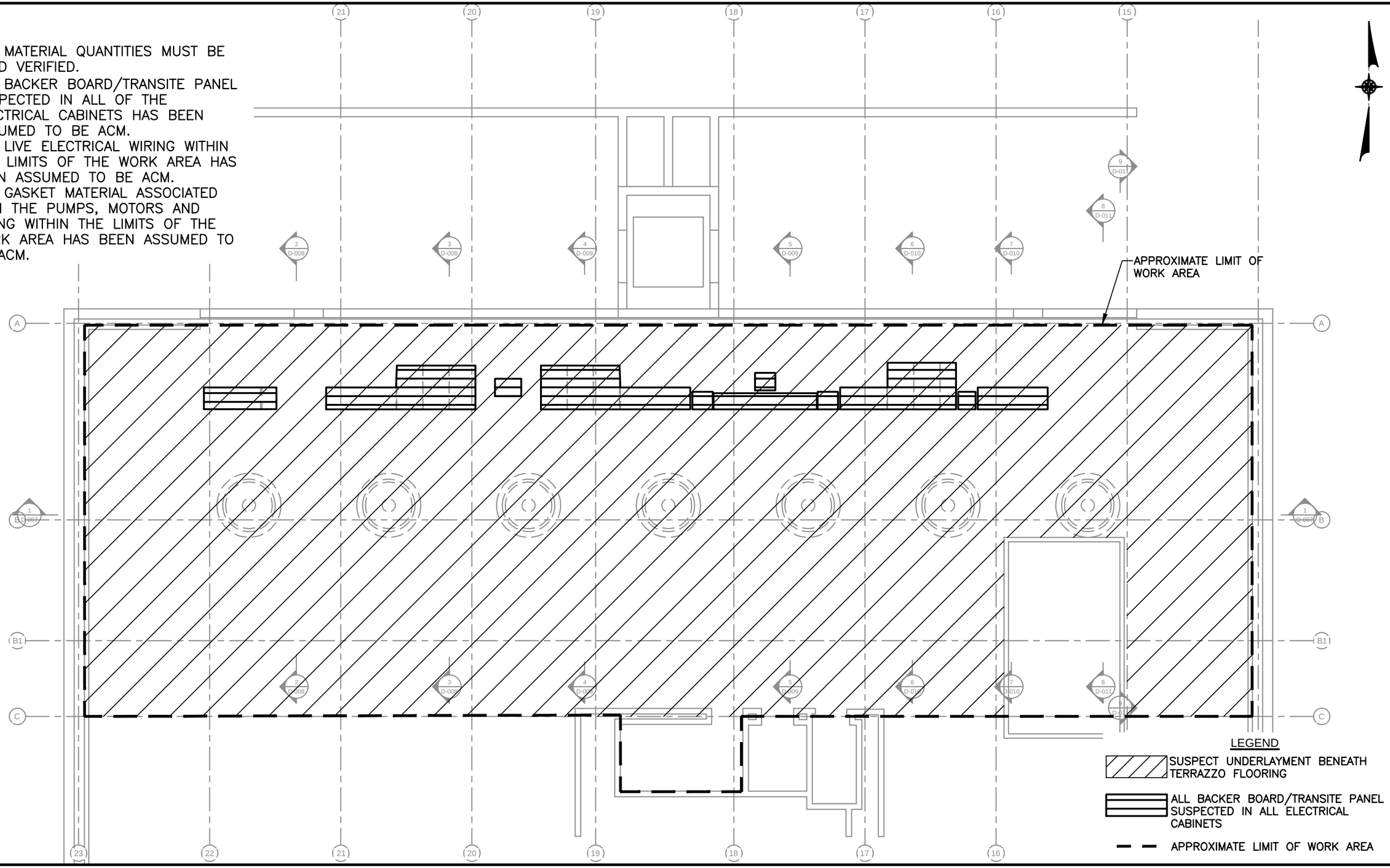
FIGURE D-5

APPENDIX E

ASBESTOS-CONTAINING MATERIAL
LOCATION PLANS

NOTES:

1. ALL MATERIAL QUANTITIES MUST BE FIELD VERIFIED.
2. ALL BACKER BOARD/TRANSITE PANEL SUSPECTED IN ALL OF THE ELECTRICAL CABINETS HAS BEEN ASSUMED TO BE ACM.
3. ALL LIVE ELECTRICAL WIRING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.
4. ALL GASKET MATERIAL ASSOCIATED WITH THE PUMPS, MOTORS AND PIPING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.



D&B ENGINEERS AND ARCHITECTS, P.C.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

MAIN BUILDING - MAIN FLOOR

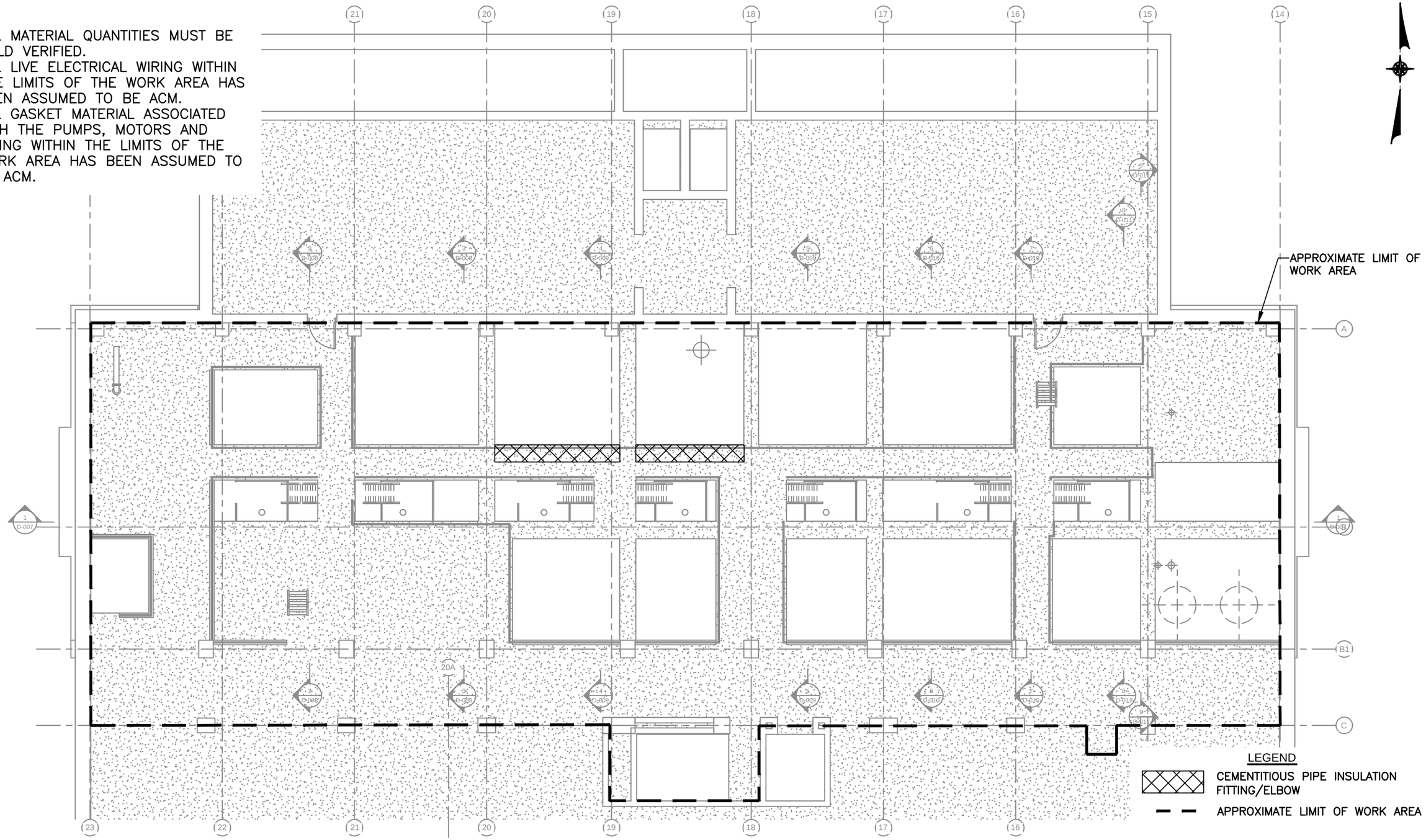
SCALE: N.T.S.

FIGURE E-1

F:\3894\Figures\3894-A-D1-MAIN FLOOR.dwg, 3/9/2017 9:22:41 AM, kalesius

NOTES:

1. ALL MATERIAL QUANTITIES MUST BE FIELD VERIFIED.
2. ALL LIVE ELECTRICAL WIRING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.
3. ALL GASKET MATERIAL ASSOCIATED WITH THE PUMPS, MOTORS AND PIPING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.



D&B ENGINEERS AND ARCHITECTS, P.C.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

MAIN BUILDING - BASEMENT

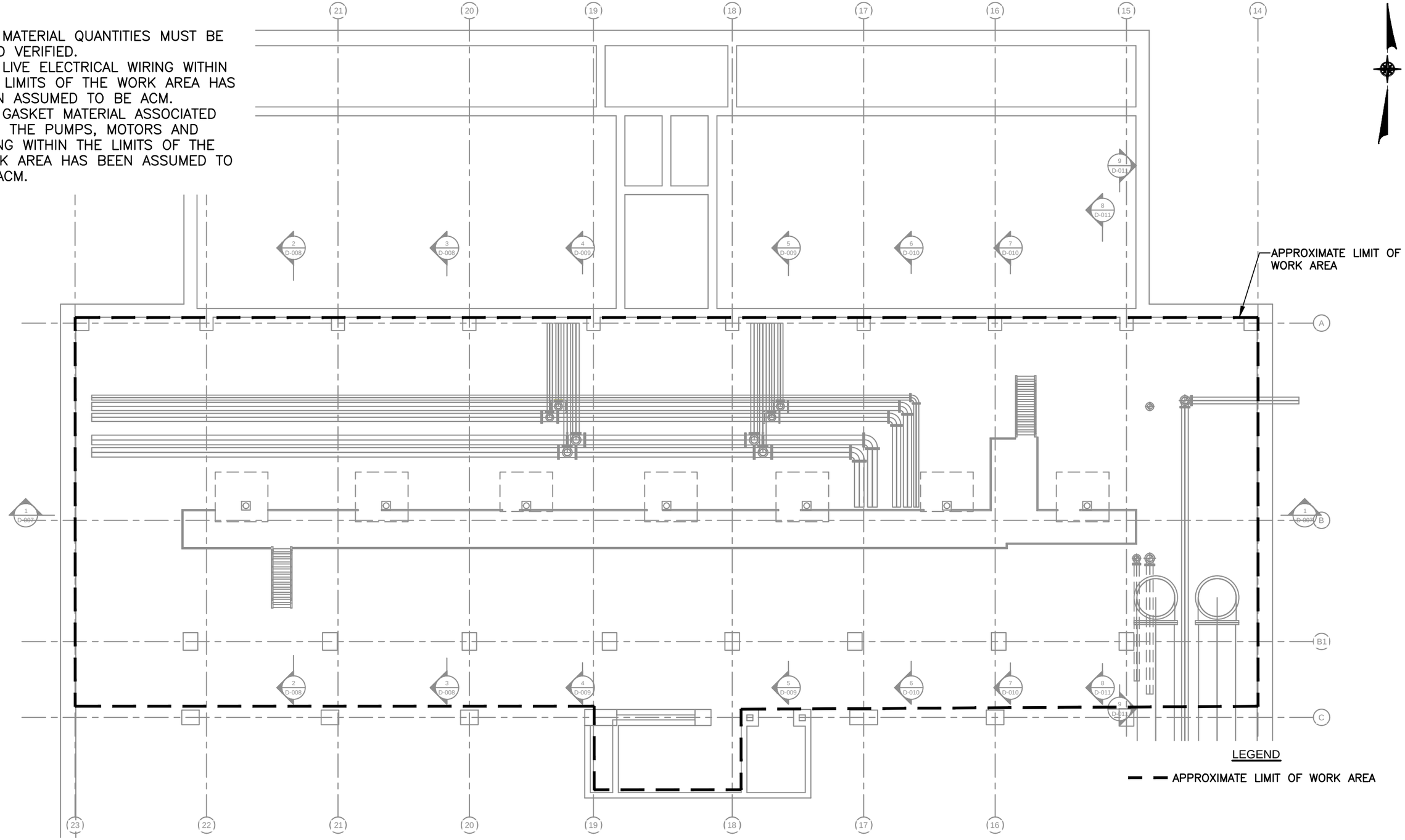
SCALE: N.T.S.

FIGURE E-2

F:\3894\Figures\3894-A-D2-MAIN BLDG_BASEMENT.dwg, 3894-A-D2-MAIN BLDG_BASEMENT - D-2 MAIN BLDG_BASEMENT, 3/8/2017 6:13:08 PM, DBCadd

NOTES:

1. ALL MATERIAL QUANTITIES MUST BE FIELD VERIFIED.
2. ALL LIVE ELECTRICAL WIRING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.
3. ALL GASKET MATERIAL ASSOCIATED WITH THE PUMPS, MOTORS AND PIPING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.



D&B ENGINEERS AND ARCHITECTS, P.C.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

MAIN BUILDING - BASEMENT CATWALK

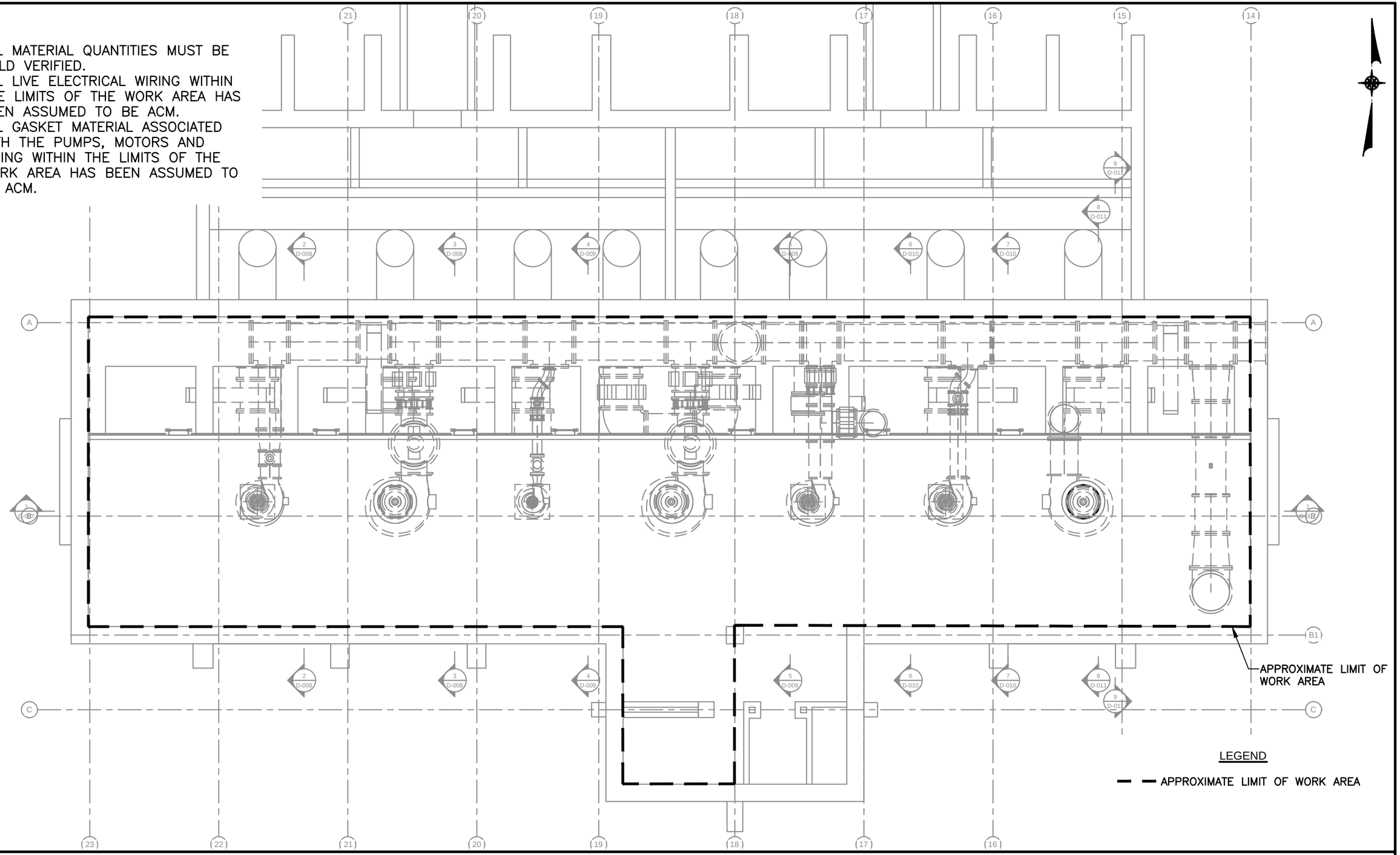
SCALE: N.T.S.

FIGURE E-3

F:\3894\Figures\3894-A-D3-MAIN BLDG_BASEMENT CAT WALK.dwg, 3894-A-D3-MAIN BLDG_BASEMENT CAT WALK - D-3 BASEMENT CAT WALK, 3/8/2017 6:21:53 PM, DBCadd

NOTES:

1. ALL MATERIAL QUANTITIES MUST BE FIELD VERIFIED.
2. ALL LIVE ELECTRICAL WIRING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.
3. ALL GASKET MATERIAL ASSOCIATED WITH THE PUMPS, MOTORS AND PIPING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.



D&B ENGINEERS AND ARCHITECTS, P.C.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

MAIN BUILDING - SUB-BASEMENT

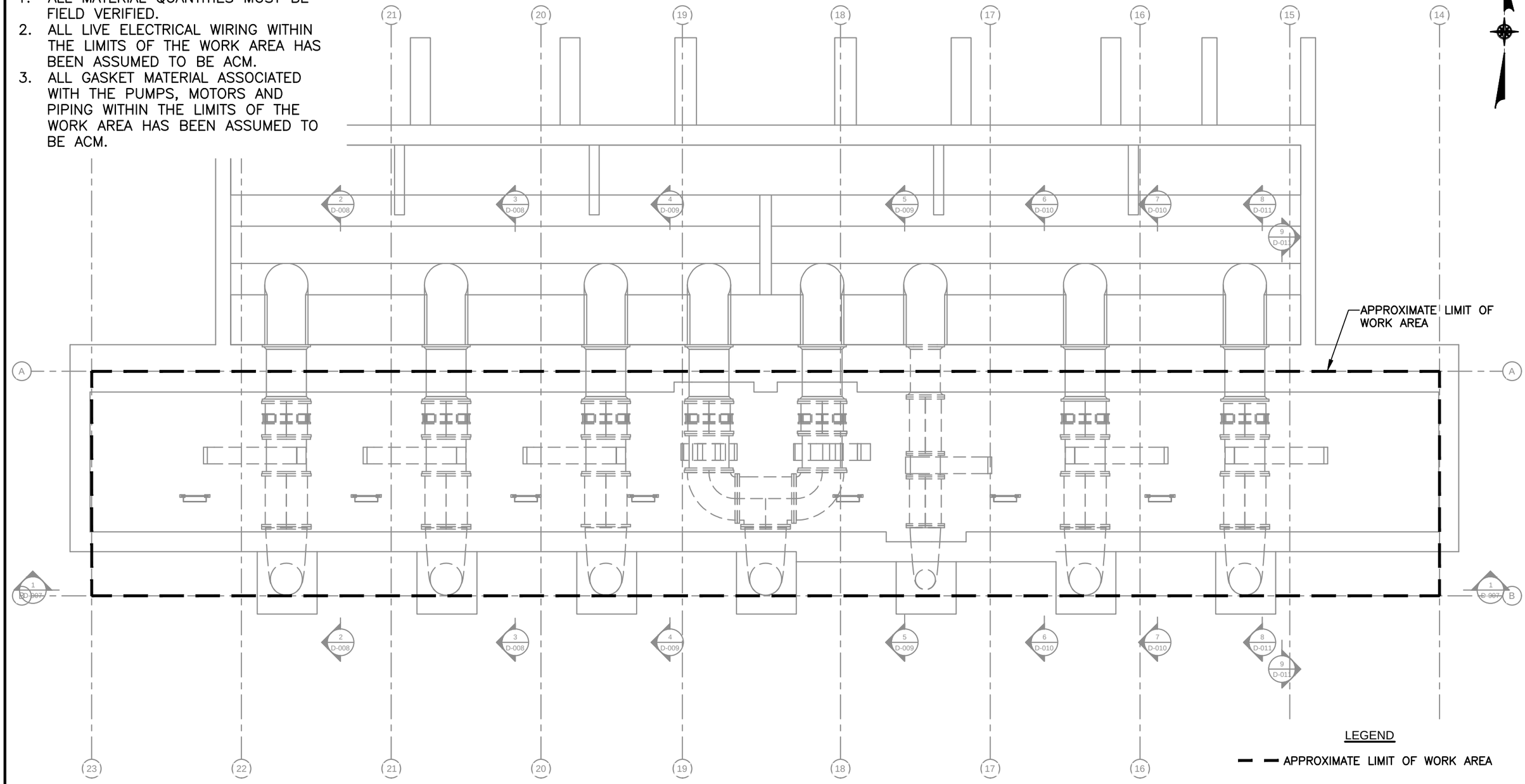
SCALE: N.T.S.

FIGURE E-4

F:\3894\Figures\3894-A-D4-MAIN BLDG_SUB BASEMENT.dwg, 3894-A-D4-MAIN BLDG_SUB BASEMENT - D-4 MAIN BLDG_SUB BASEMENT, 3/8/2017 6:24:44 PM, DBCadd

NOTES:

1. ALL MATERIAL QUANTITIES MUST BE FIELD VERIFIED.
2. ALL LIVE ELECTRICAL WIRING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.
3. ALL GASKET MATERIAL ASSOCIATED WITH THE PUMPS, MOTORS AND PIPING WITHIN THE LIMITS OF THE WORK AREA HAS BEEN ASSUMED TO BE ACM.



D&B ENGINEERS AND ARCHITECTS, P.C.

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER POLLUTION CONTROL PLANT

MAIN BUILDING - PIT LEVEL

SCALE: N.T.S.

FIGURE E-5

F:\3894\Figures\3894-A-D5-MAIN BLDG_PIT LEVEL.dwg, 3894-A-D5-MAIN BLDG_PIT LEVEL - D-5 MAIN BLDG_PIT LEVEL, 3/8/2017 6:26:24 PM, DBCadd

Appendix E 1985 Geotechnical Data Report

GEOTECHNICAL DATA REPORT
CEDAR CREEK WPCP EXPANSION,
WANTAGH, NEW YORK

Malcolm Pirnie, Inc.
2 Corporate Park Drive, Box 751
White Plains, NY 10602

Mueser Rutledge Consulting Engineers
708 Third Avenue
New York, NY 10017

April 3, 1985

MUESER RUTLEDGE CONSULTING ENGINEERS

708 THIRD AVENUE
NEW YORK, N.Y. 10017
212-490-7110
DANAROMIEL, NEW YORK

JAMES P. GOULD
ELMER A. RICHARDS
EDMUND M. BURKE
DOMINIC A. ZARRELLA
GEORGE J. TAMARO
WARREN H. ANDERSON
Partners

ROBERT C. JOHNSTON
NICHOLAS W. KOZIAKIN
Consultants

PETER H. EDINGER
VYTAUTAS ANONIS
WALTER WALCHUK
HUGH S. LACY
ALFRED H. BRAND
Senior Associates

JAMES L. KAUFMAN
WILLIAM G. SPARACIN
SERGIO L. TELLO
TONY FENNIMORE
ARTHUR M. MAYES
JOEL MOSKOWITZ
Associates

April 3, 1985

Malcolm Pirnie, Inc.
2 Corporate Park Drive, Box 751
White Plains, NY 10602

Attn: Mr. John Stankunas

RE: Geotechnical Data Report
Cedar Creek WPCP Expansion,
Wantagh, New York
MRCE #6102

Gentlemen:

Pursuant to your authorization, we have completed a subsurface exploration program at the Cedar Creek WPCP. The proposed expansion of the treatment plant comprises modification of existing structures and construction of new structures, while keeping the plant in operation. The purpose of the subsurface exploration program is to provide additional boring and laboratory test data for use in design of proposed structures and for use by contractors in preparing bids. The subsurface exploration program included a pumping test which is summarized in our March 18, 1985, report titled "Pumping Test Data Report, Cedar Creek WPCP Expansion, Wantagh, New York".

This data report summarizes the field investigation and laboratory testing of soils. It includes an evaluation of subsurface conditions at the site. Some of the information in this report is also included in our March 18, 1985 report. Interpretation of the boring data, with respect to design and construction of proposed structures, is being presented in separate letters or reports.

Exhibits

The following exhibits are attached to illustrate site conditions and to summarize laboratory test data:

Plate No. 1P	Site Vicinity Map
Plate No. 1	Project Site Prior to Treatment Plant Construction
Plate No. 2P	Map of Surficial Geology
Plate No. 3P	Schematic Section

Drawing No. B-1	Boring Location Plan
Table No. 1	Survey Data for Borings
Drawing No. GS-1P	Geologic Section
Drawing No. GS-1	Geologic Sections A-A and B-B
Drawing No. GS-2	Geologic Sections C-C and D-D
Drawing No. GS-3	Geologic Sections E-E and F-F
Table No. 2	Summary of Laboratory Test Data
Plate No. 2	Soil Properties Profile, Borings Nos. B-312U and B-313U
Plate No. 3	Soil Properties Profile, Borings Nos. B-314U and B-317U
Plate No. 4	Consolidation Test, Boring No. 312U, Sample No. 5U
Plate No. 5	Consolidation Test, Boring No. 312U, Sample No. 6U
Plate No. 6	Consolidation Test, Boring No. 313U, Sample No. 5U
Plate No. 7	Consolidation Test, Boring No. 313U, Sample No. 7U
Plate No. 8	Consolidation Test, Boring No. 314U, Sample No. 5U
Plate No. 9	Consolidation Test, Boring No. 317U, Sample No. 4U
Plate No. 5P	Gradation Curves, Stratum S1
Appendix A	MRCE Boring Logs
Appendix B	MRCE Reclassification of Samples from 1983 Borings

Plates Nos. 1P, 2P, 3P, and 5P and Drawing No. GS-1P are taken from our March 18, 1985, report regarding the pumping test.

Available Information

You have provided us with the following data:

1. Converse Consultants report titled "Report of Soils and Foundation Investigation, Proposed Cedar Creek Plant Modifications, Wantagh, New York", dated 10 June, 1983.

2. Converse Consultants report titled "Report of Soils and Foundation Investigation, Cedar Creek Expansion, Wantagh, New York", dated 22 December 1983.

3. Driller's logs of borings made by W. M. Walsh Company, Inc., dated 1966.

4. Consoer, Townsend & Associates drawing titled "Subsurface Exploration", dated June 5, 1978, showing the location of Cedar Creek and shell midden mounds prior to treatment plant construction.

5. Portions of the contract drawings for construction of the treatment plant, titled "Department of Public Works, Nassau

County, New York, Sewage Disposal District No. 3, Water Pollution Control Plant, Contract Nos. 1002-3P-1, 2, 3 & 4", prepared by Consoer, Townsend & Associates, dated 1968.

Project Description

The treatment plant site in Wantagh, NY, is shown on the Site Vicinity Map, Plate No. 1P. The treatment plant site was formerly marshland on which hydraulic fill was reportedly placed between August 1968 and September 1969. Site conditions prior to filling are illustrated on Plate No. 1. This plan shows the location of old Cedar Creek, which meandered along the eastern side of the site. Also shown are the locations of three shell midden mounds, which are reportedly of Indian origin.

You have informed us that hydraulic sand fill was placed over the site in three 5-foot thick lifts. Perimeter dikes were constructed prior to placing the first two lifts, and placement of fill proceeded from south to north. Construction of plant structures began in 1969 and was completed in 1973. The Tertiary Treatment Building was added to the treatment plant between 1977 and 1980, and the Sludge Dewatering Building was added between 1981 and 1983. Final Sedimentation Tanks Nos. 4 and 6 were added in 1979.

The proposed modifications to the treatment plant will be constructed in several phases in order to maintain the plant in operation during construction. The proposed construction phases and the facilities to be constructed in each phase are summarized below:

Phase	New Structures
IIB	Diesel Maintenance Building Cold Storage Building Construction House
IID	Modify existing Digester Tanks
IIIA	Aeration Tanks R.A.S. Pump Station Final Sedimentation Tanks Nos. 9 to 14 Odor Control Facilities for the Primary Tanks, Grit Chambers, and Sludge Thickening Tanks
IV	Influent Screening Chamber Addition Grit Chambers and Building Primary Sedimentation Tanks Odor Control Building for Aeration Tanks R.A.S. Pump Station. Final Sedimentation Tanks Nos. 15 to 18 Sludge Thickening Tanks and Building Digester Tanks and Control Building

Geologic Conditions at Project Site and Vicinity

The treatment plant site was formerly marshland that was filled in the late 1960's just prior to construction of the plant. Upper Pleistocene outwash deposits underlie the Recent salt marsh deposits, and these in turn are underlain by the Magothy formation of Late Cretaceous age.

A map of southern Nassau and southeastern Queens Counties showing surficial geology in 1954 is presented on Plate No. 2P. The map is taken from Geological Survey Water-Supply Paper 1613-A, titled "Geology and Ground-Water Conditions in Southern Nassau and Southeastern Queens Counties, Long Island, N.Y.", by N.M. Perlmutter and J.J. Geraghty, 1963. The treatment plant site was indicated to be marshland in this 1954 map. The section shown on the map in the vicinity of the treatment plant is presented on Plate No. 3P, which is also taken from the Water-Supply Paper referenced above.

The section on Plate No. 3P indicates subsurface stratification in the vicinity of the treatment plant to comprise Upper Pleistocene deposits extending to about Elev. -35, underlain by the "20 foot" clay, which in turn is underlain by the Magothy formation. The "20 foot" clay is characterized as a shallow marine deposit, possibly of Wisconsin age. Recent marsh deposits and artificial fill are not delineated on the section. The treatment plant was located in the vicinity of the indicated transition between salt and fresh groundwater in the Pleistocene deposits. The location of this transition may have shifted since 1963, when the Water-Supply Paper was published. Groundwater in the Magothy formation was indicated to be fresh. Chemical analyses of groundwater samples obtained from the Pleistocene deposits were performed by Malcolm Pirnie, Inc., and indicate chloride concentrations of about 1070 ppm. Chemical analyses data included in the December 22, 1983, Converse Consultants report indicate groundwater chloride concentrations of about 440 to 660 ppm.

The water table was shown on Plate No. 3P to be between about Elev. +1 and +3 near the treatment plant site, sloping downward to the south towards the Great South Bay. In actuality, the groundwater in the Pleistocene deposits is not unconfined as indicated, but is at least somewhat confined by the Recent organic deposits encountered at about Elev. 0. Water in the artificial fill overlying the organic soil may be at a different level than groundwater in the Pleistocene deposits. Groundwater in the Magothy formation was indicated to be under slight artesian pressure, with a head of about Elev. +8.

Field Investigation

We prepared a boring plan and specifications for a subsurface exploration program at the site. The borings were located at planned structures to supplement and confirm subsurface information obtained in earlier investigations. Proposals for the work were requested from four boring contractors, two of whom declined to bid. With your approval, the contract was awarded to Warren George, Inc.

The borings were made between February 13, and February 28, 1985, under continuous inspection of MRCE Resident Engineer Mr. Ben Mukherjee. As part of the subsurface investigation, eight well point type piezometers were installed in Borings Nos. B-302P, B-315P, B-316P(A), B-317UP, B-318P(A), B-319P, B-320P, and B-325P. The piezometers were used to monitor groundwater levels during the pumping test. Undisturbed samples were obtained in four borings: B-312U, B-313U, B-314U, and B-317UP. The subscript "P" after a boring number indicates that a piezometer was installed in the borehole, subscript "U" indicates that undisturbed samples were obtained in the boring, and subscript "A" indicates that the boring was offset from its original drilled location because an obstruction was encountered.

The borings were made by two truck mounted drillings rigs. Borings in which piezometers were installed were advanced by driving casing; all other borings were advanced using drilling mud. Dry samples of soil were obtained by driving a 2 inch diameter split spoon sampler with a 140 pound hammer free falling 30 inches. Undisturbed samples were obtained using a fixed piston sampler. All soil samples were sent to our laboratory for reclassification and testing.

Subsurface Conditions at the Treatment Plant Site

Locations of 1985 borings are plotted on the Boring Location Plan, Drawing No. B-1. The locations of all known previous borings made at the treatment plant site are also shown on Drawing No. B-1. Coordinates and elevations of the 1985 borings were determined by treatment plant personnel and are summarized on Table No. 1. Elevations refer to Nassau County Datum, in which Elev. 0 is mean sea level at Sandy Hook, New Jersey. Ground surface at the treatment plant is generally about Elev. +13 to +20.

Boring logs with reclassified soil descriptions are attached as Appendix A of this report. We have also examined and reclassified soil samples from the 1983 borings, and our sample descriptions are attached as Appendix B. Our classification of individual soil samples may or may not agree precisely with that shown on driller's logs prepared by Warren George, Inc.

Subsurface conditions are illustrated on seven geologic sections shown on Drawings Nos. GS-1P, GS-1, GS-2, and GS-3. Drawing No. GS-1P is taken from our March 18, 1985 report regarding the pumping test. Boring data plotted on the geologic sections include standard penetration resistances and groundwater levels measured in the boreholes. Major existing and proposed structures are also shown.

General characteristics of subsurface strata as interpreted from borings made for the treatment plant are described in the following paragraphs in order of increasing depth:

Stratum F - Fill. Approximately 15 feet of hydraulic sand fill was placed in the late 1960's over natural organic deposits at the treatment plant site. The hydraulic fill is generally medium-compact to compact

gray and brown fine to medium sand with a trace of silt and gravel, classified as SP in the Unified Soil Classification System. Occasionally the fill is loose, particularly where it is backfill against existing structures.

Stratum O - Organic Silty Clay and Peat. Underlying the hydraulic fill is a natural deposit of stiff to medium dark gray organic silty clay and brown peat, with a trace of fine sand, and occasionally containing fine sand seams. The thickness of the organic stratum varies between approximately one and 15 feet and is generally greatest in the eastern part of the plant. Top of Stratum O is about Elev. 0. The 1966 borings indicate top of Stratum O at about Elev. +2. These higher elevations reflect existing conditions prior to placement of fill at the treatment plant. Placement of fill has resulted in compression of the organic soils, and top of Stratum O is now about Elev. 0. Organic soils were not encountered adjacent to some existing structures where they presumably were removed during earlier construction. A layer of shells was encountered at the top of Stratum O in Boring No. B-327. These shells are presumably part of the south shell midden mound, the location of which is shown on Plate No. 1. Natural water contents of the organic soils vary from 23 to 253 percent and average about 90 percent. Water contents are expressed as a percentage of dry weight. Water contents of undisturbed samples are listed in Table No. 2; water contents of split spoon samples are tabulated in Appendix A. Low water contents reflect high sand contents in the samples.

Stratum S and O - Sand Mixed with Organic Silty Clay. This stratum was encountered in many of the borings and comprises medium compact gray fine to medium sand intermingled with pockets and layers of organic silty clay. Where present, it is typically about two to five feet thick and is generally encountered above Elev. -10. In Boring No. B-324, this stratum is about 15 feet thick and extends to approximately Elev. -27; in Boring No. B-311, it is about seven feet thick and extends to approximately Elev. -17. Available information shown on Plate No. 1 indicates that these two borings were made within the former Cedar Creek channel.

Stratum S1 - Sand. This deposit is a medium compact gray fine to coarse sand with a trace of silt and gravel, classified as SP in the Unified Soil Classification System. It is generally 30 feet thick and extends to approximately elevation -35. Stratum S1 sands are Upper Pleistocene outwash deposits.

Stratum C - Silty Clay. Underlying the sand is a stiff to hard gray silty clay. This deposit is the "20 foot" clay. It is typically 20 feet or more in thickness. Natural water contents vary between 22 and 42 percent and average about 34 percent. Water contents of individual split spoon samples are tabulated in Appendix A.

Stratum S2 - Silty Sand. This stratum is predominantly a medium compact to very compact gray silty fine to medium sand, occasionally interbedded with silty clay and/or gravel. Stratum S2 is presumably part of the Magothy formation. It was encountered between about Elev.

-55 and -95. Driller's logs of borings made by W. M. Walsh Company, Inc., dated 1966, and boring logs prepared by Converse Consultants, dated 1983, indicate that Stratum S2 is underlain by about 10 feet of hard dark gray clay, which is interbedded with seams of coarse to fine sand.

Static Ground Water Levels

Groundwater levels measured in the 1985 borings are plotted on the geologic sections. Drilling mud was used to advance all 1985 borings except those in which piezometers were installed. The measured mud levels may not correspond precisely with the groundwater table. We have therefore relied primarily on piezometer readings to establish groundwater levels in the upper strata.

Static groundwater levels measured in piezometers positioned in Stratum S1 in the vicinity of the proposed Aeration Tanks are typically about Elev. +2. The piezometer in Boring B-319P has its intake in Stratum F, Fill, and indicates a water level at almost Elev. +3, about 1 foot higher than in Stratum S1. Water levels measured in existing Borings Nos. B-206 and B-206A also indicate that the water level in the fill is about 1 foot higher than in the underlying Stratum S1.

The December 22, 1983 Converse Consultants report notes that water levels in Stratum S1 as measured in widely spaced observation wells in August and September, 1983, drop from about Elev. +3 to Elev. +1 in a southeasterly direction. Water levels measured in 1985 appear to corroborate this trend.

Water level for the 100 year storm is reported to be Elev.+ 7.

Laboratory Testing

All split spoon samples recovered from borings were delivered to our laboratory where they were examined and reclassified. Natural water contents of fine grained soil samples were determined.

Eight 3-inch diameter undisturbed samples of Stratum O soil were recovered in Borings Nos. B-312U, B-313U, B-314U, and B-317UP and were shipped to our laboratory for examination and testing. These samples were subjected to Atterberg limits, triaxial compression, and consolidation testing. Tests were performed on both peaty and non-peaty samples to obtain a range of soil parameters for Stratum O. Test results are summarized in Table No. 2. Test results are also plotted relative to depth on Soils Properties Profiles, Plates Nos. 2 and 3. Natural water contents and Atterberg limits are plotted versus depth on the right panel of Plates Nos. 2 and 3; strength and preconsolidation data are plotted versus depth on the left panel of Plates Nos. 2 and 3. Data for individual consolidation tests are presented on Plates Nos. 4 through 9.

Atterberg limits were determined for each undisturbed sample. The data indicate that the organic soils are generally classified as OH and Pt in the Unified Soil Classification System. Measured liquid limits of

the organic soil samples vary from 90 to 309 percent and average about 170 percent. Corresponding plasticity indices vary from 42 to 128 percent and average about 80 percent. Natural water contents of the limit samples typically fall between the liquid and plastic limits.

Measured specific gravities of the organic soils vary between 1.96 and 2.67. The lower specific gravities reflect a high organic fiber content in the samples.

Unconsolidated-undrained triaxial compression tests were performed on all undisturbed samples. Measured compressive strengths range from 0.4 to 1.7 tons per square foot. Measured strengths tend to increase with depth. The higher strengths were measured in samples that contained a large percentage of peaty fibers.

Consolidation test data indicate that Stratum O is overconsolidated by about 0.4 to 1.1 tons per square foot in excess of existing soil overburden stresses. Available site history data do not indicate surcharging in excess of existing soil overburden stresses. We believe that the high measured preconsolidation stresses may be the result of a combination of factors, including temporary stockpiling of equipment or excavated soil during plant construction, dewatering during previous construction, and a higher sand unit weight when saturated during hydraulic fill placement. The undisturbed sample borings are located near major existing structures, and it appears likely that temporary stockpiling during previous construction may be a significant contributing factor to the high measured preconsolidation stress. It is noted, however, that the preconsolidation of the organic soils may be lower in other areas of the treatment plant that are farther from previous construction and in which undisturbed samples were not obtained.

Five typical gradations of Stratum S1 sand are shown on Plate No. 5P. Superposed on Plate No. 5P is the range of gradations of Stratum S1 sand taken from the December 22, 1983, Converse Consultants report. The data indicate that Stratum S1 is generally fine to coarse or fine to medium sand with a trace of gravel and silt.

Summary and Conclusions

A boring investigation was made at the Cedar Creek WPCP to provide additional subsurface and laboratory test data for use in design of the proposed expansion of the treatment plant. As part of the investigation, a pumping test was performed in Stratum S1 to evaluate aquifer characteristics and the effects of construction dewatering on existing structures. Pumping test data are summarized in our March 18, 1985, report titled "Pumping Test Data Report, Cedar Creek WPCP Expansion, Wantagh, NY". This geotechnical data report, our March 18, 1985, pumping test report, and all other subsurface data and reports should be made available to contractors for their use in preparing bids.

This report is intended only to summarize data from the 1985 subsurface investigation. Interpretation of this information with respect to design and construction of new structures is being presented

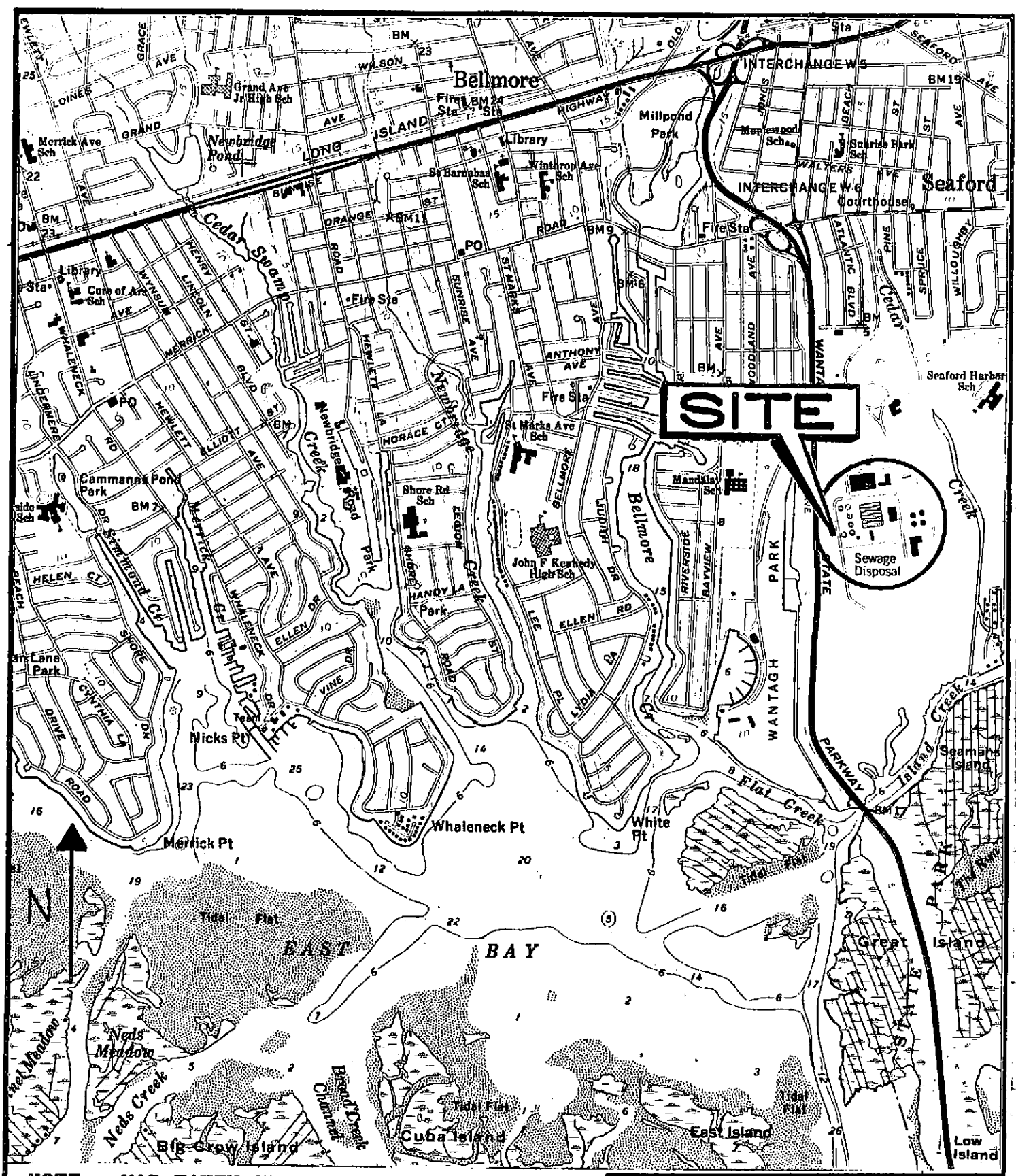
in separate letters or reports. Subsurface conditions revealed by the 1985 borings generally corroborate boring data from earlier subsurface investigations.

Very truly yours,

MUESER RUTLEDGE CONSULTING ENGINEERS

By _____
Elmer A. Richards

CHF:EAR:HSL/dj



NOTE: MAP TAKEN FROM USGS FREEPORT, N.Y., QUADRANGLE, 1969, PHOTOREVISED 1979.

CEDAR CREEK WPCP

Wantagh New York

MUESER RUTLEDGE CONSULTING ENGINEERS

708 THIRD AVENUE, NEW YORK, N.Y. 10017

SCALE	MADE BY	DATE	FILE NO
1"=2000'	CHF	3/85	6102
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SITE VICINITY MAP — PLATE NO. 1P

S3C067-11G

Page 2493 of 2953

Nassau County DPW

NOTE: BASE PLAN TITLED "SUBSURFACE EXPLORATION" DATED JUNE 5, 1978 WAS PROVIDED BY MALCOLM PIRNIE, INC.

BORING DEPTHS

B51 100'
B52 100'
ALL OTHER A-B 35' MAX

BORINGS B51 & B52
BORINGS NOTED TO BE 100 FT. DEEP SHALL BE CARRIED TO DEPTH REQUIRED TO DETERMINE LENGTH OF 50 TON CAPACITY DISPLACEMENT TYPE DRIVEN PILE.

SEAFORD PARK

OLD CEDAR CREEK

WANTAGH-OYSTER BAY EXPRESSWAY (PROPOSED)

DIGESTER & DIGESTER CONTROL BUILDING

SLUDGE THICKENING TANKS & BUILDING

PROPOSED CHEMICAL DELIVERY AND STORAGE FACILITY

SEWER MAINTENANCE BUILDING

BULK STORAGE

MIDDLE MOUND

NORTH MOUND

GRIT CHAMBERS BUILDING

PRIMARY SEDIMENTATION TANKS & BUILDING

FUTURE PRIMARY

SLUDGE HANDLING BUILDING

FUTURE TERTIARY

UNDERGROUND STORAGE

CURING & STORAGE PAD

INFLUENT SCREENING CHAMBER

MAIN EQUIPMENT BUILDING

GAS STORAGE

WATER STORAGE

AERATION TANKS

FUTURE SECONDARY

EFFLUENT SCREENING, CHLORINATION & PUMPING FACILITIES

UNDERGROUND METHANE STORAGE TANK AND PUMPING STATION

EXPLOSIVES BUILDING

WAREHOUSE MAINTENANCE BUILDING

RETURN ACTIVATED SLUDGE WELLS

UNDERGROUND PUMPING STATION

FINAL SEDIMENTATION TANKS

WOODCHIP STORAGE AND MIXING PAD

DRY AND SCREENING BUILDING

OFFICE & GARAGE BUILDINGS

POND

COMPOSTING PAD

SHACKS NO LONGER IN EXISTENCE

E 2,138,000

E 2,137,000

E 2,136,600

N 156,000

N 155,000

SOIL BORING LEGEND :

- B1 THRU B32 SOIL BORINGS COMPLETED NOV. 1966
- B41 " B47 " " " MAR. 1975
- B51 & B52 PROPOSED SOIL BORINGS JUNE, 1978
- A1 THRU A58 PROPOSED ARCHAEOLOGICAL BORINGS

KEY

SWELL MIDDEN MOUND

REPORTED MOUND LIMITS

GRAPHIC SCALE
100' 50' 0' 100' 200'

78082

1	12 JUNE 78	ADD ARCHAEOLOGICAL BORINGS A1-A58	GW		
NO.	DATE	DESCRIPTION	APPROVED		
REVISIONS				DESIGNED JWC DRAWN ATP & RLB/GRSC CHECKED	SCALE 1"=100'

CONSOER TOWNSEND & ASSOCIATES
CONSULTING ENGINEERS
NEW YORK CHICAGO

NASSAU COUNTY, NEW YORK
DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WATER RECLAMATION FACILITIES

SUBSURFACE EXPLORATION

DATE JUNE 5, 1978
SHEET

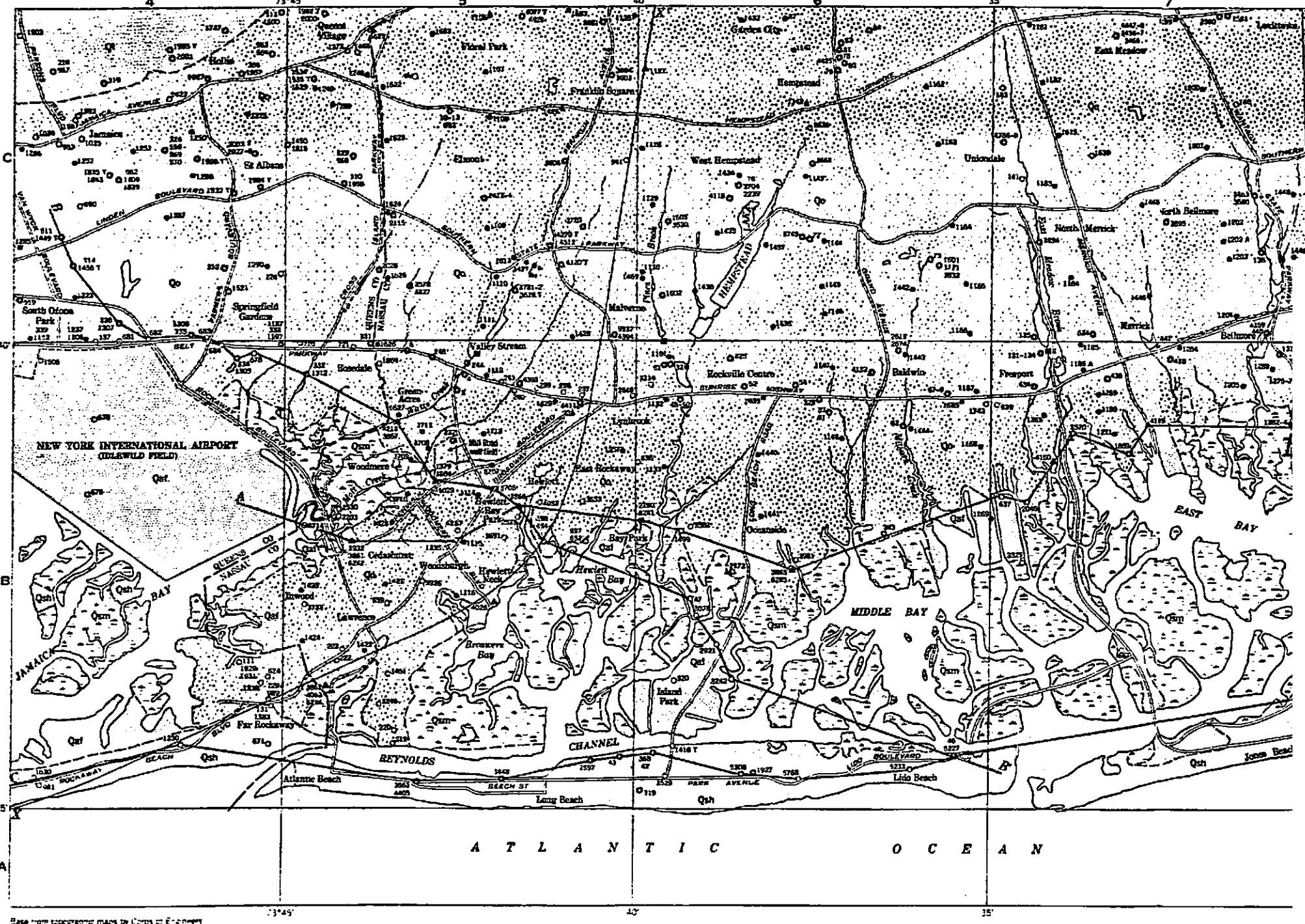
MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, N.Y. 10017

SCALE	MADE BY	DATE	FILE NO
GRAPHIC	M.G.	4-1-85	6102
	CHKD BY F.A.	DATE 4-1-86	

PROJECT SITE PRIOR TO TREATMENT PLANT CONSTRUCTION — PLATE NO. 1

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-SUPPLY PAPER 1613-A
PLATE 1



Base from topographic maps by Corps of Engineers U. S. Army and U. S. Geological Survey, 1954-58

Geology edited from H. L. Fuller, modified on basis of topographic maps and field observations, 1954

EXPLANATION

Recent

Qaf — Artificial fill
Made land; mostly sand and gravel but includes some cinders and rubble

Qsm — Salt-marsh deposits
Chiefly organic mud, some silt and sand, are rarely less than 10 feet thick. Saturated with salty water. Not a source of water

Qsh — Shore deposits
Mainly beach sand and coarse sand, medium- to coarse-grained; scattered shell fragments. Contains thin lenses of fresh water underlain by salt water, relatively permeable but only small water supplies developed locally

Pleistocene — Wisconsin stage

UPPER PLEISTOCENE DEPOSITS

Qt — Till
Clay, sand, gravel, and boulders. Permeability generally low. Not a source of water

Qo — Outwash
Includes Recent alluvium along stream channels. Chiefly medium- to coarse-grained sand and some gravel deposited by glacial melt water; well stratified, crossbedding common. Highly permeable, yields large supplies to individual wells. Contains mostly fresh water but near the shore contains salt water

Contact, approximately located

Domestic, industrial, agricultural, or institutional well, and well number
o728

Public-supply well
●1507

Water-level observation well
●1163

Outpost well
▲1127

Stream-gaging station

Infiltration gallery owned by New York City

A — A'
Line of geologic section

Y — Y'
Line of flow section

More than one number at well symbol indicates wells at same locality. Prefix Q, Queens County and N, Nassau County omitted from well numbers on map. Letter T after well number signifies test well

MAP OF SOUTHERN NASSAU AND SOUTHEASTERN QUEENS COUNTIES, LONG ISLAND, NEW YO K, SHOWING SURFICIAL GEOLOGY AND LOCATION OF WELLS AND STREAM-GAGING STATIONS

1 0 1 2 3 4 5 MILES

NOTE: MAP TAKEN FROM GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1613A, "GEOLOGY AND GOUND-WATER CONDITIONS IN SOUTHERN NASSAU AND SOUTHEASTERN QUEENS COUNTIES, LONG ISLAND, N.Y." 1963

CEDAR CREEK WPCP
Wantagh New York

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, N.Y. 10017

SCALE	MADE BY CHF DATE 3/85	FILE NO 6102
—	CHKD BY DATE	
MAP OF SURFICIAL GEOLOGY		PLATE NO. 2P

S3C067-11G
Page 2494 of 2953
Nassau County DPW

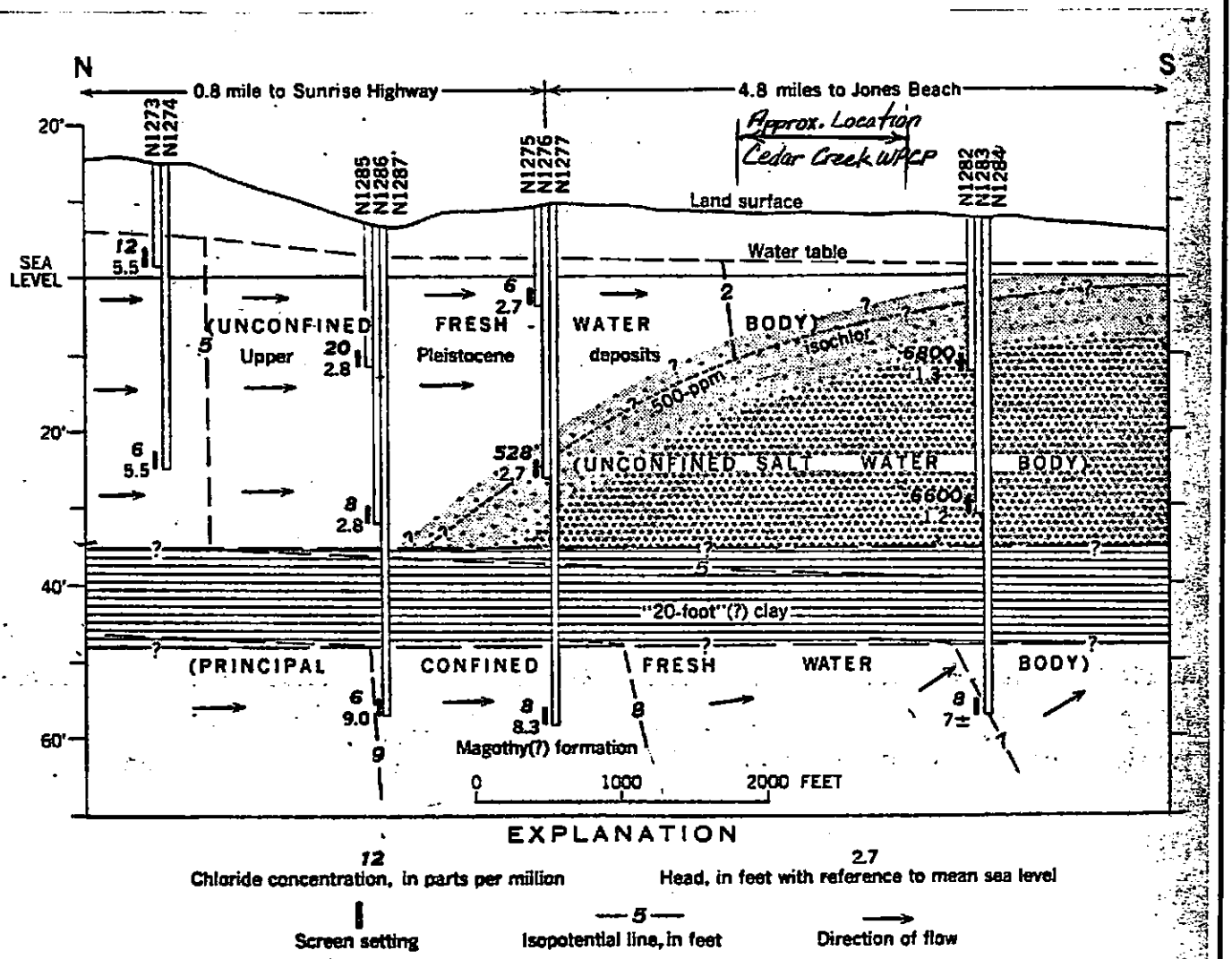


FIGURE 10.—Section showing relation between fresh and salt water at shallow depth south of Wantagh, Nassau County, N.Y.

FOR LOCATION OF SECTION, SEE PLATE NO. 2P

NOTE: MAP TAKEN FROM GEOLOGICAL SURVEY WATER - SUPPLY PAPER 1613A, "GEOLOGY AND GROUND-WATER CONDITIONS IN SOUTHERN NASSAU AND SOUTHEASTERN QUEENS COUNTIES, LONG ISLAND, N.Y.", 1963.

CEDAR CREEK WPCP	
Wantagh	New York
MUESER RUTLEDGE CONSULTING ENGINEERS 708 THIRD AVENUE, NEW YORK, N.Y. 10017	
SCALE — MADE BY CHF DATE 3/85 CHKD BY DATE	FILE NO 6102
SCHEMATIC SECTION	PLATE NO. 3P

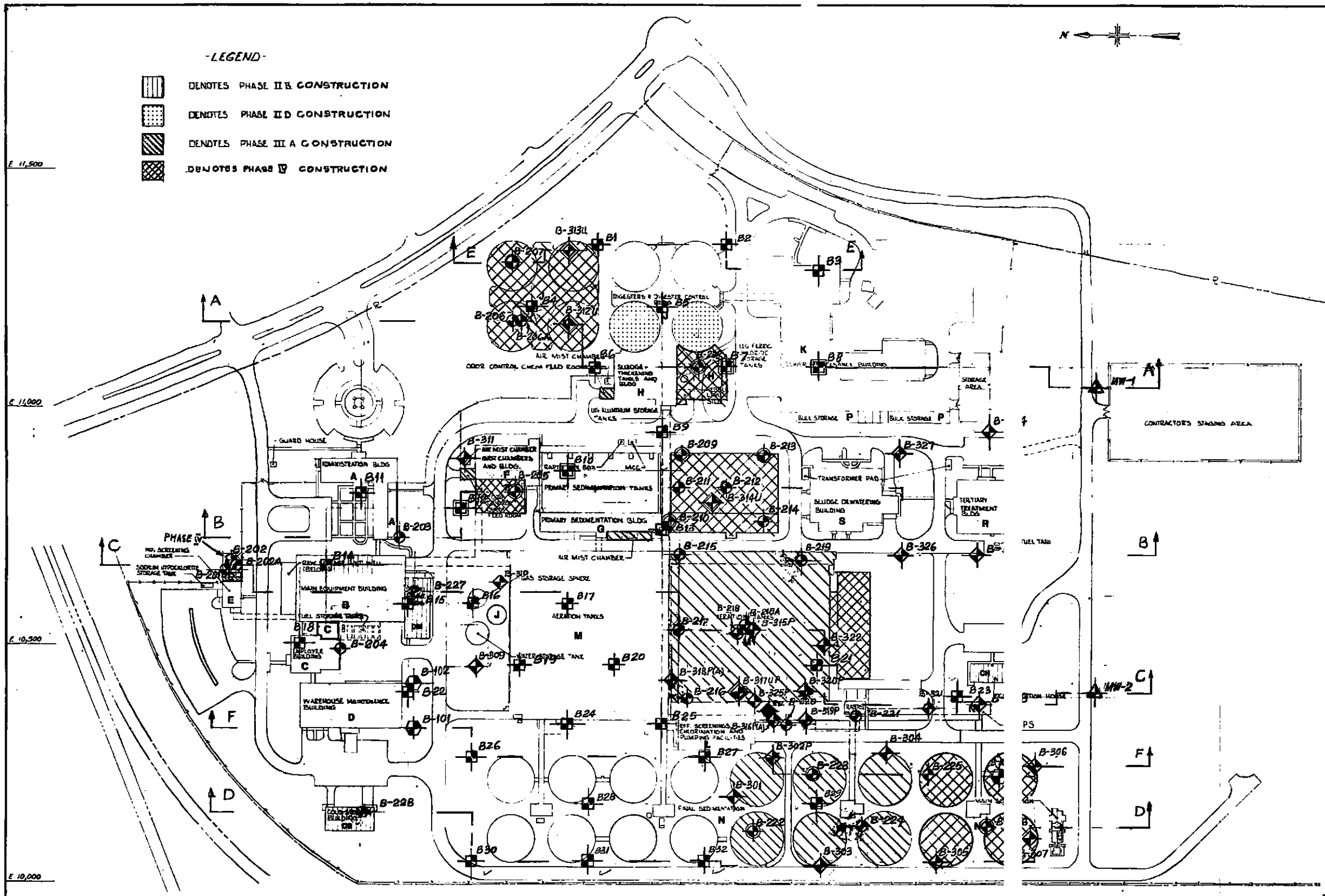
-LEGEND-

DENOTES PHASE II B CONSTRUCTION

DENOTES PHASE II D CONSTRUCTION

DENOTES PHASE III A CONSTRUCTION

DENOTES PHASE IV CONSTRUCTION



LEGEND

- 3-1/2" DIA. DRY SAMPLE BORING MADE IN 1985 BY WARREN GEORGE, INC., UNDER CONTINUOUS INSPECTION OF MECE.
- 3-1/2" DIA UNDISTURBED SAMPLE BORING MADE IN 1985 BY WARREN GEORGE, INC., UNDER CONTINUOUS INSPECTION OF MECE.
- PUMP WELL INSTALLED IN 1985 BY MORETRENCH AMERICAN CORP., UNDER CONTINUOUS INSPECTION OF MECE.
- DRY SAMPLE BORING MADE IN 1983 BY WARREN GEORGE, INC., FOR CONVERSE CONSULTANTS, INC.
- UNDISTURBED SAMPLE BORING MADE IN 1983 BY WARREN GEORGE, INC., FOR CONVERSE CONSULTANTS, INC.
- DRY SAMPLE BORING MADE IN 1983 BY SLACKE TEST BORING CO., INC., FOR CONVERSE CONSULTANTS, INC.
- DRY SAMPLE BORING MADE IN 1966 BY W.H. WALSH CO., INC.
- UNDISTURBED SAMPLE BORING MADE IN 1966 BY W.H. WALSH CO., INC.
- GROUNDWATER MONITORING WELL INSTALLED IN 1983 BY WARREN GEORGE, INC., FOR CONVERSE CONSULTANTS, INC.

GENERAL NOTES

1. BASE PLAN FOR DWG. NO. S-1 TITLED "SITE PLAN", UNDATED, WAS PROVIDED BY MALCOLM PIRNIE, INC.
2. ALL 300 SERIES BORINGS WERE MADE BY WARREN GEORGE, INC., BETWEEN FEBRUARY 13, AND FEBRUARY 28, 1985, UNDER CONTINUOUS INSPECTION OF MECE.
3. PUMP WELL WAS INSTALLED BY MORETRENCH AMERICAN CORP., ON FEBRUARY 21 AND 22, 1985, UNDER CONTINUOUS INSPECTION OF MECE.
4. ALL 100 SERIES AND 200 SERIES BORINGS, PLUS GROUNDWATER MONITORING WELLS (SERIES MW), WERE MADE IN 1983 FOR CONVERSE CONSULTANTS, INC., BY SLACKE TEST BORING CO., INC. AND WARREN GEORGE, INC., RESPECTIVELY. SINGLE AND DOUBLE DIGIT B SERIES BORINGS WERE MADE IN 1966 BY W.H. WALSH COMPANY INC.
5. ELEVATIONS AND COORDINATES OF 300 SERIES BORINGS WERE PROVIDED BY CEDAR CREEK WPCP PERSONNEL. ELEVATIONS REFER TO NASSAU COUNTY DATUM, IN WHICH ELEVATION 0 IS MEAN SEA LEVEL, SANDY HOOK, N.J.
6. STRATIFICATIONS SHOWN ON DWGS. GS-1P, GS-1, GS-2 AND GS-3 ARE NECESSARY INTERPOLATIONS BETWEEN BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS. FOR INDIVIDUAL SOIL CLASSIFICATIONS SEE MECE BORING LOGS.
7. GROUNDWATER LEVELS WERE NOT MEASURED IN 1966 AND 1983 BORINGS EXCEPT WHERE PIEZOMETERS WERE INSTALLED.

NOTES:

1. FOR GEOLOGIC SECTIONS, SEE DWGS. NOS. GS-1P, GS-1, GS-2 AND GS-3.

GRAPHIC SCALE

100' 50' 0' 100' 200'

MUESER RUTLEDGE CONSULTING ENGINEERS

708 THIRD AVENUE, NEW YORK, N.Y. 10017

SCALE	MADE BY	DATE	FILE NO
GRAPHIC	M.G.	3-28-85	6102
	CHKD BY F.A.	DATE 3-28-85	DRAWING NO

BORING LOCATION PLAN — B-1

MALCOLM PIRNIE

REVISIONS			
NO.	BY	DATE	REMARKS

DES

DWN PJT

CKD

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK W.P.C.P. IMPROVEMENTS

SITE PLAN

SCALE 1'-100'

MALCOLM PIRNIE, INC.

DATE

SHEET OF

DWG NO.

Nassau County DPW

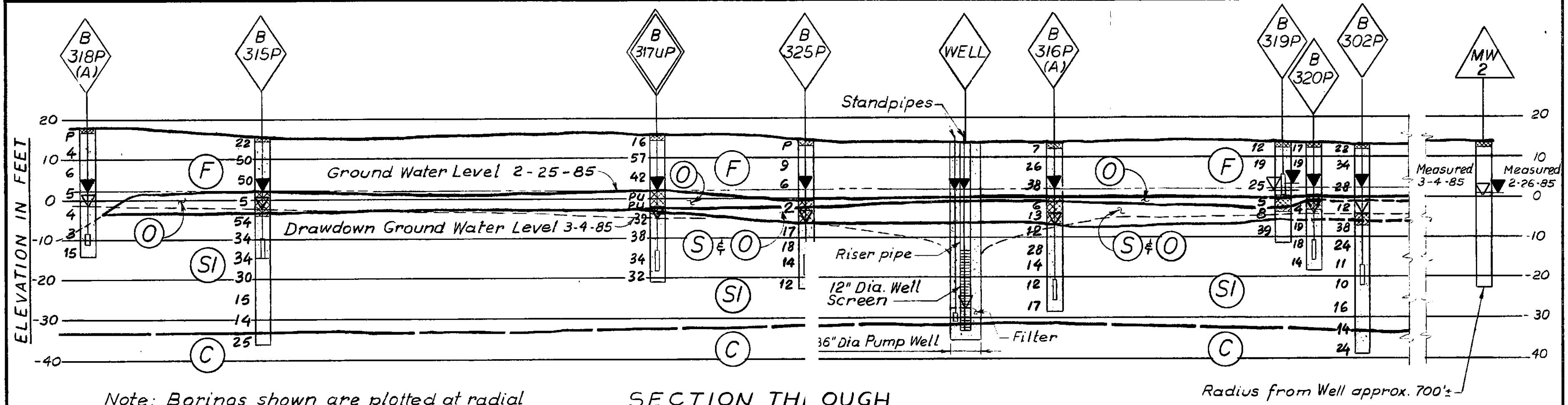
TABLE NO. 1
SURVEY DATA FOR BORINGS

BORING NO.	COORDINATES NORTH	EAST	GROUND SURFACE ELEVATION (FT.)
B-301	N. 9204	E. 10181	13.8
B-302P	N. 9124	E. 10263	13.0
B-303	N. 9020	E. 10037	12.4
B-304	N. 8891	E. 10273	13.3
B-305	N. 8783	E. 10045	14.5
B-306	N. 8571	E. 10249	13.6
B-307	N. 8586	E. 10093	14.7
B-308	N. 8700	E. 10374	13.4
B-309	N. 9753	E. 10456	16.7
B-310	N. 9702	E. 10631	16.5
B-311	N. 9781	E. 10890	15.3
B-312 U	N. 9555	E. 11171	14.4
B-313 U	N. 9555	E. 11327	16.1
B-314 U	N. 9256	E. 10801	18.3
B-315P	N. 9169	E. 10532	15.5
B-316 P(A)	N. 9120	E. 10343	13.7
B-317 UP	N. 9198	E. 10403	16.1
B-318 P(A)	N. 9340	E. 10435	18.0
B-319 P	N. 9053	E. 10345	13.8
B-320 P	N. 9057	E. 10405	13.6
B-321	N. 8797	E. 10366	13.8
B-322	N. 9014	E. 10500	15.4
B-323	N. 8695	E. 10686	14.5
B-324	N. 8675	E. 10945	14.8
B-325 P	N. 9165	E. 10382	14.5
B-326	N. 8860	E. 10691	14.7
B-327	N. 8860	E. 10901	13.9

NOTE:

THE ABOVE ELEVATIONS AND COORDINATES WERE PROVIDED BY CEDAR CREEK WPCP PERSONNEL. ELEVATIONS REFER TO NASSAU COUNTY DATUM, IN WHICH ELEVATION 0.0 IS MEAN SEA LEVEL, SANDY HOOK, N.J.

CEDAR CREEK WPCP
MRCE NO. 6102



Note: Borings shown are plotted at radial distance from Well.

SECTION THROUGH PUMP WELL

GENERAL STRATA DESCRIPTIONS

(F) FILL-COMPACT TO LOOSE GRAY AND BROWN FINE TO MEDIUM SAND, TRACE SILT, GRAVEL.

(O) ORGANIC SILTY CLAY AND PEAT-STIFF TO MEDIUM DARK GRAY ORGANIC SILTY CLAY AND BROWN PEAT, TRACE TO SOME FINE SAND.

(S & O) SAND MIXED WITH ORGANIC SILTY CLAY-MEDIUM COMPACT GRAY FINE TO MEDIUM SAND WITH SOME TO TRACE DARK GRAY ORGANIC SILTY CLAY POCKETS AND LAYERS.

(S1) SAND-MEDIUM COMPACT GRAY FINE TO MEDIUM SAND, TRACE TO SOME COARSE SAND, TRACE GRAVEL, SILT.

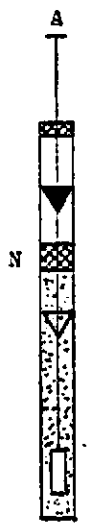
(C) CLAY-HARD TO STIFF GRAY SILTY CLAY, TRACE FINE SAND.

(S2) SILTY SAND-MEDIUM COMPACT TO VERY COMPACT GRAY SILTY FINE TO MEDIUM SAND, OCCASIONALLY INTERBEDDED WITH SILTY CLAY AND/OR GRAVEL.

NOTES:

1. BORINGS SHOWN ARE ONLY THOSE PIE METER HOLES USED DURING THE PUMP TEST. OTHER BOR GS ARE NOT SHOWN.
2. FOR BORING LOCATION PLAN AND GEN AL NOTES, SEE DWG, NO. B-1.
3. ADDED STANDARD PENETRATION RESIS NCES AND REVISED GENERAL STRATA DESCRIPTIONS AND TES.

LEGEND



A NUMBER, TYPE AND LOCATION OF BORING.

N STANDARD PENETRATION RESISTANCE.

(PU) PUSHED UNDISTURBED SAMPLE)

IMPERVIOUS SEAL.

SAND FILTER SURROUNDING PIEZOMETER INTAKE POINT.

PIEZOMETER INTAKE POINT.

STATIC WATER LEVEL BEFORE START OF PUMPING TEST.

DRAWNDOWN WATER LEVEL AT END OF PUMPING TEST.

REV.	DATE	REVISION	BY
1	3-29-85	REVISED AS NOTE NO.3	M.G.

CEDAR CREEK WPCP
WANTAGH N.Y.

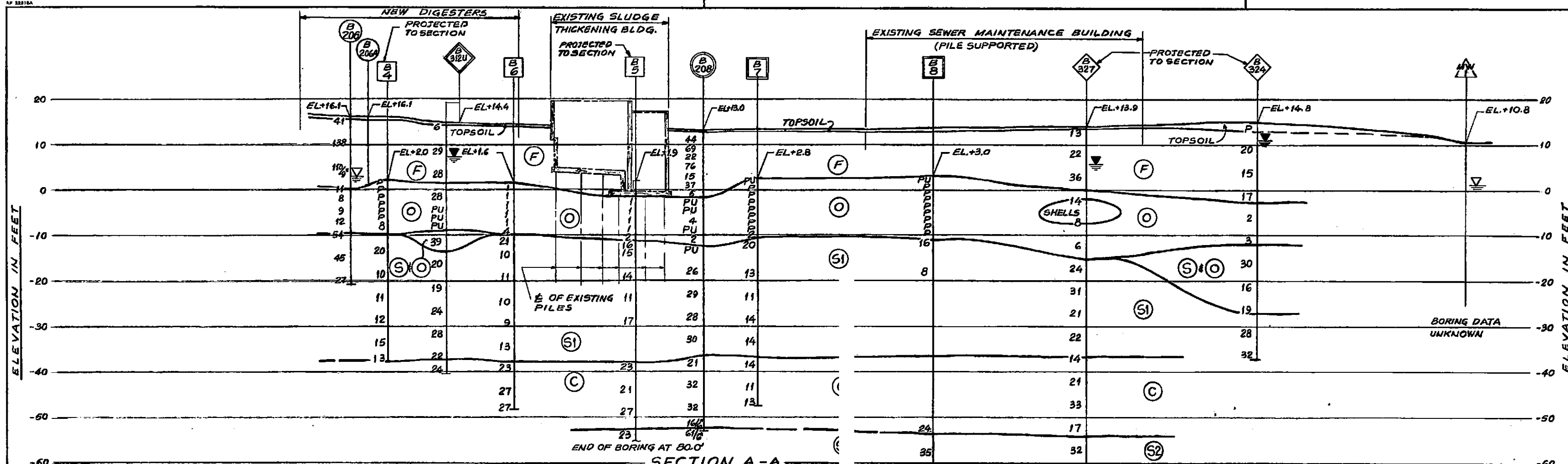
MALCOLM PIRNIE, INC.
WHITE PLAINS N.Y.

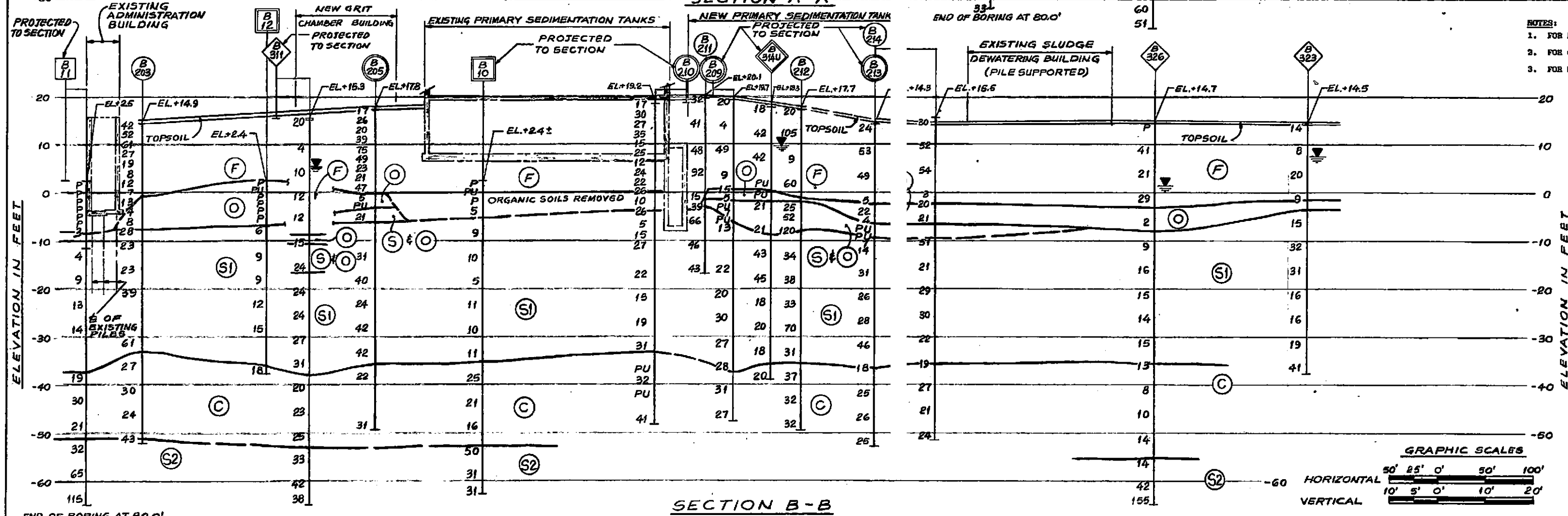
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SCALE	MADE BY	DATE	FILE NO.
1"=20'	O.E.V.	3-11-85	6102
	CHKD BY F.A.	DATE 3-11-85	

GEOLOGIC SECTION — DRAWING NO. GS-1P

S3C067-11G
Page 2498 of 2953
Nassau County DPW





NOTES:

1. FOR BORING LOCATION PLAN AND GENERAL NOTES, SEE DWG. NO. B-1.
2. FOR GENERAL STRATA DESCRIPTIONS, SEE DWG. NO. GS-1P.
3. FOR BORING LEGEND, SEE DWG. NO. GS-3.

GRAPHIC SCALES

HORIZONTAL 50' 25' 0' 50' 100'

VERTICAL 10' 5' 0' 10' 20'

CEDAR CREEK W.P.C.P.

WANTAGH NEW YORK

MALCOLM PIRNIE, INC.

WHITE PLAINS NEW YORK

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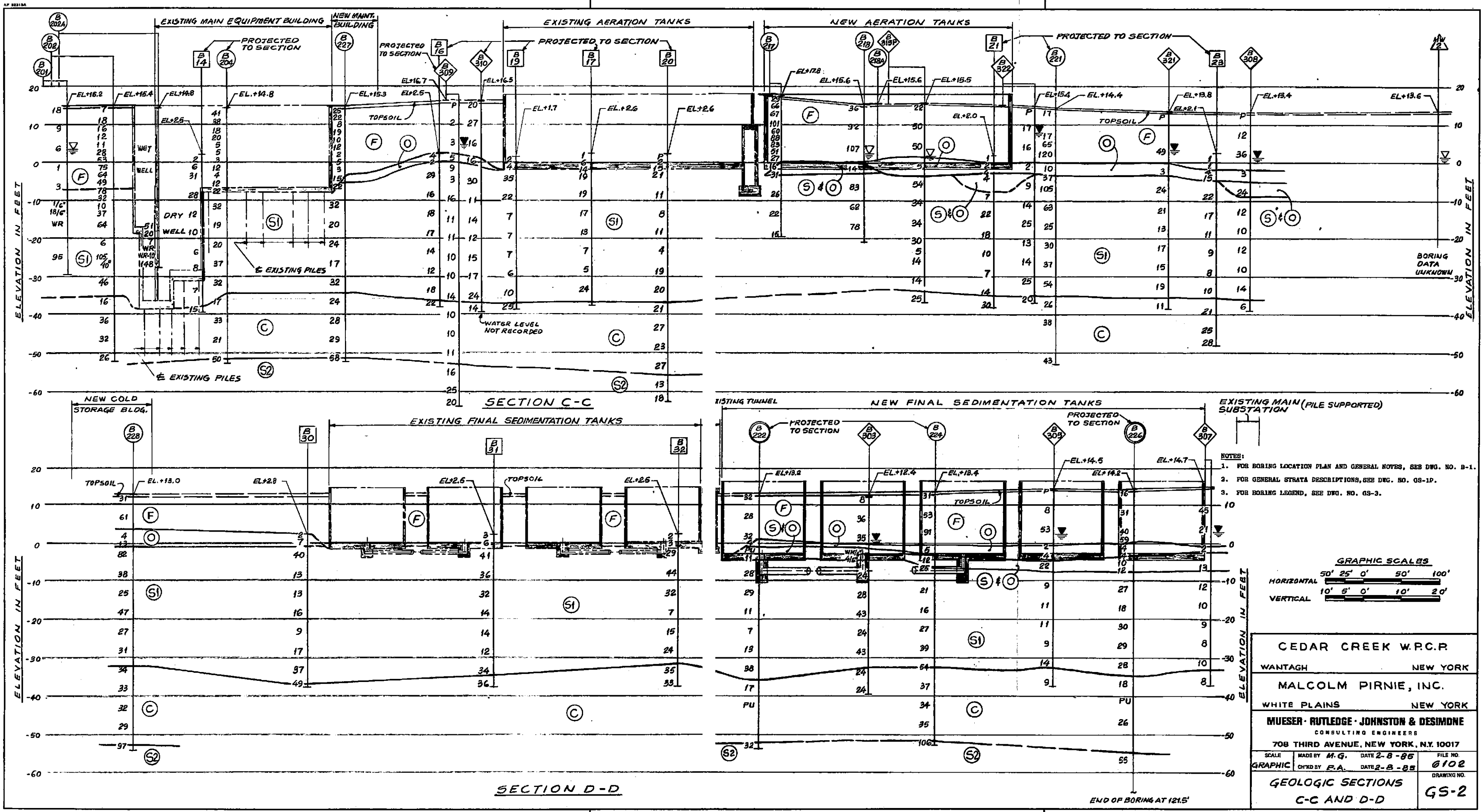
708 THIRD AVENUE, NEW YORK, N.Y. 10017

SCALE	MADE BY	DATE	FILE NO.
GRAPHIC	M.G.	2-8-85	6102
	CHK'D BY R.A.	DATE 2-8-85	DRAWING NO.

GEOLOGIC SECTIONS A-A AND B-B

GS-1

S3C067-11G
Page 2499 of 2953
Nassau County DPW



NOTES:

1. FOR BORING LOCATION PLAN AND GENERAL NOTES, SEE DWG. NO. B-1.
2. FOR GENERAL STRATA DESCRIPTIONS, SEE DWG. NO. GS-1P.
3. FOR BORING LEGEND, SEE DWG. NO. GS-3.

GRAPHIC SCALES

HORIZONTAL 50' 25' 0' 50' 100'

VERTICAL 10' 5' 0' 10' 20'

CEDAR CREEK W.P.C.P.

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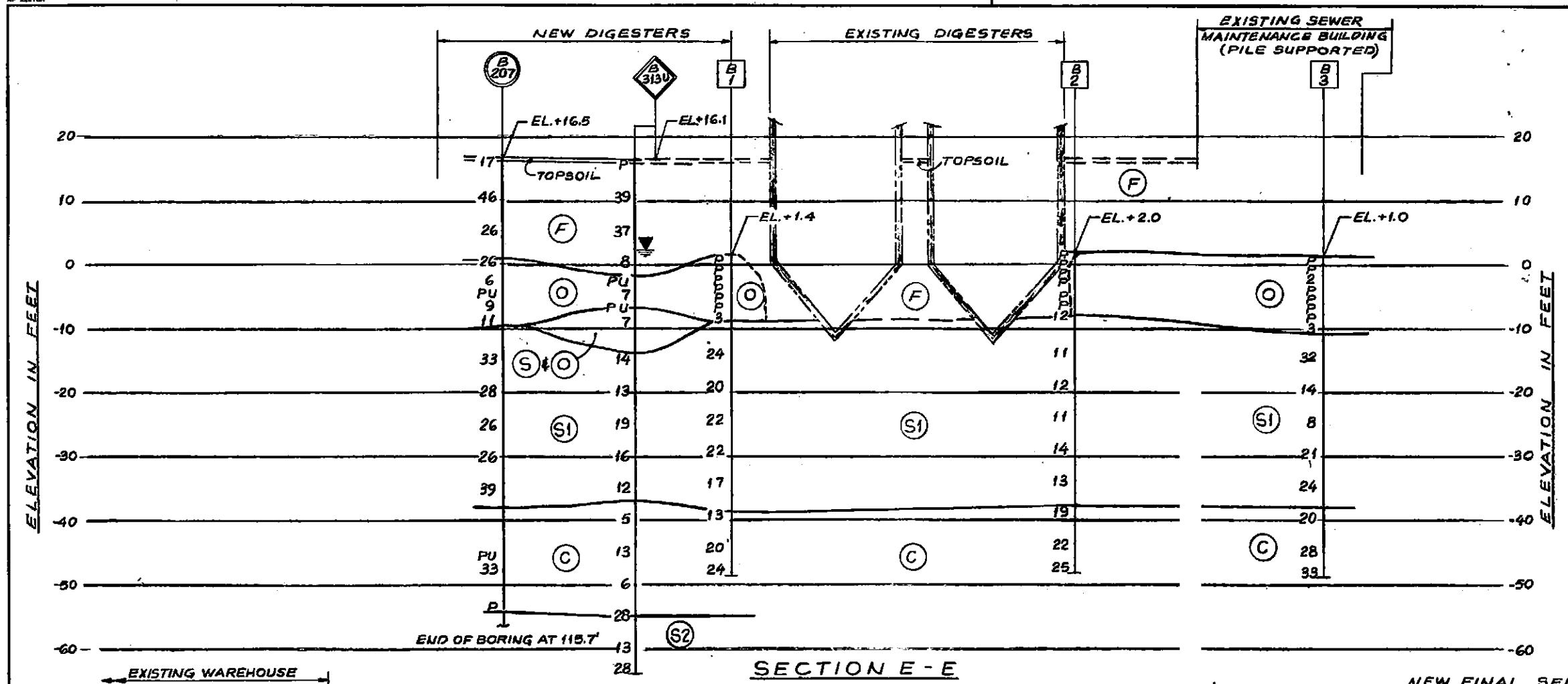
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GRAPHIC	CHKD BY P.A.	DATE 2-8-88	6102

DRAWING NO. GS-2

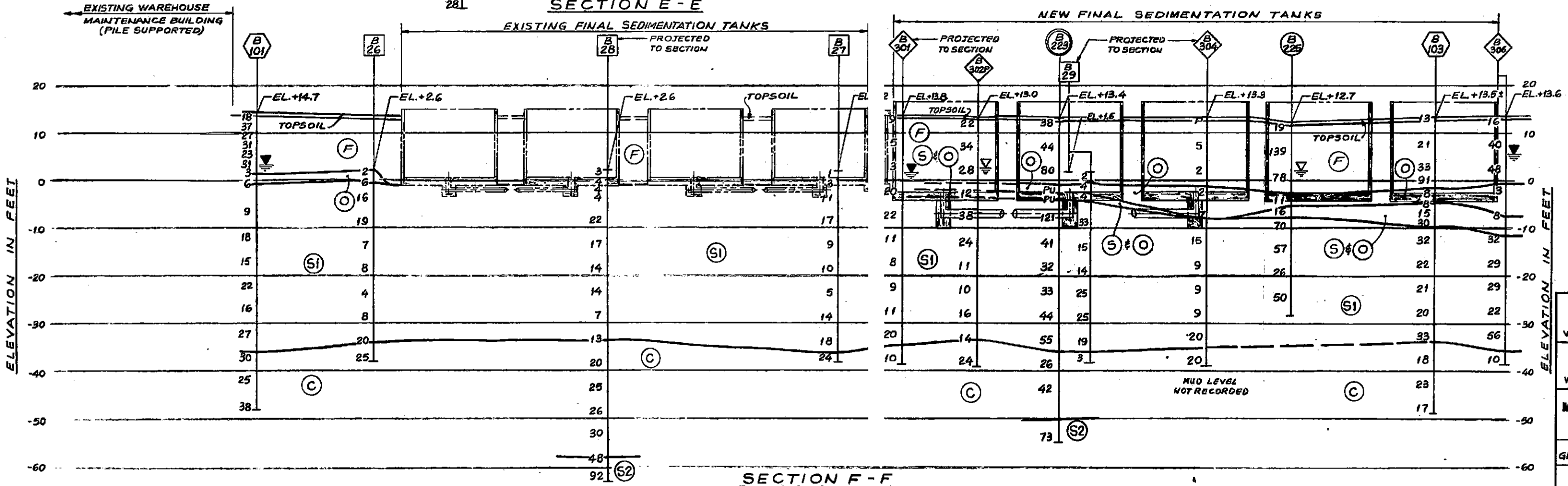
GEOLOGIC SECTIONS C-C AND D-D

S3C067-11G
Page 2500 of 2953
Nassau County DPW

S3C067-11G



SECTION E-E



SECTION F-F

BORING LEGEND

A — NUMBER, TYPE AND LOCATION OF BORING.

EL. — GROUND SURFACE ELEVATION AT BORING.

N — STANDARD PENETRATION RESISTANCE. NUMBER OF BLOWS FROM 140 LB. HAMMER FREE FALLING 30 INCHES, REQUIRED TO DRIVE 2 INCH O.D. SPLIT SPOON SAMPLER ONE FOOT AFTER INITIAL PENETRATION OF 6 INCHES, UNLESS A SPECIFIC PENETRATION IS INDICATED.

P PRESSED OR PUSH SPLIT SPOON SAMPLE.

PU PRESSED OR PUSH UNDISTURBED SAMPLE.

WH SAMPLE TAKEN UNDER WEIGHT OF HAMMER AND RODS.

WR SAMPLE TAKEN UNDER WEIGHT OF RODS.

— LEVEL OF DRILLING MUD OBSERVED IN BORING.

— GROUND WATER LEVEL OBSERVED IN PIEZOMETER.

NOTES:

1. FOR BORING LOCATION PLAN AND GENERAL NOTES, SEE DWG. NO. B-1.
2. FOR GENERAL STRATA DESCRIPTIONS, SEE DWG. NO. GS-1P.

GRAPHIC SCALES

HORIZONTAL 50' 25' 0' 50' 100'

VERTICAL 10' 5' 0' 10' 20'

CEDAR CREEK W.P.C.P.

WANTAGH NEW YORK

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708 THIRD AVENUE, NEW YORK, N.Y. 10017

SCALE	MADE BY M.G.	DATE 3-25-85	FILE NO.
GRAPHIC	CHKD BY F.A.	DATE 3-26-85	6102

GEOLOGIC SECTIONS E-E AND F-F

DRAWING NO. GS-3

Nassau County DPW

TABLE NO. 2
SUMMARY OF LABORATORY TEST DATA

SAMPLE IDENTIFICATION					CLASSIFICATION PROPERTIES								PHYSICAL PROPERTIES											
										UNIFIED SOIL CLASSIFICATION SYSTEM			STRENGTH						CONSOLIDATION						
BORING NUMBER	SAMPLE NUMBER	ELEVATION, FT.	STRATUM DESIGNATION	SOIL TYPE	AVERAGE NATURAL WATER CONTENT, w_n, %	LIQUID LIMIT, w_L, %	PLASTICITY INDEX, I_p, %	NATURAL WATER CONTENT OF LIMIT SAMPLE, w_n, %	SPECIFIC GRAVITY OF SOLIDS, G_s	GROUP SYMBOL	% SAND (#4 >#200 SIEVE)	% FINES (< #200 SIEVE)	TYPE OF TEST	COMPRESSIVE STRENGTH (σ_1-σ_3), TSF	CONFINING PRESSURE σ_3, TSF	STRAIN AT FAILURE, %	NATURAL WATER CONTENT, w_n, %	WATER CONTENT AT END OF TEST, w_f, %	NATURAL WATER CONTENT, w_n, %	INITIAL VOID RATIO, e_o	EXISTING OVERBURDEN STRESS, P_o, TSF	ESTIMATED PRECONSOLIDATION STRESS, P_c, TSF	COMPRESSION INDEX, C_c	SWELLING INDEX, C_s	VOID RATIO AT START OF SWELL, e_f
312U	5U	-4.4	0		64	91	42	64.6	2.66	OH			UU	0.78	0.89	9.9	65.3	64.4	66.8	1.733	0.89	1.75	0.718	0.105	0.959
	6U	-6.6	0		72	90	46	62.8	2.67	OH			UU	1.01	0.93	9.9	61.4	60.7	63.2	1.716	0.93	1.50	0.646	0.100	0.990
	7U	-8.6	0		93	118	73	78.9		OH-CH SM			UU	0.41	0.97	7.6	104.7	103.3							
313U	5U	-2.8	0		136	221	115	145.7	2.15	Pt OH			UU	1.33	0.98	6.3	137.6	136.1	163.7	3.670	0.98	1.4	2.16	0.38	1.924
	7U	-6.8	0		115	309	128	221.7	2.27	Pt OH SM			UU	1.76	1.05	4.9	95.7	96.0	159.4	3.696	1.06	2.15	2.34	0.32	1.784
314U	5U	-0.7	0		137	151	80	61.1	2.44	OH			UNC	1.72	0	12.9	158.7	156.5	121.3	3.147	1.04	1.4	1.51	0.31	1.495
													UU	1.22	1.04	13.5	128.3	126.1							
317UP	4U	+0.2	0		130	205	72	140.6	1.96	Pt			UU	2.57	0.89	19.9	156.0	143.3	203.4	4.138	0.89	1.6	2.51	0.40	1.670
	5U	-1.7	S&D							SM															

STRATA DESCRIPTION

STRATUM ⓪ - Medium to stiff dark gray organic silty clay and brown peat, trace fine sand.

NOTES

1. All tests summarized were performed in the soil laboratory of Mueser Rutledge Consulting Engineers.
2. The sample elevation is the average of the sampling interval.
3. Ground surface elevations at borings are:

BORING NO.	ELEVATION FT.	BORING NO.	ELEVATION FT.
312U	14.4	314U	18.3
313U	16.1	317U	16.1

NOTES

4. "Average natural water content" is a weighted average of all material types recovered.
5. Compression tests performed were;
   UNC - Unconfined Compression
   UU - Unconsolidated Undrained Triaxial Compression
6. Strength tests were performed on samples approximately 2.8 inches in diameter with a height-to-diameter ratio of 2, at a rate of strain of approximately 1% per minute.
7. Compression Index, C_c = the slope of the virgin curve (straight line portion of the consolidation test e-log p plot).
   $e_2 = e_1 - C_c \times \log (P_2/P_1)$
8. Swelling Index, C_s = the slope of the rebound curve of the consolidation test.
   $e_2 = e_1 + C_s \times \log (P_1/P_2)$

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708 THIRD AVENUE, NEW YORK, N.Y. 10017

CEDAR CREEK WPCP
WANTAGH NEW YORK

DATE: 3-22-85 FILE NO. 6102 SHEET 1 OF 1 TABLE NO. 2

GROUND SURFACE

EFFECTIVE OVERBURDEN STRESS
BORING B-312U
BORING B-313U

0.89 0.98
0.93 1.06
0.97

WL 309

B-312U
GROUND SURFACE ELEVATION= 14.4'

B-313U
GROUND SURFACE ELEVATION= 16.1'

1D F
2D
3D
4D O
5U
6U
7U S&O
8D
9D
10D S1
11D
12D
13D
14D C

BOTTOM OF BORING AT EL.-40.6'

BOTTOM OF BORING AT ELEV. -63.9'

DESCRIPTIONS OF STRATA

0.5 1.0 1.5 2.0 2.5
OVERBURDEN & PRECONSOLIDATION STRESSES AND COMPRESSIVE STRENGTH—TONS PER SQ. FT.

40 80 120 160 200
NATURAL WATER CONTENTS AND PLASTICITY LIMITS—PER CENT OF DRY WEIGHT

BORINGS
O_x 312U
$\square_x$ 313U
X

▼ - GROUND WATER LEVEL OBSERVED IN BORING

RANGE OF PRECONSOLIDATION STRESS VALUES:
MINIMUM POSSIBLE — MOST PROBABLE

Unconsolidated Undrained Triaxial Compression Test
Confining Pressure σ_3 tsf.

⊙ - AVERAGE NATURAL WATER CONTENT OF ENTIRE UNDISTURBED SAMPLE
⊙ - NATURAL WATER CONTENT OF DRY SAMPLE OR NATURAL WATER CONTENT OF PORTION OF UNDISTURBED SAMPLE

PLASTIC LIMIT — LIQUID LIMIT
NATURAL WATER CONTENT OF LIMIT SPECIMEN

ELEVATION
SAMPLE NUMBER AND POSITION

CEDAR CREEK WPCP
Wantagh New York

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708 THIRD AVENUE NEW YORK, N.Y. 10017

MADE BY: CJM DATE: 3-15-85
CH'KD BY: RF DATE: 3-18-85

FILE NO. 6102

SOIL PROPERTIES PROFILE
BORINGS B-312U & B-313U

PLATE NO. 2

No. PR-1

S3C067-11G

Page 2503 of 2953

Nassau County DPW

GROUND SURFACE

EFFECTIVE OVERBURDEN STRESS
BORING B-317UP
BORING B-314U

.04

0.89

0.5 1.0 1.5 2.0 2.5

OVERBURDEN & PRECONSOLIDATION STRESSES AND COMPRESSIVE STRENGTH—TONS PER SQ. FT.

40 80 120 16 200

NATURAL WATER CONTENTS AND PLASTICITY LIMITS—PER CENT OF DRY EIGHT

30
20
10
0
10
20
30
40

GROUND SURFACE ELEVATION =

B-314U

GROUND SURFACE ELEVATION = 18.3'

1D 2D 3D 4UD 5U 6D 7D 8D 9D 10D 11D 12D 13D

F

O

S&O

S1

C

BOTTOM OF BORING AT EL.-38.7'

B-317UP

GROUND SURFACE ELEVATION = 16.1'

1D 2D 3D 4U 5U 6D 7D 8D 9D

F

O

S&O

S1

BOTTOM OF BORING AT EL.-20.9'

DESCRIPTIONS OF STRATA

BORINGS

314U ○
317UP □

▼ — GROUND WATER LEVEL OBSERVED IN BORING

RANGE OF PRECONSOLIDATION STRESS VALUES:
MINIMUM POSSIBLE — MOST PROBABLE

○ Unconfined Compression Test

○x □x Unconsolidated Undrained Triaxial Compression Test

X Confining Pressure $\bar{\sigma}_3$ tsf.

⊙ AVERAGE NATURAL WATER CONTENT OF ENTIRE UNDISTU D SAMPLE
⊙ NATURAL WATER CONTENT OF DRY SAMPLE OR NATURA WATER
CONTENT OF PORTION OF UNDISTURBED SAMPL

PLASTIC LIMIT — L ID LIMIT

NATURAL WATER CONTENT OF LIMIT SPECIME

ELEVATION

SAMPLE NUMBER AND POSITION

CEDAR CREEK WPCP

Wantagh New York

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708 THIRD AVENUE NEW YORK, N.Y. 10017

MADE BY: CJM DATE: 3-15-85
CH'KD BY: RF DATE: 3-18-85

FILE NO. 6102

SOIL PROPERTIES PROFILE
BORINGS B-314U & B-317UP

PLATE NO. 3

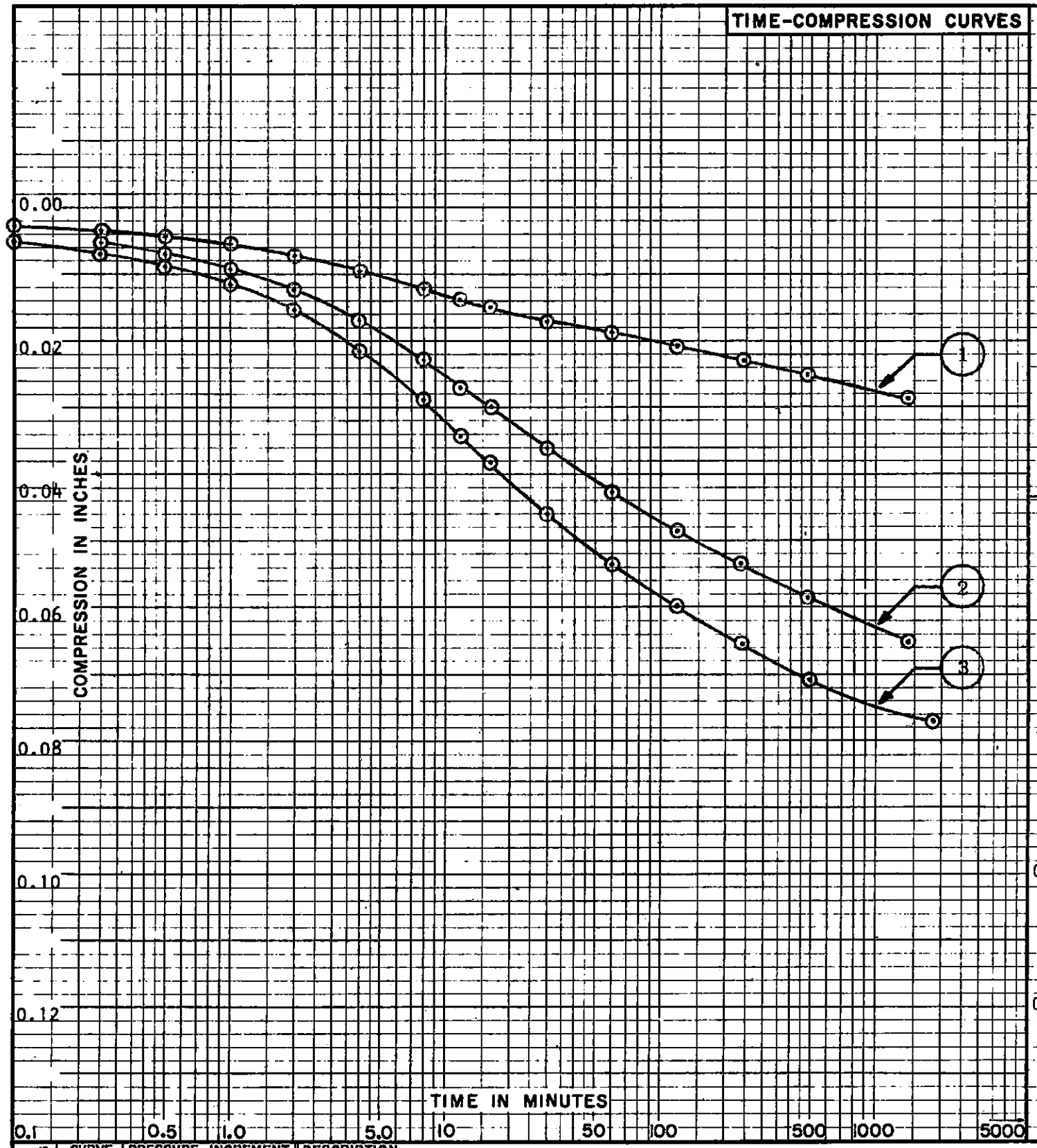
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S3C067-11G

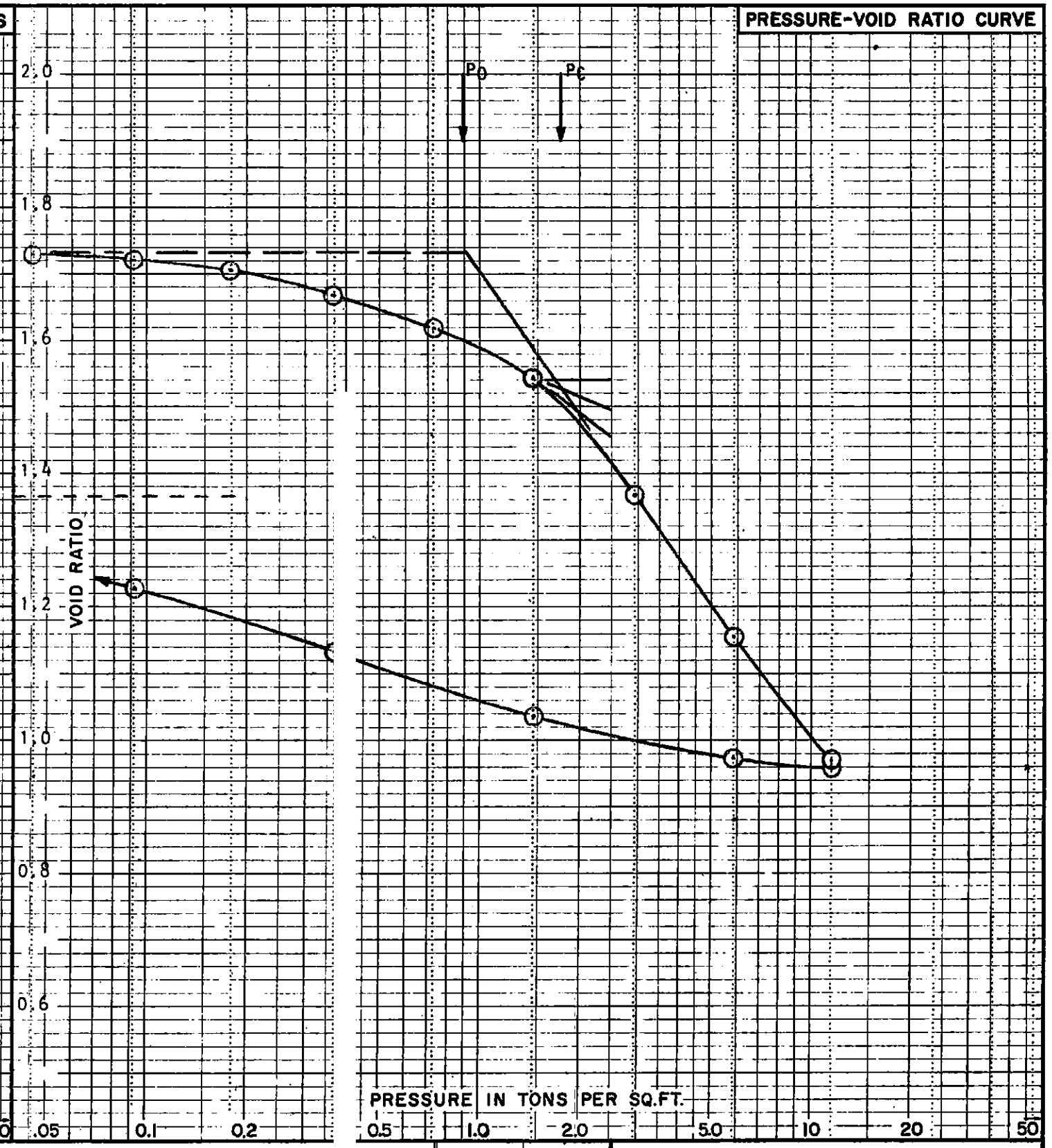
Page 2504 of 2953

Nassau County DPW

TIME-COMPRESSION CURVES



PRESSURE-VOID RATIO CURVE



S3C067-11G

PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES

CURVE NUMBER	PRESSURE FROM (TSF)	INCREMENT TO (TSF)
①	0.733	1.47
②	1.47	2.93
③	2.93	5.87
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: Medium dark gray organic silty clay

PROPERTIES OF PLASTICITY LIMIT SPECIMEN

UNIFIED CLASSIFICATION	OH
LIQUID LIMIT (w_L)	91
PLASTIC LIMIT (w_p)	49
PLASTICITY INDEX (I_p)	42
NATURAL WATER CONT. % (w)	64.6
LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.37
SPECIFIC GRAVITY (G_s)	2.66

PROPERTIES OF CONSOLIDATION SPECIMEN

ELEVATION OF SPECIMEN	-4.6
DEPTH OF SPECIMEN (FT.)	19.0
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	0.99
INITIAL WATER CONTENT %	65.8
FINAL WATER CONTENT %	51.7
INITIAL DEGREE SATURATION %	101
FINAL DEGREE SATURATION %	101

	STRATUM	0
INITIAL VOID RATIO (e_o), SHOWN THUS: ———		1.733
FINAL VOID RATIO (e_f), SHOWN THUS: - - - - - -		1.366
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) SHOWN THUS: P_c		1.75
EXISTING OVERBURDEN STRESS (TSF) SHOWN THUS: P_o		0.89
COMPRESSION INDEX (C_c)		0.718
SWELLING INDEX (C_s), REBOUND FROM e = 0.959		0.105

CEDAR CREEK WPCP

Wantagh New York

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CONSULTING ENGINEERS
708 THIRD AVENUE NEW YORK, N.Y. 10017

MADE BY: CJM DATE: 3-26-85
CH'KD BY: FA DATE: 3-29-85

FILE NO. 6102

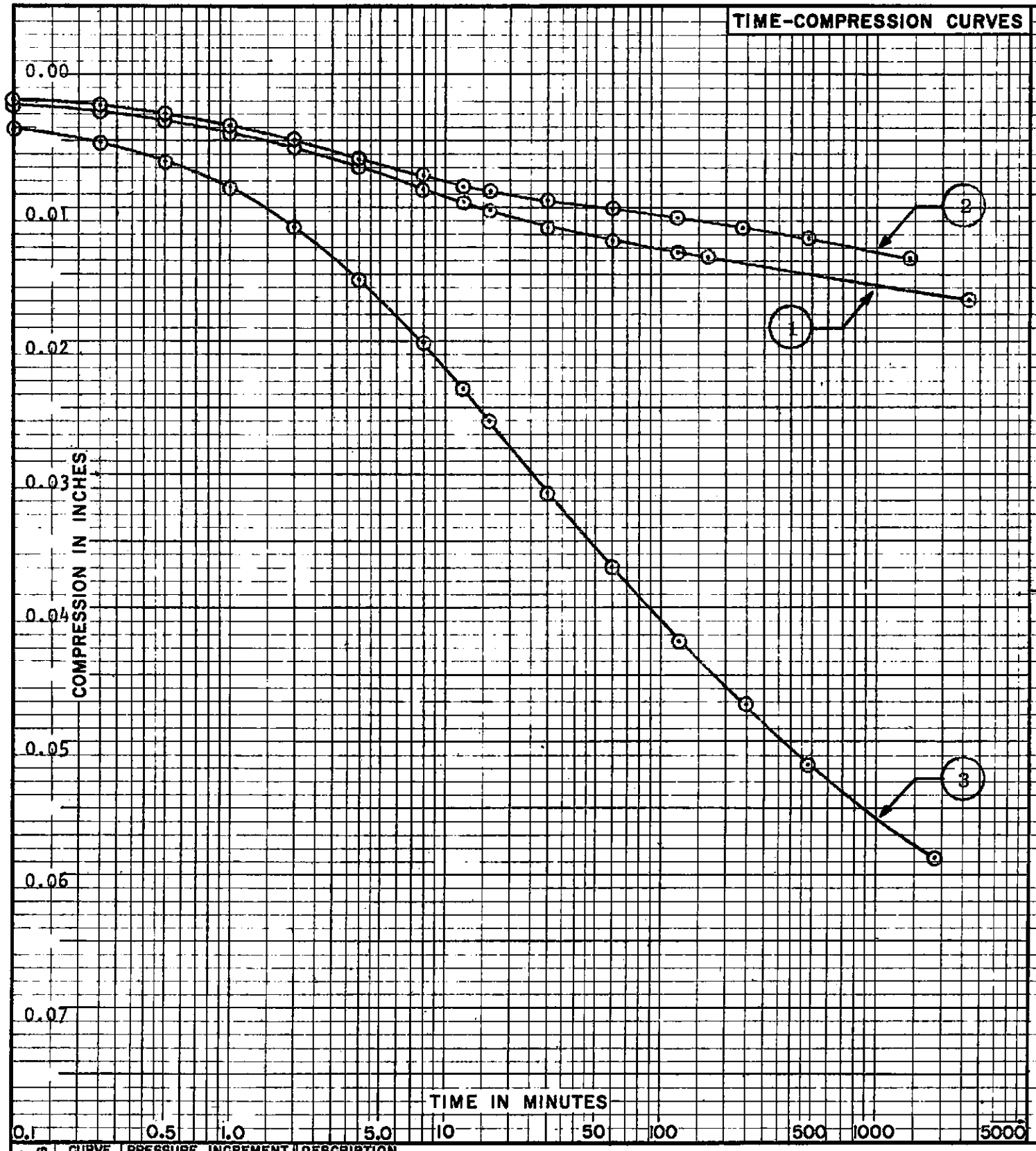
CONSOLIDATION TEST

BORING NO. B-312U SAMPLE NO. 5U

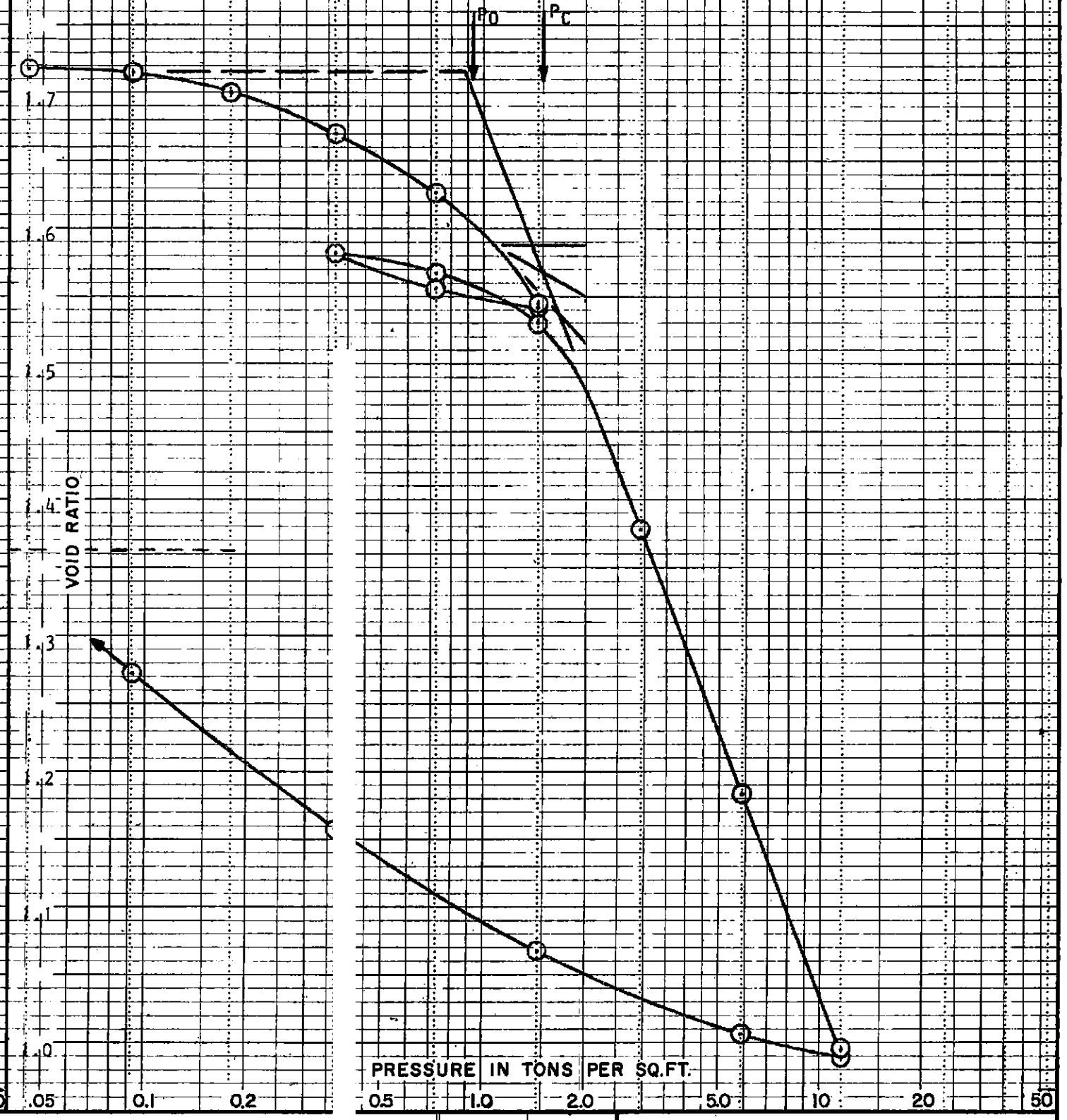
PLATE NO. 4

Nassau County DPW

TIME-COMPRESSION CURVES



PRESSURE-VOID RATIO CURVE



PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES	CURVE NUMBER	PRESSURE FROM (TSF)	INCREMENT TO (TSF)
	①	0.367	0.733
	②*	0.733*	1.47*
	③	1.47	2.93
	④		
	⑤		
	⑥		
	⑦		
	⑧		

DESCRIPTION OF SPECIMEN: Stiff dark gray organic silty clay

PROPERTIES OF PLASTICITY LIMIT SPECIMEN		
	UNIFIED CLASSIFICATION	OH
	LIQUID LIMIT (w_L)	90
	PLASTIC LIMIT (w_p)	44
	PLASTICITY INDEX (I_p)	46
	NATURAL WATER CONT. % (w)	62.8
	LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.41
	SPECIFIC GRAVITY (G_s)	2.67

PROPERTIES OF CONSOLIDATION SPECIMEN		
	ELEVATION OF SPECIMEN	-6.6
	DEPTH OF SPECIMEN (FT.)	21.0
	DIAMETER OF SPECIMEN (IN.)	2.50
	INITIAL THICKNESS OF SPECIMEN (IN.)	1.00
	INITIAL WATER CONTENT %	63.2
	FINAL WATER CONTENT %	50.8
	INITIAL DEGREE SATURATION %	98.4
	FINAL DEGREE SATURATION %	99.6

	STRATUM	0
INITIAL VOID RATIO (e_o), SH…N THUS: ———		1.716
FINAL VOID RATIO (e_f), SH…N THUS: - - - - -		1.362
MOST PROBABLE PRECONSOL…ATION STRESS (TSF) SHOWN THUS: P_c↓		1.50
EXISTING OVERBURDEN ST…SS (TSF) SHOWN THUS: P_o↓		0.93
COMPRESSION INDEX (C_c)		0.646
SWELLING INDEX (C_s), REBOUND FROM * 0.990		0.100
RECOMPRESSION INDEX (Cr)		0.074

CEDAR CREEK WPCP

Wantagh New York

MUESER · RUTLEDGE · JOHNSTON & DESIMONE
CONSULTING ENGINEERS
708 THIRD AVENUE NEW YORK, N.Y. 10017

MADE BY: CJM DATE: 3-29-85 FILE NO. 6102
CH'KD BY: GCB DATE: 4-01-85

CONSOLIDATION TEST

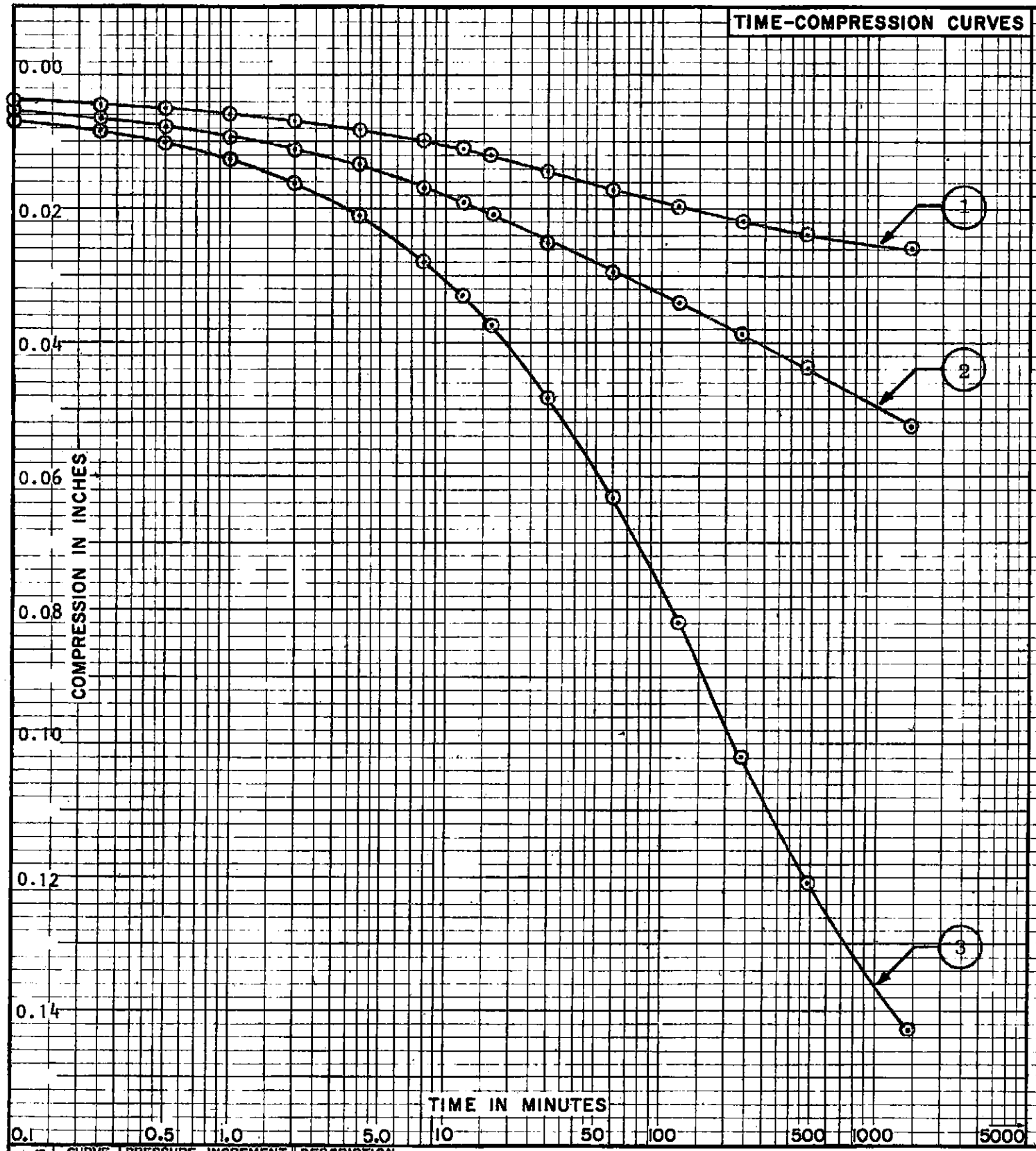
BORING NO. B-312U SAMPLE NO. 6U PLATE NO. 5

* INDICATES RECOMPRESSION

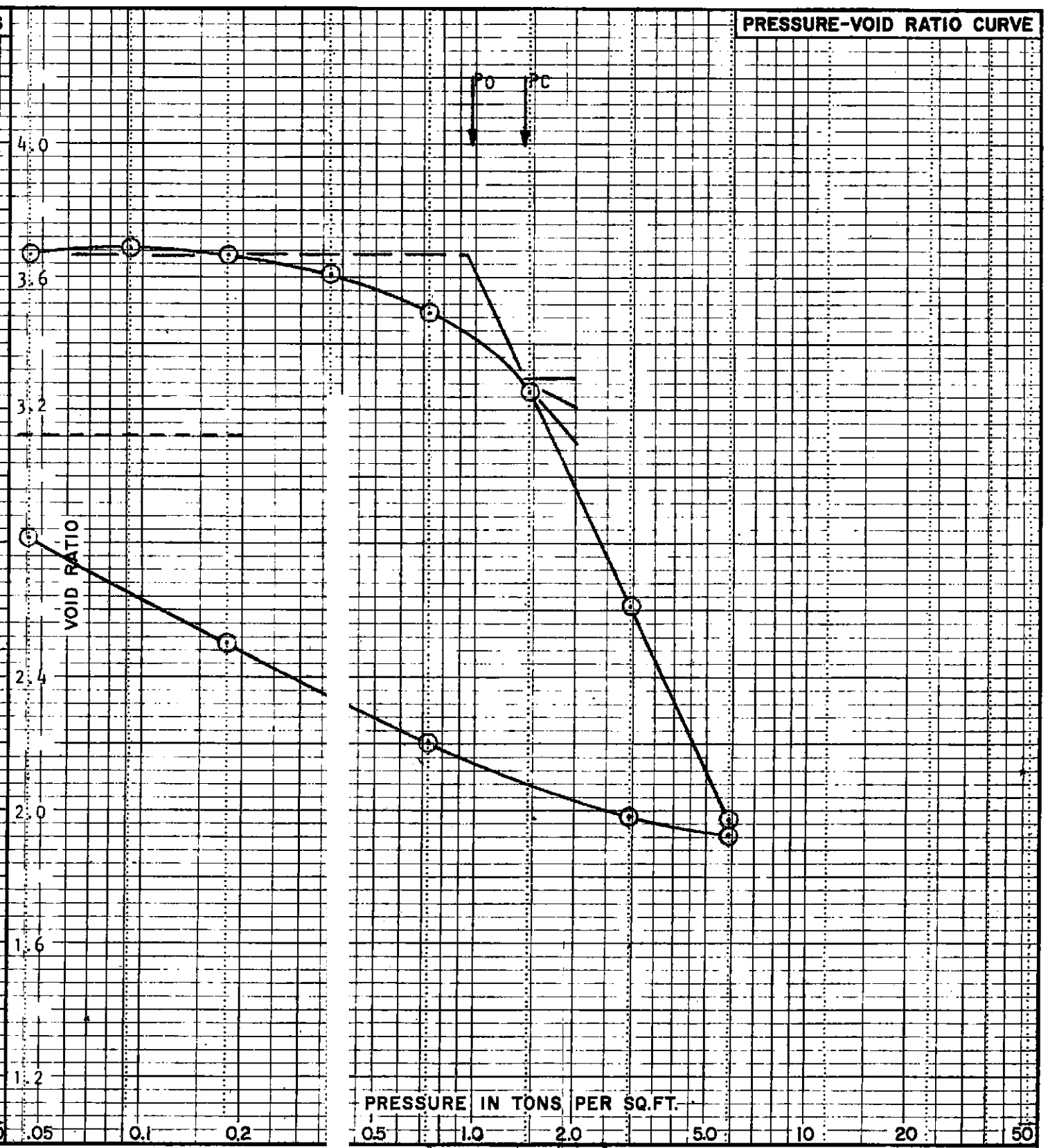
C-1

S3C067-11G
Page 2506 of 2953
Nassau County DPW

TIME-COMPRESSION CURVES



PRESSURE-VOID RATIO CURVE



PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES

CURVE NUMBER	PRESSURE FROM (TSF)	INCREMENT TO (TSF)
①	0.367	0.733
②	0.733	1.47
③	1.47	2.93
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: Brown peat

PROPERTIES OF PLASTICITY LIMIT SPECIMEN

UNIFIED CLASSIFICATION	Pt
LIQUID LIMIT (w_L)	221
PLASTIC LIMIT (w_p)	106
PLASTICITY INDEX (I_p)	115
NATURAL WATER CONT. % (w)	145.7
LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.35
SPECIFIC GRAVITY (G_s)	2.15

PROPERTIES OF CONSOLIDATION SPECIMEN

ELEVATION OF SPECIMEN	-2.2
DEPTH OF SPECIMEN (FT.)	18.3
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	1.00
INITIAL WATER CONTENT %	163.7
FINAL WATER CONTENT %	142.0
INITIAL DEGREE SATURATION %	95.9
FINAL DEGREE SATURATION %	97.8

INITIAL VOID RATIO (e_o), SHOWN THUS: ———	3.670
FINAL VOID RATIO (e_f), SHOWN THUS: - - - - - -	3.123
MOST PROBABLE PRECONSOLIDATION STRESS (TSF) SHOWN THUS P_c	1.4
EXISTING OVERBURDEN STRESS (TSF) SHOWN THUS P_o	0.98
COMPRESSION INDEX (C_c)	2.16
SWELLING INDEX (C_s), REBOUND FROM e = 1.924	0.38

STRATUM: 0

CEDAR CREEK WPCP

Wantagh New York

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708 THIRD AVENUE NEW YORK, N.Y. 10017

MADE BY: CJM DATE: 3-28-85
CH'KD BY: FA DATE: 3-29-85
FILE NO. 6102

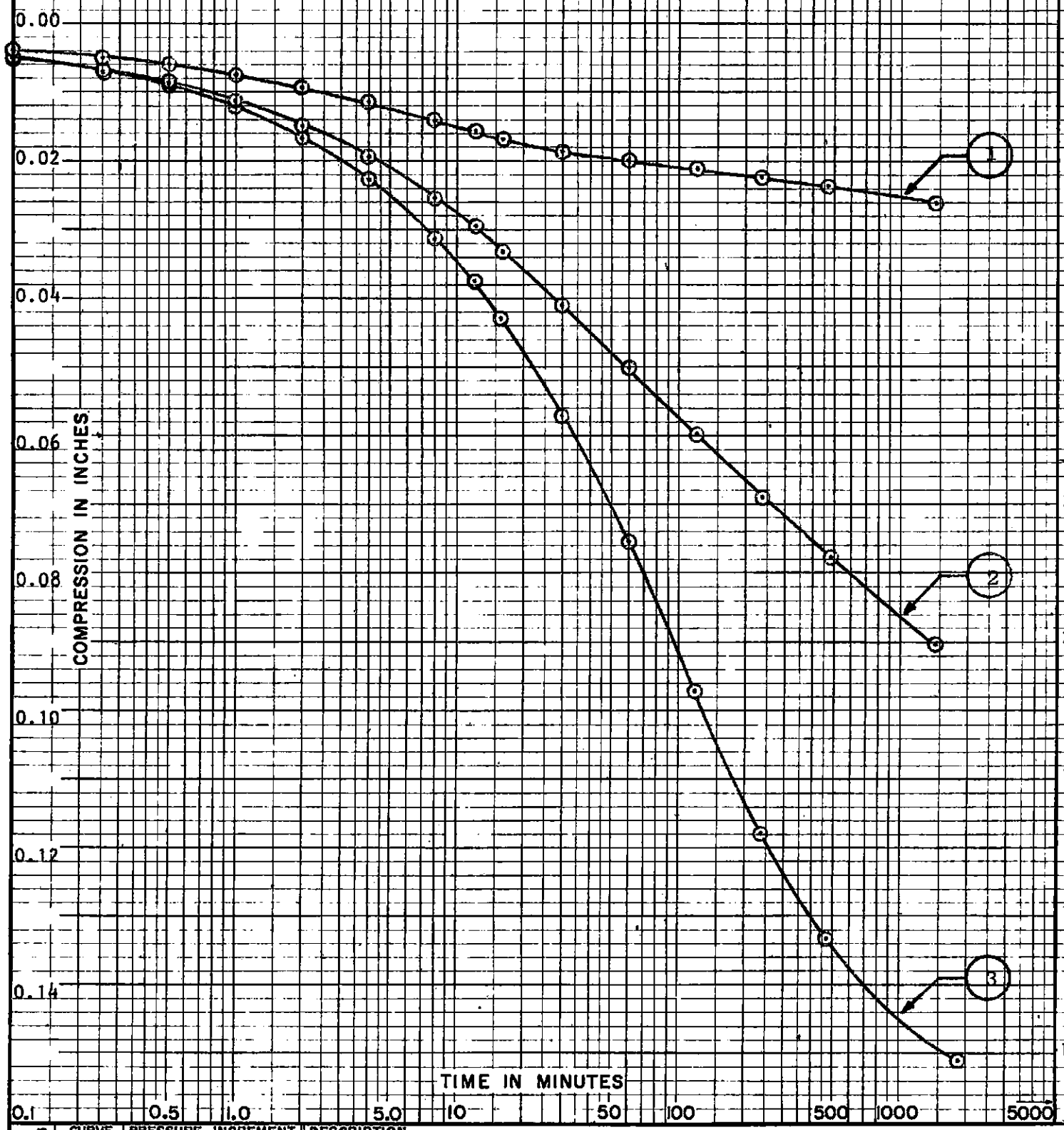
CONSOLIDATION TEST
BORING NO. B-313U SAMPLE NO. 5U
PLATE NO. 6

S3C067-11G

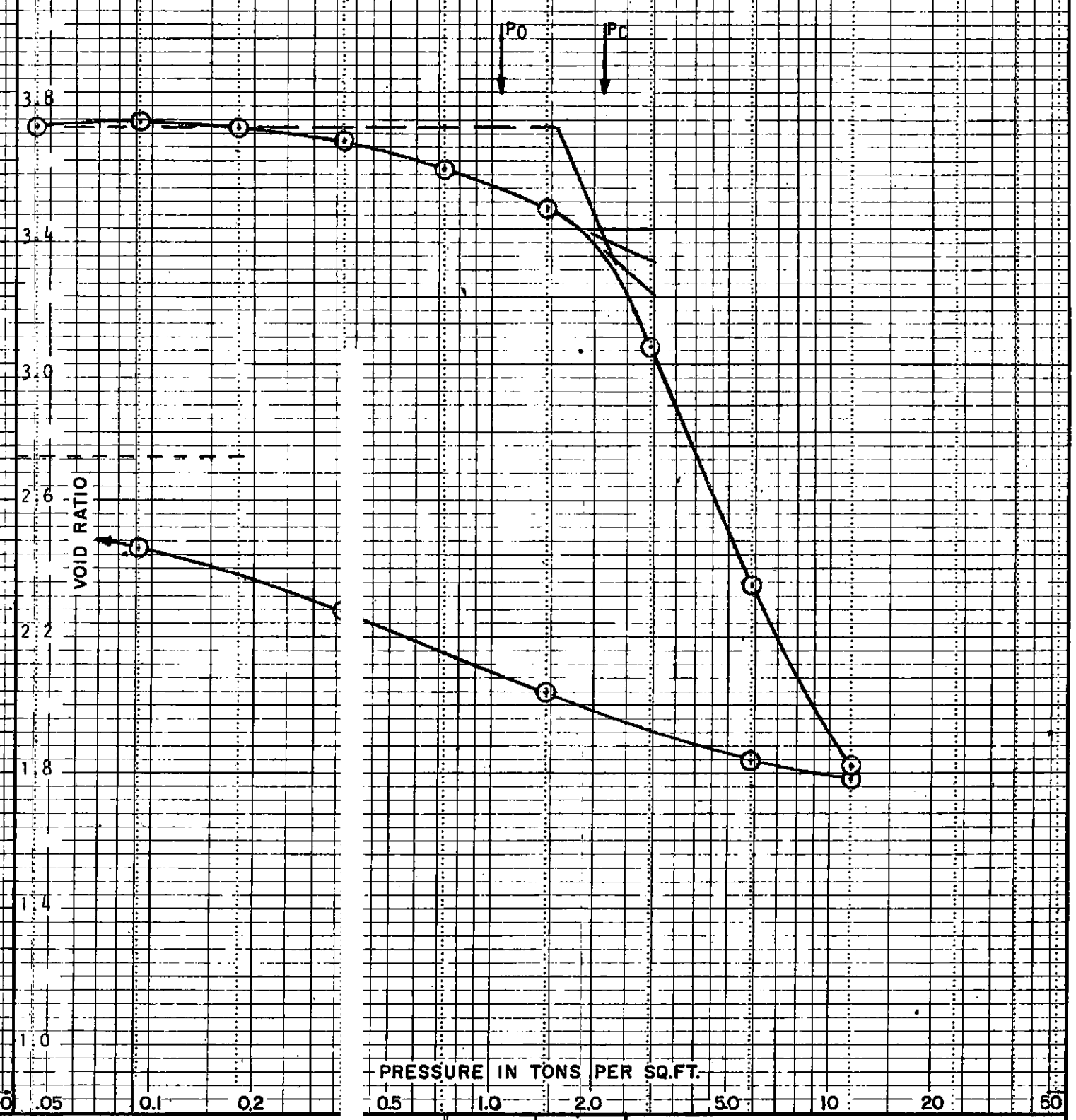
Nassau County DPW

C-1

TIME-COMPRESSION CURVES



PRESSURE-VOID RATIO CURVE



PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES

CURVE NUMBER	PRESSURE FROM (TSF)	INCREMENT TO (TSF)
①	0.733	1.47
②	1.47	2.93
③	2.93	5.87
④		
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: Stiff dark brown organic silty clay, trace roots, decomposed vegetation

STRATUM: 0

PROPERTIES OF PLASTICITY LIMIT SPECIMEN

UNIFIED CLASSIFICATION	Pt
LIQUID LIMIT (w_L)	309
PLASTIC LIMIT (w_p)	180
PLASTICITY INDEX (I_p)	129
NATURAL WATER CONT. % (w)	221.7
LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.32
SPECIFIC GRAVITY (G_s)	2.27

PROPERTIES OF CONSOLIDATION SPECIMEN

ELEVATION OF SPECIMEN	-6.2
DEPTH OF SPECIMEN (FT.)	22.3
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	1.00
INITIAL WATER CONTENT %	159.4
FINAL WATER CONTENT %	117.4
INITIAL DEGREE SATURATION %	97.4
FINAL DEGREE SATURATION %	97.8

INITIAL VOID RATIO (e_o), SH…WN THUS: ———	3.696
FINAL VOID RATIO (e_f), SH…WN THUS: - - - - - -	2.725
MOST PROBABLE PRECONSOL…ATION STRESS (TSF) SHOWN THU… P_c	2.15
EXISTING OVERBURDEN ST…SS (TSF) SHOWN THU… P_o	1.06
COMPRESSION INDEX (C_c)	2.34
SWELLING INDEX (C_s), REBOUND FROM e = 1.784	0.32

CEDAR CREEK WPCP

Wantagh New York

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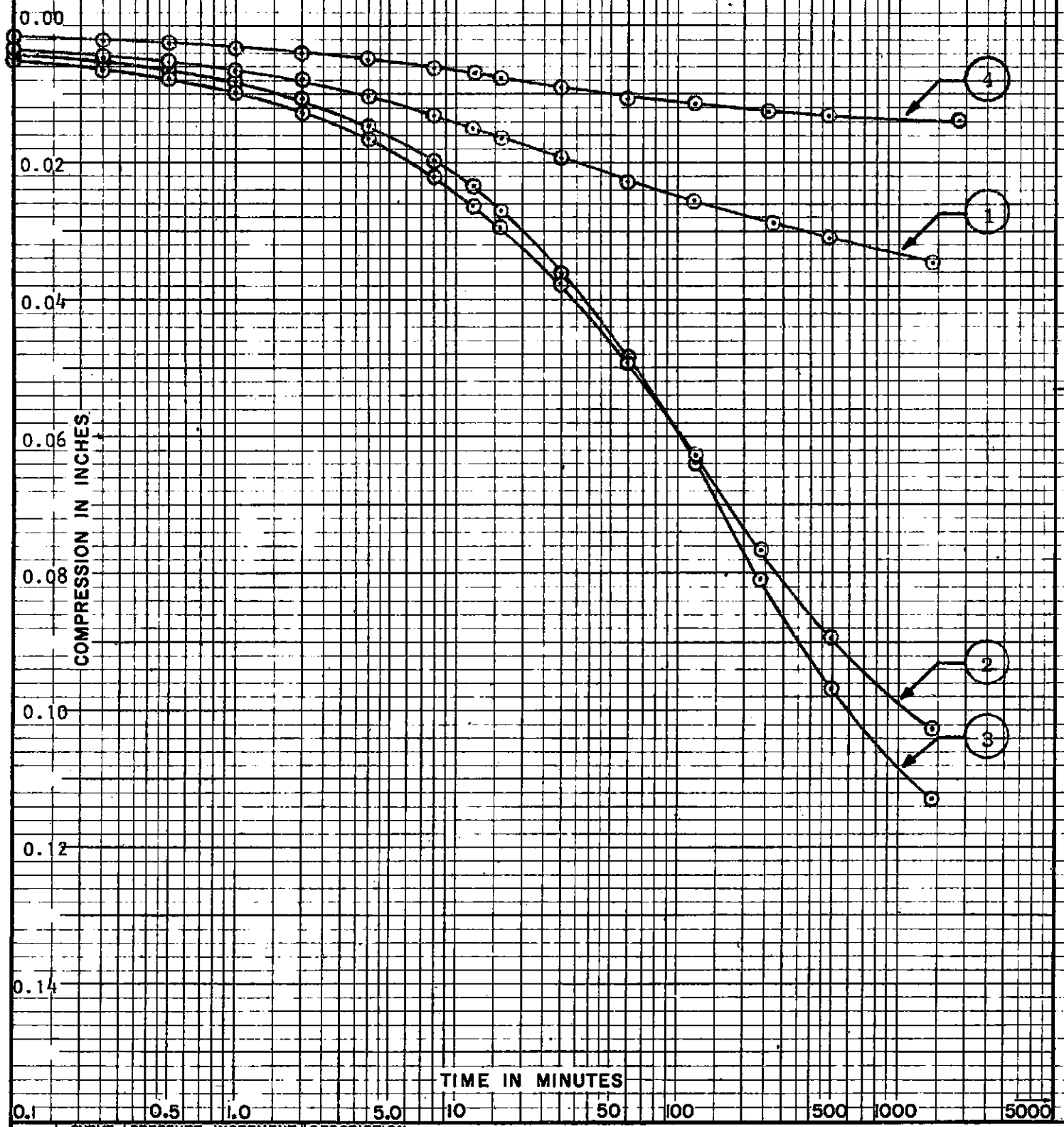
MADE BY: CJM DATE: 3-28-85 FILE NO. 6102
CH'KD BY: GCB DATE: 4-01-85

CONSOLIDATION TEST PLATE NO. 7

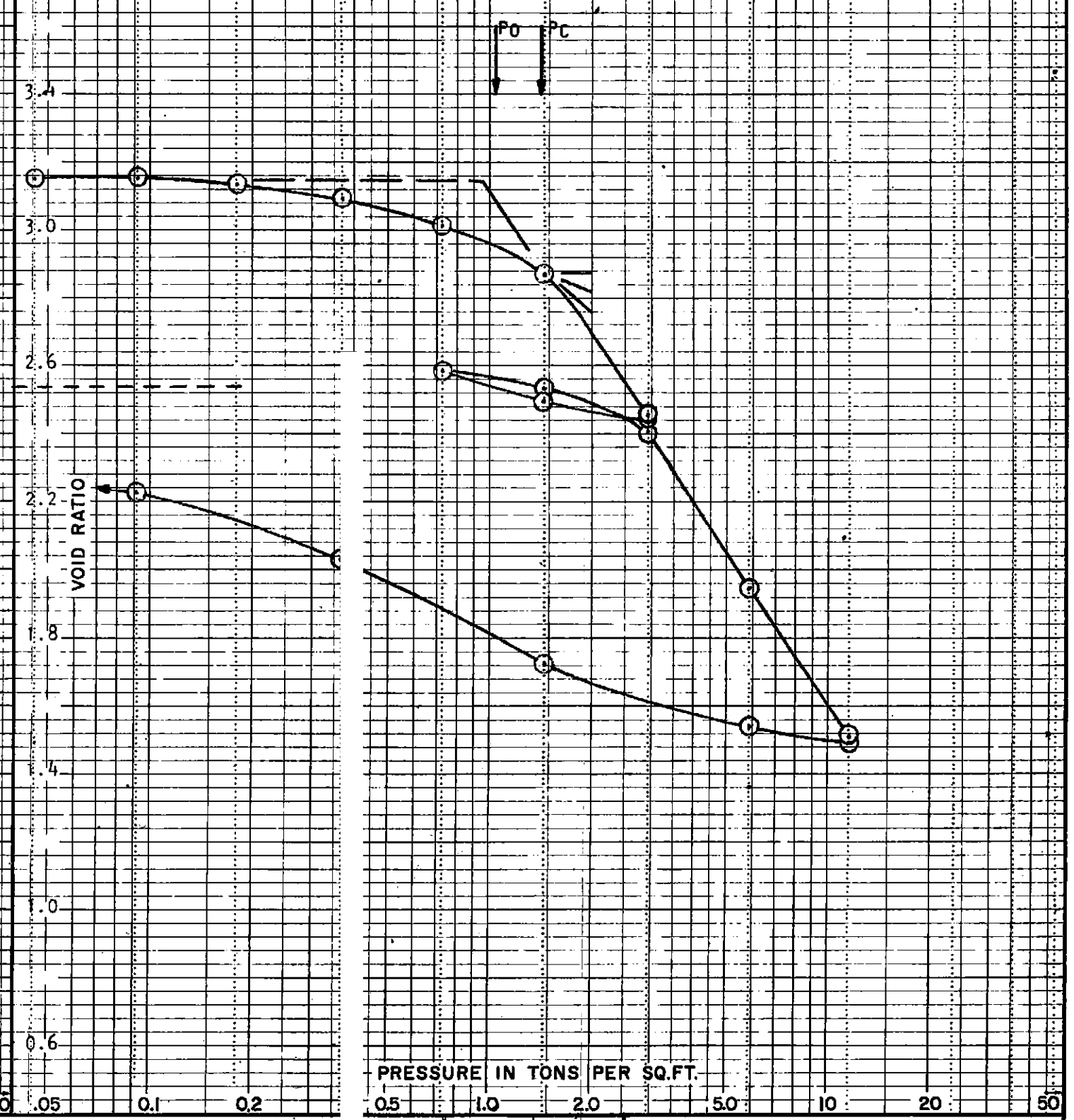
BORING NO. B-313U SAMPLE NO. 7U

S3C067-11G
Page 2508 of 2953
Nassau County DPW

TIME-COMPRESSION CURVES



PRESSURE-VOID RATIO CURVE



PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES

CURVE NUMBER	PRESSURE FROM (TSF)	INCREMENT TO (TSF)
①	0.733	1.47
②	1.47	2.93
③	2.93	5.87
④*	0.733*	1.47*
⑤		
⑥		
⑦		
⑧		

DESCRIPTION OF SPECIMEN: Medium black organic silty clay, trace roots

PROPERTIES OF PLASTICITY LIMIT SPECIMEN

UNIFIED CLASSIFICATION	OH
LIQUID LIMIT (w_L)	151
PLASTIC LIMIT (w_p)	71
PLASTICITY INDEX (I_p)	80
NATURAL WATER CONT. % (w)	61.1
LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	-0.12
SPECIFIC GRAVITY (G_s)	2.44

PROPERTIES OF CONSOLIDATION SPECIMEN

ELEVATION OF SPECIMEN	-1.1
DEPTH OF SPECIMEN (FT.)	19.4
DIAMETER OF SPECIMEN (IN.)	2.50
INITIAL THICKNESS OF SPECIMEN (IN.)	1.00
INITIAL WATER CONTENT %	121.3
FINAL WATER CONTENT %	100.8
INITIAL DEGREE SATURATION %	94.1
FINAL DEGREE SATURATION %	96.8

INITIAL VOID RATIO (e_o), SH…N THUS: ———	3.147
FINAL VOID RATIO (e_f), SH…N THUS: - - - - - -	2.541
MOST PROBABLE PRECONSOL…ATION STRESS (TSF) SHOWN THU… P_c	1.4
EXISTING OVERBURDEN ST…S (TSF) SHOWN THU… P_o	1.04
COMPRESSION INDEX (C_c)	1.51
SWELLING INDEX (C_s), REBOUND FROM e = 1.495	0.31
Recompression Index (Cr)	0.26

STRATUM 0

CEDAR CREEK WPCP

Wantagh New York

MUESER · RUTLEDGE · JOHNSTON & DESIMONE
CONSULTING ENGINEERS
708 THIRD AVENUE NEW YORK, N.Y. 10017

MADE BY: CJM DATE: 4-01-85
CH'KD BY: GCB DATE: 4-02-85
FILE NO. 6102

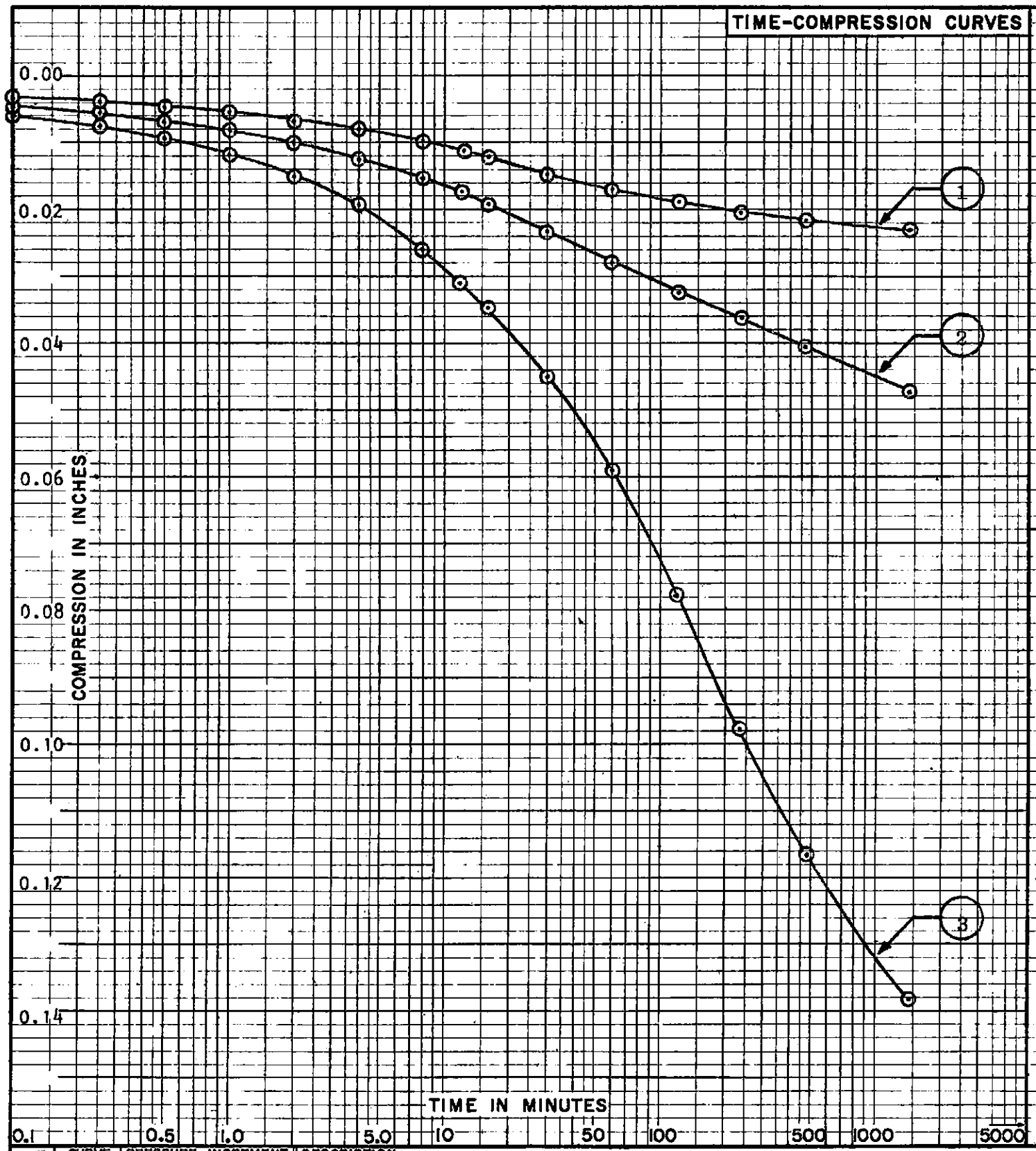
CONSOLIDATION TEST
BORING NO. B-314U SAMPLE NO. 5U
PLATE NO. 8

* Indicates Recompression

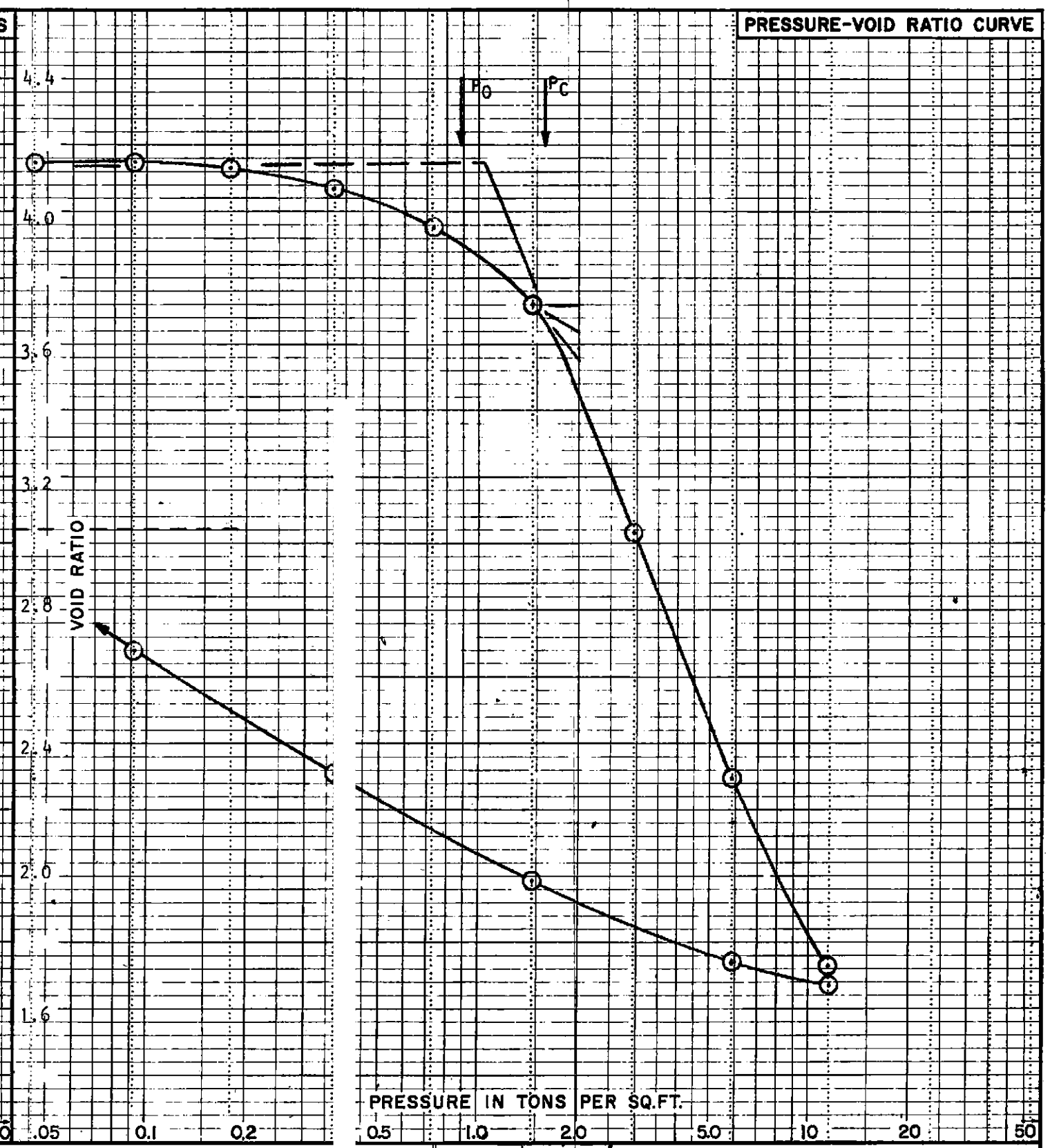
C-1

S3C067-11G
Page 2509 of 2953
Nassau County DPW

TIME-COMPRESSION CURVES



PRESSURE-VOID RATIO CURVE



PRESSURE INCREMENTS OF TIME-COMPRESSION CURVES	CURVE NUMBER	PRESSURE FROM (TSF)	INCREMENT TO (TSF)
	①	0.367	0.733
	②	0.733	1.47
	③	1.47	2.93
	④		
	⑤		
	⑥		
	⑦		
	⑧		

DESCRIPTION OF SPECIMEN: Brown peat

PROPERTIES OF PLASTICITY LIMIT SPECIMEN		
	UNIFIED CLASSIFICATION	Pt
	LIQUID LIMIT (w_L)	205
	PLASTIC LIMIT (w_p)	133
	PLASTICITY INDEX (I_p)	72
	NATURAL WATER CONT. % (w)	140.6
	LIQUIDITY INDEX = $\frac{w-w_p}{I_p}$	0.11
	SPECIFIC GRAVITY (G_s)	1.96

PROPERTIES OF CONSOLIDATION SPECIMEN		
	ELEVATION OF SPECIMEN	+0.1
	DEPTH OF SPECIMEN (FT.)	16.0
	DIAMETER OF SPECIMEN (IN.)	2.50
	INITIAL THICKNESS OF SPECIMEN (IN.)	1.00
	INITIAL WATER CONTENT %	203.4
	FINAL WATER CONTENT %	155.5
	INITIAL DEGREE SATURATION %	96.3
	FINAL DEGREE SATURATION %	100

STRATUM	0
INITIAL VOID RATIO (e_o), SH…N THUS: —— ——	4.138
FINAL VOID RATIO (e_f), SH…N THUS: - - - - - -	3.041
MOST PROBABLE PRECONSOL…ATION STRESS (TSF) SHOWN THU… P_c	1.6
EXISTING OVERBURDEN STI…S (TSF) SHOWN THU… P_o	0.89
COMPRESSION INDEX (C_c)	2.51
SWELLING INDEX (C_s), RESOUND FROM e_f 1.670	0.40

CEDAR CREEK WPCP

Wantagh New York

MUESER · RUTLEDGE · JOHNSTON & DESIMONE
CONSULTING ENGINEERS
708 THIRD AVENUE NEW YORK, N.Y. 10017

MADE BY: CJM	DATE: 3-29-85	FILE NO. 6102
CH'KD BY: GCB	DATE: 4-01-85	

CONSOLIDATION TEST

BORING NO B-317U SAMPLE NO. 4U

PLATE NO. 9

C-1

S3C067-11G
Page 2510 of 2953
Nassau County DPW

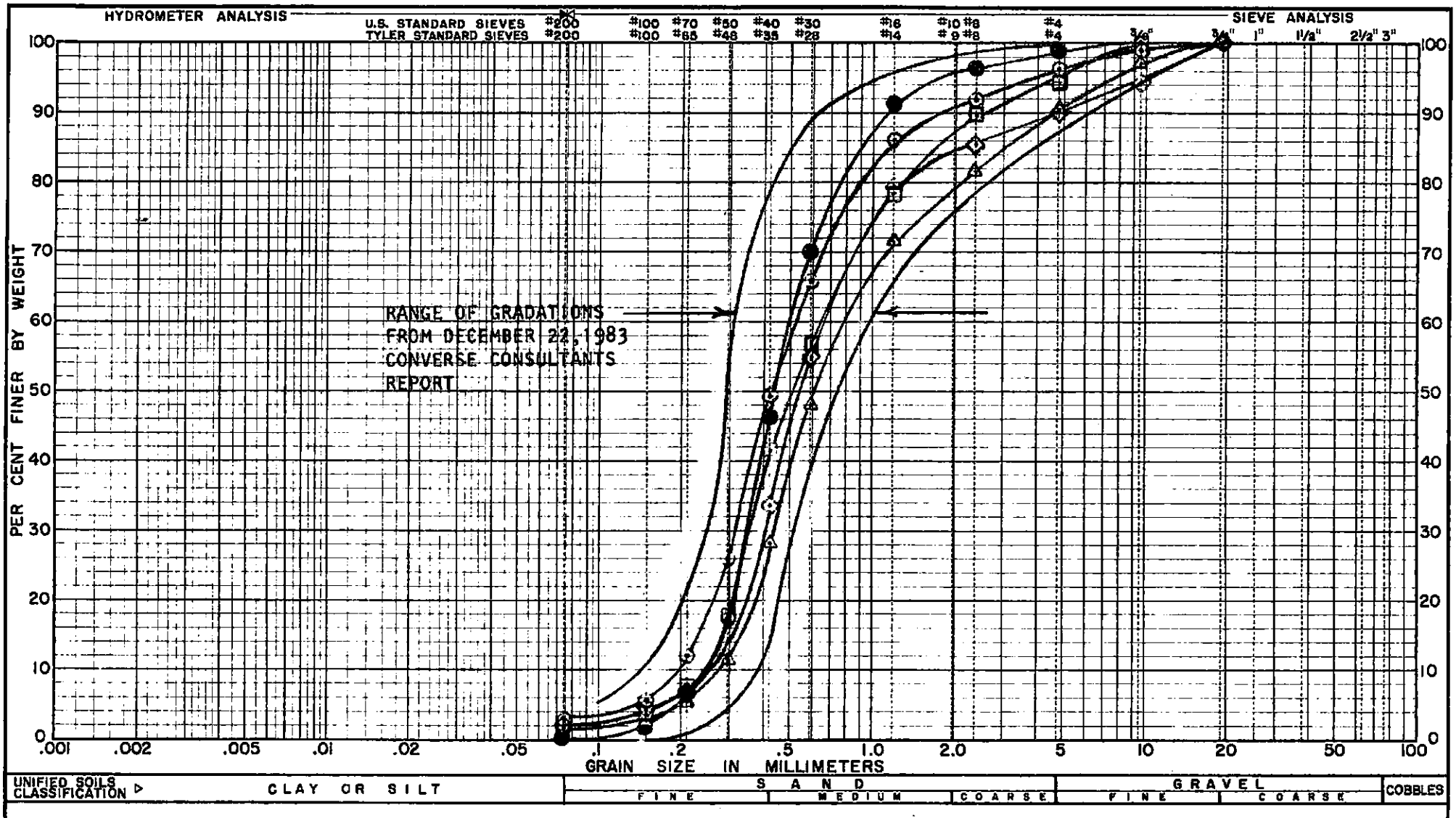


PLATE NO. 5P

SYMBOL	BORING	SAMPLE	DESCRIPTION OF SAMPLE	
⊙	B-316	5D	Light brown fine to coarse sand, trace gravel, silt	(SP)
⊡	B-316	7D	Light brown fine to coarse sand, trace gravel, silt	(SP)
△	B-320	6D	Light brown fine to coarse sand, trace gravel, silt	(SP)
◇	B-325	6D	Light brown fine to coarse sand, trace gravel, silt	(SP)
●	B-325	8D	Light brown fine to coarse sand	(SP)

CEDAR CREEK WPCP

Wantagh New York

MUESER · RUTLEDGE · JOHNSTON & DESIMONE
CONSULTING ENGINEERS

MADE BY: GCB DATE: 3-14-85
CHK'D BY: RF DATE: 3-14-85

FILE NO. 6102

GRADATION CURVES
STRATUM S1

PLATE NO. 5P

Nassau County DPW
Page 2511 of 2953
S3C067-11G

APPENDIX A

Boring Logs

GENERAL STRATA DESCRIPTIONS

(F) FILL-COMPACT TO LOOSE GRAY AND BROWN FINE TO MEDIUM SAND, TRACE SILT, GRAVEL.

(O) ORGANIC SILTY CLAY AND PEAT-STIFF TO MEDIUM DARK GRAY ORGANIC SILTY CLAY AND BROWN PEAT, TRACE TO SOME FINE SAND.

(S) & (O) SAND MIXED WITH ORGANIC SILTY CLAY-MEDIUM COMPACT GRAY FINE TO MEDIUM SAND WITH SOME TO TRACE DARK GRAY ORGANIC SILTY CLAY POCKETS AND LAYERS.

(S1) SAND-MEDIUM COMPACT GRAY FINE TO MEDIUM SAND, TRACE TO SOME COARSE SAND, TRACE GRAVEL, SILT.

(C) CLAY-HARD TO STIFF GRAY SILTY CLAY, TRACE FINE SAND.

(S2) SILTY SAND-MEDIUM COMPACT TO VERY COMPACT GRAY SILTY FINE TO MEDIUM SAND, OCCASIONALLY INTERBEDDED WITH SILTY CLAY AND/OR GRAVEL.

ABBREVIATIONS FOR SOIL SAMPLE DESCRIPTIONS

CONSISTENCY

compact	- cpt
medium compact	- med cpt
hard	- hd

GRAIN SIZE AND SHAPE

angular	- ang
coarse	- c
coarse to fine	- c-f
coarse to medium	- c-m
fine	- f
fine to coarse	- f-c
fine to medium	- f-m
medium	- m
medium to coarse	- m-c
medium to fine	- m-f
round	- rnd
small	- sml
subround	- sbrnd

SOIL TYPE

boulder	- bldr
brick	- brk
calcareous	- calc
carbonaceous	- carb
cinders	- cndr
clay	- cl
clayey sand	- cl sa
clayey silt	- cl si
cobble	- cbl
gravel	- gvl
meadow mat	- mdw mt
organic	- org
peat	- pt
roots	- rts
sand	- sa
sandy clay	- sa cl
shells	- sls
silt	- si
silty clay	- si cl
vegetation	- veg

COLOR

black	- blk
blue	- bl
brown	- brn
dark	- dk
gray	- gry
green	- grn
light	- lt
mottled	- mtld
orange	- or
white	- wht
yellow	- yel

MISCELLANEOUS

and	- &
bottom	- bot
cavities	- cvts
concretions	- conc
crystalline	- xln
decayed	- dcyd
disintegrated	- dsntg
ditto	- do
fragments	- fgmts
interbedded	- intrbd
layers	- lyrs
lenses	- lns
material	- mtl
matter	- mtr
micaceous	- mic
miscellaneous	- misc
numerous	- num
occasional	- occ
pieces, particles	- pcs
pocket	- pkt
porous	- por
seams	- sms
solution	- sol
some	- sm
trace	- tr
varved	- vvd
very	- v
with	- w

SUMMARY OF WATER CONTENTS

Boring No.	Sample No.	water content, %	Stratum
B-301	11D	31	C
B-302P	10D	22	C
	11D	35	C
B-303	4D (TOP)	33	O
	10D	34	C
	11D	32	C
B-304	4D	102	O
	11D	36	C
B-305	4D	144	O
	5D	137	O
	12D	32	C
B-306	4D	143	O
	5D (TOP)	29	O
	11D	24	C
B-307	4D (BOT)	170	O
	11D	31	C
B-308	4D	89	O
	11D	34	C
B-309	4D	29	O
	12D	28	C
	13D	36	C
	14D	33	C
	15D	41	C
B-310	11D (BOT)	27	C
	12D	36	C
B-311	6D	33	O
	12D	34	C
	13D	42	C
	14D	39	C
B-312U	4D (BOT)	137	O
	14D	35	C

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
CONSULTING ENGINEERS

FILE 6102
FORM 3 FOR Cedar Creek WPCP
MADE BY CHF DATE 4-2-85
CHECKED BY ____ DATE ____

SUMMARY OF WATER CONTENTS

Boring No.	Sample No.	water content, %	Stratum
B-313A	6D	70	O
	14D	41	C
	15D	39	C
	16D	41	C
	17D	35	C
B-314A	13D	35	C
B-315P	4D	41	O
	11D	34	C
B-316P(A)	2D	129	O
B-319P	4D	29	O
B-320P	4D	48	O
B-321	3D	23	O
	10D	34	C
B-322	4D	113	O
	11D	32	C
B-323	4D (BOT)	123	O
B-324	5D	54	O
	6D	79	O
B-325	4D	23	O
B-326	5D	253	O
	11D	34	C
	12D	34	C
	13D	33	C
	14D	36	C
B-327	4D	93	O
	5D	32	O
	6D	72	O
	11D	25	C
	12D	31	C
	13D	29	C
	14D	31	C

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102
BORING NO. B-301
SURFACE ELEV. +13.8

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1100	1D	0.0 2.0	3-6 3-7	Top: Topsoil Bot: Gray medium to fine sand(SP)				0'-5', drilled ahead of casing.
						5		
	2D	5.0 7.0	3-3 2-3	Gray medium to fine sand, trace shells (SP)				5'-52', used mud.
						10		
	3D	10.0 12.0	1-1 2-2	Gray medium to fine sand, trace coarse sand (SP)	F			
						15		
	4D	15.0 17.0	6-8 12-14	Gray medium to fine sand, trace gravel, organic silt layers (SP)				
						20		
	5D	20.0 22.0	9-9 13-12	Yellow brown medium to fine sand, trace silt, gravel (SP)		23		
						25		
	6D	25.0 27.0	4-5 6-6	Gray brown medium to coarse sand, trace silt (SP)				
						30		
	7D	30.0 32.0	3-4 4-5	Yellow brown medium to fine sand, trace coarse sand, silt (SP)	S_1			
						35		
	8D	35.0 37.0	4-4 5-6	Gray medium to fine sand, trace silt, coarse sand (SP)				
						40		
	9D	40.0 42.0	5-6 5-5	Do 8D (SP)				
						45		
	10D	45.0 47.0	8-12 8-12	Gray fine sand, trace gravel (SP)		48		
					C	50		
1500	11D	50.0 52.0	4-4 6-7	Stiff dark gray silty clay (CL)		52		End of boring @ 52.0'.

WEDNESDAY, 2-13-85 - SUNNY, 35°F

BORING NO. B-301

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-301
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 15/16"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-14-85	0800	-	5.0'	12.0'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-14-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-301

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-320P

SURFACE ELEV. +13.6

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0830	1D	0.0 2.0	7-8 9-9	Light brown-gray fine to medium sand, trace coarse sand (SP)			18 40 45 53	
						5	60	
	2D	5.0 7.0	8-9 10-13	Do 1D (SP)	F		18 21 24 27	
						10	33	
	3D	10.0 12.0	10-13 14-14	Gray fine sand (SP)			21 33 43	
						14	48	
					O	15	57	
FRIDAY, 2-15-85 - 29°F	4D	15.0 17.0	1-1 3-3	Top: Soft gray organic silty clay, trace peat (OH & Pt) Bot: Gray-brown coarse to fine sand, some silt, trace organic silt (SM)	S&O		14 21 30 41	
						20	44	
	5D	20.0 22.0	5-9 10-11	Gray brown coarse to fine sand, some silt, trace organic silt (SM)		22	29 43 49 76	
						25	80	
	6D	25.0 27.0	8-9 9-11	Gray brown fine to medium sand, trace coarse sand (SP)	S1		45 53 51 66	
						30	70	
	7D	30.0 32.0	5-7 7-9	Do 6D (SP)		32		End of boring @ 32.0'
1200								
						35		
						40		
						45		
						50		

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-302P

SURFACE ELEV. +13.0

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1100	1D	0.0 2.0	17-11 11-12	Top: Topsoil Bot: Gray medium to fine sand(SP)			5 5 10 14	
						5	14	
	2D	5.0 7.0	3-30 4-8	Gray medium to fine sand and gravel (SP&GP)			5 5 17 10	
					F	10	13	
	3D	10.0 12.0	15-20 8-12	Gray medium to fine sand (SP)			4 5 11 14	
						15	13	
	4D	15.0 17.0	3-4 8-12	Brown medium to fine sand, trace roots, silt (SP)			14 14 24 24	
						20	20	
	5D	20.0 22.0	12-17 21-24	Yellow brown medium to fine sand trace silt (SP)			22 27 39 44	
1500 WEDNESDAY, 2-13-85 - SUNNY, 35°F						25	56	
0800	6D	25.0 27.0	9-10 14-17	Brown medium to fine sand (SP)			24 27 39 46	
						30	61	
	7D	30.0 32.0	3-5 6-13	Gray brown medium to fine sand, trace coarse sand, gravel (SP)			27 34 43 62	
						35	67	
	8D	35.0 37.0	3-5 5-6	Gray brown medium to fine sand (SP)	S1		23 25 30 34	
						40	41	
	9D	40.0 42.0	4-6 10-11	Gray brown medium to fine sand, trace coarse sand, gravel (SP)			25 37 46 62	
						45	71	
	10D	45.0 47.0	6-6 8-13	Top: Do 9D (SP) Bot: Stiff gray silty clay, tr fine sand (CL)		46.5	34 41	
					C		59 73	
						50	84	
THURSDAY, 2-14-85 - SUNNY, 30°F	11D	50.0 52.0	9-10 14-17	Gray silty clay, trace fine sand (CL)		52		End of boring @ 52.0'.
1200								

BORING NO. B-302P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-302P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.0 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0, DEPTH FROM 0.0' TO 50.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2-15/16
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N, D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER , U-SAMPLER
CORE BARREL , CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300, AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-14-85	0800	25.0'	25.0'	10.0'	
2-14-85	1200	35.0'	35.0'	10.7'	AFTER COMPLETION OF HOLE
2-14-85	1330			10.5'	PIEZOMETER READING
2-15-85	0830			10.5'	PIEZOMETER READING
2-19-85	1300			10.9'	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC, ID 1.25, LENGTH 30.5', TOP ELEV. +13.5
INTAKE POINT: TYPE PVC-SLOTTED, OD 1.5", LENGTH 5.0', TIP ELEV. -22.0
FILTER: MATERIAL SAND, OD 3.0", LENGTH , BOT. ELEV. -39.0

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-14-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

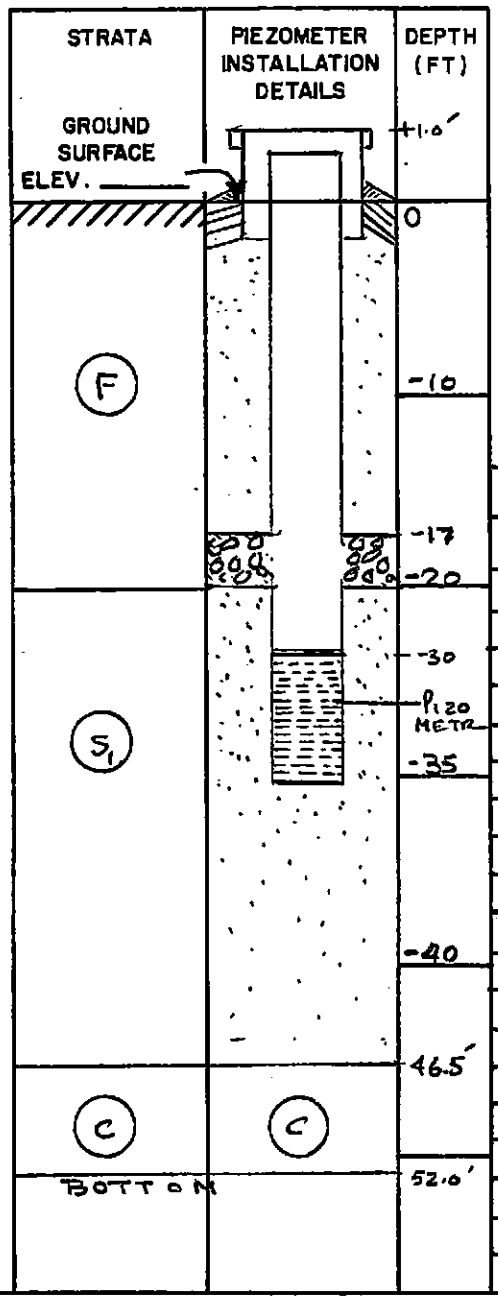
PROJECT CEDAR CREEK WPCP. EXPANSION. PIEZOMETER NO. 302 P

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION SOUTH SIDE OF THE PUMPING WELL DATE OF INSTALLATION 2-14-85

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE.

PIEZOMETER TYPE PVC (SCH 40)



INTAKE POINT

depth to bottom, ft = -35.0'
depth to top, ft = -30.0'
length, ft = 5.0' = L
diameter, in = 1 1/4 (I.D), ft = _____ = 2R

STANDPIPE/RISER (PVC)

elevation of rim, ft = +13.5'
diameter, in = 1 1/4 (I.D), ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
2-15	0830	10.5 (G.S)	+2.5'	
COULD NOT FILL UP THE PIEZOMETER PUMPED WATER FOR 5 MIN.				
2-19	1300	10.9	+2.1'	

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. 13.00

PIEZOMETER NO. 302 P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

BORING NO. B-303

SURFACE ELEV. +12.4

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0800	1D	0.0 2.0	4-4 4-7	Top: Topsoil Bot: Gray fine sand (SP)				
	2D	5.0 7.0	10-18 18-24	Gray fine sand (SP)	F	5		5'-52', used mud.
	3D	10.0 12.0	9-16 19-22	Do 2D (SP)		10		
	4D	15.0 17.0	WOH/12" 4-4	Top: Medium dark gray organic silty clay (OH) Bot: Brown medium to fine sand, trace silt, gravel (SP)	O	14 15		
	5D	20.0 22.0	10-12 12-14	Gray brown medium to fine sand, trace gravel, silt (SP)		20		
	6D	25.0 27.0	8-14 14-16	Gray brown medium to fine sand, some gravel, trace silt (SP)	S_1	25		
	7D	30.0 32.0	12-18 25-27	Gray fine to medium sand, trace silt (SP)		30		
	8D	35.0 37.0	10-12 12-9	Gray fine to medium sand, trace coarse sand, silt (SP)		35		
	9D	40.0 42.0	12-18 25-27	Gray fine to medium sand (SP)		40		
	10D	45.0 47.0	15-12 12-13	Hard gray silty clay (CL)	C	45		
1200	11D	50.0 52.0	10-12 12-13	Do 10D (CL)		50 52		End of boring @ 52.0'.

35° - 40°

TUESDAY, 2-19-85

BORING NO. B-303

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-303
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +12.4 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300, AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-19-85	1200	-	-	12.0'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-19-85

NOTES:

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4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102
BORING NO. B-304
SURFACE ELEV. +13.3

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. GERALD C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1300	1D	0.0 2.0	PUSH	Brown fine to coarse sand, trace silt, organic silt seams (SP)				
	2D	5.0 7.0	2-2 2-3	Do 1D (SP)	F	5		
	3D	10.0 12.0	1-1 1-2	Gray fine to coarse sand, trace silt, organic silt and peat seams, gravel (SM)		10		
	4D	15.0 17.0	1-1 1-2	Medium gray organic silty clay, trace peat (OH-Pt)	O	15		
	5D	20.0 22.0	1-1 6-9	Top: Medium gray organic clayey silt, tr coarse to fine sand (OH) Bot: Gray coarse to fine sand, some silt (SM)		20 21		
	6D	25.0 27.0	6-7 9-10	Tan coarse to fine sand, trace gravel (SP)		25		
	7D	30.0 32.0	4-4 5-4	Do 6D, trace gray clayey silt seams (SP)	S_1	30		
	8D	35.0 37.0	4-4 5-5	Tan fine to coarse sand, trace gravel (SP)		35		
	9D	40.0 42.0	4-4 5-6	Tan medium to fine sand, trace coarse sand, gravel (SP)		40		
	10D	45.0 47.0	6-9 11-16	Tan coarse to fine sand, some gravel, tr gray clayey silt seams (SP)		45 48		
1600	11D	50.0 52.0	5-9 11-12	Stiff gray silty clay, trace fine sand (CL)	C	50 52		End of boring @52.0'.

2-18-85 - SUNNY, 35°F

BORING NO B-304

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-304
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.3 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 2-18-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
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6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-305

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +14.5

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0800	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand(SP)				
	2D	5.0 7.0	5-4 4-10	Do 1D, bottom (SP)	F	5		5'-52', used mud.
	3D	10.0 12.0	15-23 30-35	Gray medium to fine sand (SP)		10		
	4D	15.0 17.0	4-1 1-2	Soft gray organic clay, some peat (OH-Pt)	O	15		
	5D	17.0 19.0	1-2 2-2	Do 4D (OH-Pt)		19		
	6D	20.0 22.0	1-8 14-18	Gray brown medium to fine sand, trace organic silt (SP-SM)	S & O	20 22		
TUESDAY, 2-19-85 35°-40°	7D	25.0 27.0	3-3 6-7	Brown fine to medium sand, trace coarse sand, silt (SP)		25		
	8D	30.0 32.0	5-5 6-6	Do 7D (SP)	S_1	30		
	9D	35.0 37.0	5-5 6-9	Do 7D (SP)		35		
	10D	40.0 42.0	3-4 5-7	Do 7D (SP)		40		
	11D	45.0 47.0	5-6 8-7	Gray fine to medium sand, trace coarse sand (SP)		45 47		
1200	12D	50.0 52.0	3-4 5-5	Stiff gray silty clay (CL)	C	50 52		End of boring @ 52.0'.

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-305
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.5' DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3", DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS -, AVERAGE FALL, INCHES -
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-19-85	1130	52.0'	5.0'	12.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-19-85

NOTES:

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5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO: B-306

SURFACE ELEV. +13.6

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1300	1D	0.0 2.0	6-7 9-11	Top: Topsoil Bot: Gray brown fine to medium sand, trace silt (SP-SM)				
	2D	5.0 7.0	12-17 23-31	Gray medium to fine sand, trace shells (SP)	F	5		5'-52' used mud.
	3D	10.0 12.0	15-21 27-33	Do 2D, trace gravel (SP)		10 14		
TUESDAY, 2-19-85	4D	15.0 17.0	1-1 2-3	Medium gray organic silty clay, some peat (OH-Pt)	O	15		
	5D	20.0 22.0	3-4 4-3	Top: Do 4D, sm fine sand (OH-Pt) Bot: Brown medium to fine sand, some organic silt (SM)	S&O	20 21 25		
1500 0800	6D	25.0 27.0	12-15 17-22	Gray medium to fine sand, trace coarse sand, silt (SP-SM)		30		
30°F	7D	30.0 32.0	11-14 15-17	Gray fine to medium sand (SP)	S_1	35		
	8D	35.0 37.0	12-14 15-19	Do 7D (SP)		40		
WEDNESDAY, 2-20-85	9D	40.0 42.0	10-12 10-14	Gray fine to medium sand, trace coarse sand (SP)		45		
	10D	45.0 47.0	12-25 31-27	Do 9D (SP)		49 50		
1030	11D	50.0 52.0	3-4 6-7	Stiff gray silty clay, some fine sand (CL)	C	52		End of boring @ 52.0'.

BORING NO. B-306

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-306
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.6 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 15/16"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N, D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER , U-SAMPLER
CORE BARREL , CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-20-85	1100	52.0'	5.0'	8.0'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-20-85

NOTES:

1. Make a separate log of each boring and each unsucoessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102
BORING NO. B-307
SURFACE ELEV. +14.7

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1300	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand(SP)				
	2D	5.0 7.0	14-23 22-22	Light gray coarse to fine sand, trace gravel (SP)	F	5 10		5'-52', used mud.
	3D	10.0 12.0	7-7 14-23	Gray fine to medium sand (SP)		15		
TUESDAY, 2-19-85	4D	15.0 17.0	4-1 1-2	Top: Do 3D (SP) Bot: Medium gray organic silty clay, trace peat (OH & Pt)	O	15.5 18		
	5D	20.0 22.0	8-7 6-7	Gray fine to coarse sand, some organic silt (SM)	S&O	20 22		
	6D	25.0 27.0	6-7 5-7	Brown medium to fine sand, trace silt (SP)		25		
1500 0800	7D	30.0 32.0	3-5 5-6	Gray medium to fine sand, trace coarse sand (SP)		30		
	8D	35.0 37.0	2-4 5-5	Do 7D (SP)	S_1	35		
WEDNESDAY, 2-20-85 30°	9D	40.0 42.0	4-4 4-7	Do 7D (SP)		40		
	10D	45.0 47.0	5-5 5-6	Do 7D (SP)		45 48		
1100	11D	50.0 52.0	3-4 4-5	Stiff gray silty clay (CL)	C	50 52		End of boring @ 52.0'

BORING NO. B-307

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-307

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +14.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 5.0'

DIAMETER, INCHES , DEPTH FROM TO

☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 15/16"

TYPE OF DRILLING MUD REVERT

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES

SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-20-85	1030	52.0'	5.0'	12.0'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON

STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.

INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.

FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES

___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-23-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-307

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-308

SURFACE ELEV. +13.4

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1030	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand (SP)				
	2D	5.0 7.0	7-6 6-5	Gray fine to medium sand, trace roots (SP)	F	5		5'-52', used mud.
	3D	10.0 12.0	9-18 18-18	Do 2D (SP)		10		
	4D	15.0 17.0	1-1 2-3	Medium gray organic silty clay, some peat (OH & Pt)	O	15		
	5D	20.0 22.0	9-12 12-18	Brown coarse to fine sand, trace organic silt (SP)	S&O	18 20 22		
	6D	25.0 27.0	5-6 6-7	Gray fine to medium sand, trace coarse sand, silt (SP)		25		
	7D	30.0 32.0	3-4 6-4	Do 6D (SP)	S_1	30		
	8D	35.0 37.0	5-5 7-7	Do 6D (SP)		35		
	9D	40.0 42.0	3-5 5-8	Gray medium to fine sand, trace coarse sand, gravel, silt (SP)		40		
	10D	45.0 47.0	3-6 8-9	Do 9D (SP)		45 49		
1400	11D	50.0 52.0	1-2 4-4	Stiff gray silty clay, trace fine sand (CL)	C	50 52		End of boring @ 52.0'.

WEDNESDAY, 2-20-85 - 29°F

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-308
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.4 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 1/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW, D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER , U-SAMPLER
CORE BARREL , CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-20-85	1400	52.0'	5.0'	11.8'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-23-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-309

SURFACE ELEV. +16.7

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0800	1D	0.0 2.0	PUSH	Topsoil				
	2D	5.0 7.0	1-1 1-1	Gray fine to medium sand, trace silt (SP-SM)	F	5 10		5'-80', used mud.
	3D	10.0 12.0	1-1 2-4	Gray fine to medium sand, trace coarse sand (SP)		15		
	4D	15.0 17.0	4-3 2-2	Medium gray organic silty clay, some peat (OH-Pt)	O			
	5D	17.0 19.0	5-4 5-6	Top: Do 4D (OH-Pt) Bot: Brown fine to medium sand, some organic silt (SM)	S&O	18 20		
	6D	20.0 22.0	2-2 1-2	Gray brown fine to medium sand, some silt (SM)		25		
	7D	25.0 27.0	8-8 8-13	Brown medium to fine sand, trace coarse sand, silt (SP)		30		
	8D	30.0 32.0	4-5 6-9	Gray fine to medium sand (SP)	S_1	35		
	9D	35.0 37.0	4-5 6-8	Do 8D, trace coarse sand (SP)		40		
	10D	40.0 42.0	4-5 5-6	Gray fine to coarse sand (SP)		45		
	11D	45.0 47.0	5-5 5-6	Gray fine to medium sand, trace silt (SP)		49		
	12D	50.0 52.0	7-7 7-7	Stiff gray silty clay, trace fine sand (CL)	C	50		

THURSDAY, 2-21-85 - SUNNY 33°

BORING NO. B-309

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-309

SURFACE ELEV. +16.7

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
						55		
	13D	55.0 57.0	5-5 5-7	Do 12D (CL)				
					C	60		
	14D	60.0 62.0	3-5 5-6	Do 12D (CL)				
						65		
FEBRUARY 21, 1985	15D	65.0 67.0	3-5 6-8	Do 12D (CL)				
						69		
						70		
	16D	70.0 72.0	10-9 7-7	Gray fine to medium sand (SP)				
					S_2	75		
	17D	75.0 77.0	8-11 14-21	Gray fine to medium sand, trace silt (SP-SM)				
1400	18D	78.0 80.0	7-9 11-16	Do 17D (SP-SM)		80		End of boring @ 80.0'.
						85		
						90		
						95		
						100		

BORING NO. B-309

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-309
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +16.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3-3/4, 2-15/16
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-85	1400	80.0	5.0'	11.5'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 80.0. NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-21-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-309

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

BORING NO. B-310

SURFACE ELEV. +16.5

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1100	1D	0.0 2.0	7-9 11-4	Top: Topsoil Bot: Gray fine to medium sand (SP)				
	2D	5.0 7.0	9-14 13-17	Gray brown fine to medium sand, trace coarse sand, silt, gravel (SP-SM)		5		5'-55', used mud.
	3D	10.0 12.0	5-7 9-9	Gray brown fine to medium sand (SP)	F	10		
	4D	15.0 17.0	5-7 9-9	Do 3D, trace coarse sand (SP)		15		
	5D	20.0 22.0	17-19 11-12	Do 4D (SP)		20		
	6D	25.0 27.0	4-5 6-6	Brown medium to fine sand, trace silt pockets, gravel (SP-SM)		25		
	7D	30.0 32.0	4-5 9-12	Brown fine to medium sand, trace coarse sand, gravel (SP)	S_1	30		
	8D	35.0 37.0	4-6 6-7	Brown fine to medium sand, trace coarse sand, silt (SP)		35		
	9D	40.0 42.0	4-6 9-11	Do 8D (SP)		40		
	10D	45.0 47.0	5-7 10-12	Do 8D (SP)		45		
	11D	50.0 52.0	7-9 15-17	Top: Gray fine to medium sand(SP) Bot: Hard gray silty clay (CL)	C.	50 51		

WEDNESDAY, 2-20-85 - SUNNY, 29°-42°F

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-310

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +16.5

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
WED. 2-20-85 1430	12D	53.0 55.0	7-7 7-9	Stiff gray silty clay, trace fine sand (CL)	C	55		End of boring @ 55.0'.

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-310
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +16.5 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 55.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-20-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-310

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-311

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +15.3

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0800	1D	0.0 2.0	2-9 11-15	Top: Topsoil Bot: Gray fine to medium sand(SP)				
	2D	5.0 7.0	4-2 2-3	Gray fine to medium sand, trace coarse sand, silt (SP)		5		5'-80', used mud.
	3D	10.0 12.0	4-5 5-7	Do 2D (SP)	F	10		
	4D	15.0 17.0	5-5 7-7	Gray fine to medium sand (SP)		15		
	5D	20.0 22.0	5-6 6-7	Do 4D (SP)		20		
						24		
	6D	25.0 27.0	4-6 9-11	Top: Medium gray organic silt(OH) Bot: Brown coarse to fine sand, some organic silt (SM)	O	25 26		
	7D	30.0 32.0	10-12 12-17	Do 6D (SM)	S&O	30 32		
	8D	35.0 37.0	9-12 12-16	Gray fine to coarse sand, trace silt (SP)		35		
	9D	40.0 42.0	10-12 12-14	Do 8D (SP)	S_1	40		
	10D	45.0 47.0	12-12 15-21	Gray fine sand, trace silt (SP)		45		
	11D	50.0 52.0	11-14 17-19	Gray fine sand, trace silt (SP-SM)		50		

THURSDAY, 2-21-85 - SUNNY, 33° - 42°

BORING NO. B-311

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

FILE NO. 6102

BORING NO. B-311

SURFACE ELEV. +15.3

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
					S_1	53		
	12D	55.0 57.0	9-10 10-12	Stiff gray silty clay, trace fine sand (CL)		55		
THURSDAY, 2-21-85 - SUNNY, 33°-42°	13D	60.0 62.0	8-11 12-14	Do 12D (CL)	C	60		
	14D	65.0 67.0	12-12 13-17	Do 12D (CL)		65		
						68		
	15D	70.0 72.0	11-15 18-22	Gray fine to medium sand, trace silt (SP)		70		
					S_2	75		
	16D	75.0 77.0	13-20 22-27	Do 15D (SP)				
1500	17D	78.0 80.0	12-17 21-23	Gray fine to medium sand (SP)		80		End of boring @ 80.0'.
						85		
						90		
						95		
						100		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-311

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +15.3 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0 TO 5.0

DIAMETER, INCHES , DEPTH FROM TO

☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 15/16"

TYPE OF DRILLING MUD REVERT

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES

SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-85	1430	80.0	5.0	10.0	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON

STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.

INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.

FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 80.0. NO. OF 2" SHELBY TUBE SAMPLES

DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER SAL DAMICO HELPERS BOB WOJCIK

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-21-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6102
BORING NO. B-312U
SURFACE ELEV. +14.4

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1100	1D	0.0 2.0	2-2 4-7	Top: Topsoil Bot: Gray brown fine to medium sand, trace roots, silt (SP-SM)				
	2D	5.0 7.0	9-12 17-19	Brown fine to medium sand, trace coarse sand, silt (SP-SM)	F	5		5'-55', used mud.
	3D	10.0 12.0	8-13 15-17	Gray fine to medium sand (SP)		10		
	4D	15.0 17.0	9-13 15-8	Top: Do 3D (SP) Bot: Medium dark gray organic silt, some veg (OH)		15 15.5		
	5U	18.0 20.0	P=24" R=19"	Med dk gray organic silty clay, tr fibers, shells (OH)	O	20		
	6U	20.0 22.0	P=24" R=23"	Stiff dk gry organic silty clay, tr fine sand, fibers (OH)				
	7U	22.0 24.0	P=24" R=23"	Top: Soft dk gry org silty clay (OH) Bot: Brn f-c sand, sm silt, trace fibers (SM)		23.5		
1400 0800	8D	25.0 27.0	15-17 22-25	Brown fine to coarse sand, some organic silt (SP-SM)	S&O	25 27		
	9D	30.0 32.0	8-7 13-10	Gray fine to coarse sand, trace gravel (SP)		30		
	10D	35.0 37.0	16-12 7-11	Do 9D (SP)		35		
	11D	40.0 42.0	9-12 12-14	Gray fine to medium sand (SP)	S_1	40		
	12D	45.0 47.0	8-13 15-17	Gray fine to coarse sand (SP)		45		
	13D	50.0 52.0	8-10 12-14	Gray fine to medium sand, trace coarse sand (SP)		50		

MONDAY, 2-25-85 - CLOUDY, 45°F - 50°F
TUESDAY, 2-26-85 - SHOWERS, 44°F

BORING NO. B-312U

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

FILE NO. 6102

BORING NO. B-312U

SURFACE ELEV. +14.4

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
TUESDAY 2-26-85 SHOWERS 44°F 1000	14D	53.0 55.0	10-11 13-13	Hard gray silty clay (CL)	S1 / C	53 55 60 65 70 75 80 85 90 95 100		End of boring @ 55.0'.

BORING NO. B-312U

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-312U
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.4 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-26-85	1000	55.0'	5.0'	7.5'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 30.0. NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 25.0. NO. OF 3" UNDISTURBED SAMPLES 3
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS JOHN IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-26-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-313U

SURFACE ELEV. +16.1

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1100	1D	0.0 2.0	PUSH	Topsoil				
	2D	5.0 7.0	7-18 21-19	Gray fine to medium sand (SP)		5		5'-80', used mud.
	3D	10.0 12.0	12-17 20-24	Do 2D (SP)	F	10		
	4D	15.0 17.0	8-5 3-4	Do 2D (SP)		15		
	5U	18.0 20.0	P=24" R=22"	Stiff brn peat and dk gry organic silty clay (Pt & OH)		18		
	6D	20.0 22.0	4-4 3-4	Medium dark gray organic silt (OH)	O	20		
	7U	22.0 24.0	P=24" R=22"	Stiff dark brown organic silty clay, some peat (OH & Pt)		23		
	8D	24.0 26.0	2-2 5-7	Dark gray medium to fine sand, some organic silt (SM)	S&O	25		
	9D	30.0 32.0	5-6 8-13	Gray brown fine to coarse sand, trace silt, gravel (SP)		30		
1430 0800	10D	35.0 37.0	6-6 7-8	Brown fine to coarse sand, trace gravel (SP)		35		
	11D	40.0 42.0	6-9 10-11	Do 10D (SP)	S_1	40		
	12D	45.0 47.0	7-8 8-10	Gray fine to medium sand, trace coarse sand (SP)		45		
	13D	50.0 52.0	5-5 7-7	Do 12D (SP)		50		

FRIDAY, 2-22-85 - CLOUDY, 42°F-48°F

MONDAY, 2-25-85 - 45°

BORING NO. B-313U

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-313U

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +16.1

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
					S_1	53		
	14D	55.0 57.0	2-2 3-3	Stiff gray silty clay, trace fine sand (CL)		55		
	15D	60.0 62.0	4-4 9-8	Do 14D (CL)	C	60		
MONDAY, 2-25-85 - 45°	16D	65.0 67.0	3-3 3-5	Stiff gray silty clay, some silty fine sand layers (CL)		65		
	17D	70.0 72.0	8-10 18-38	Gray silty fine to medium sand, trace gravel, clay (SM)		70		
	18D	75.0 77.0	5-4 9-11	Gray silty fine to medium sand, trace gravel (SM)	S_2	75		
± 1200	19D	78.0 80.0	11-12 16-15	Gray silty fine to medium sand (SM)		80		End of boring @ 80.0'.
						85		
						90		
						95		
						100		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-313U
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +16.1 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4", 2 15/16", 2 1/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-25-85	1200	80.0'	5.0'	14.0'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 50.0 . NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 30.0 . NO. OF 3" UNDISTURBED SAMPLES 2
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JOE IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-25-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-313U

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-314U

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +18.3

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0730	1D	0.0 2.0	7-9 9-12	Top: Topsoil Bot: Brown fine to medium sand, trace silt (SP-SM)		5		
	2D	5.0 7.0	10-17 25-25	Brown fine to medium sand, trace silt (SP-SM)	F	10		5'-57', used mud.
	3D	10.0 12.0	9-17 25-25	Gray fine to medium sand (SP)		15		
	4UD	15.0 17.0	P=24" R=6"	Do 3D, trace shells (SP)		18		
	5U	18.0 20.0	P=24" R=24"	Stiff dark gray organic silty clay and peat (OH & Pt)	O	20		
	6D	20.0 22.0	9-10 11-13	Gray fine to medium sand, some organic silt (SM)	S&O	25		
	7D	25.0 27.0	10-10 11-13	Do 6D, trace roots (SM)		27		
	8D	30.0 32.0	12-19 24-27	Gray brown medium to fine sand, trace gravel (SP)		30		
	9D	35.0 37.0	15-18 27-28	Gray brown coarse to fine sand (SP)	S_1	35		
	10D	40.0 42.0	8-9 9-10	Brown medium to fine sand, trace coarse sand, silt (SP)		40		
	11D	45.0 47.0	8-10 10-9	Gray fine to medium sand (SP)		45		
	12D	50.0 52.0	8-9 9-11	Do 11D (SP)		50		

FRIDAY, 2-22-85 - CLOUDY, 40°F

BORING NO. B-314U

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-314U

SURFACE ELEV. +18.3

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
FRIDAY 2-22-85					S_1	54		
	13D	55.0	8-10	Hard gray silty clay, trace fine		55		
		57.0	10-12	sand (CL)	C	57		End of boring @ 57.0'
1430						60		
						65		
						70		
						75		
						80		
						85		
						90		
						95		
						100		

BORING NO. B-314U

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-314U
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +18.3 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-22-85	1330	57.0'	-	8.5'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 32.0 . NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 25.0 . NO. OF 3" UNDISTURBED SAMPLES 1
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-22-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6102
BORING NO. B-315P
SURFACE ELEV. +15.5

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. GERALD C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0830	1D	0.0 2.0	12-11 11-13	Brown medium to fine sand, some silt, trace clay pockets, gravel (SM)			PUSHED PUSHED 15 29 63	
	2D	5.0 7.0	12-25 25-28	White fine to medium sand, trace coarse sand, shells (SP)	F	5 10	15 25 37 44 61	
	3D	10.0 12.0	15-23 27-44	Gray fine to medium sand, trace coarse sand, shells (SP)		14 15	27 39 61 69 83	
	4D	15.0 17.0	2-2 3-3	Black organic silty clay, some medium to fine sand, trace roots (OH)	O	19 20	24 33 40 43 59	
	5D	20.0 22.0	12-24 30-35	Tan coarse to fine sand, trace gravel (SP)		25	31 47 63 79 96	
	6D	25.0 27.0	11-15 19-17	Do 5D (SP)		30	40 57 69 81 115	
	7D	30.0 32.0	12-15 19-27	Do 5D (SP)	S_1	35	43 64 79 89 102	
	8D	35.0 37.0	11-14 16-21	Do 5D (SP)		40	47 63 75 89 96	
	9D	40.0 42.0	7-7 8-7	Tan fine to coarse sand (SP)		45	54 71 78 83 81	
	10D	45.0 47.0	4-7 7-13	Do 9D, trace gravel (SP)		48.5 50	55 74 86 97 117	
1350	11D	50.0 52.0	12-12 13-17	Stiff gray silty clay, trace silty fine sand layers (CL)	C	52		End of boring @ 52.0'.

MONDAY, 2-18-85 - SUNNY, 35°F

BORING NO. B-315P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-315P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +15.5 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4, DEPTH FROM 0.0' TO 50.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300, AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC, ID 1.25", LENGTH 25.0', TOP ELEV.
INTAKE POINT: TYPE PVC-SLOTTED, OD 1.5", LENGTH 5.0', TIP ELEV. -14.5'
FILTER: MATERIAL SAND, OD 4.0", LENGTH , BOT. ELEV. -36.5'

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 2-18-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

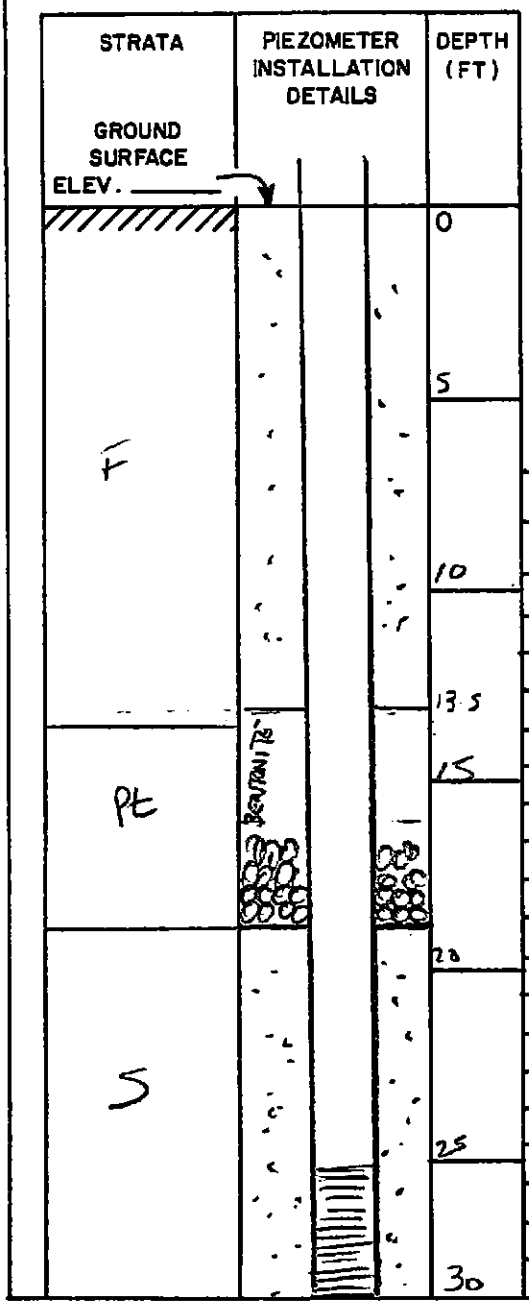
SHEET 3 OF 3
FILE NO. 6102
SUBCODE _____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

PROJECT CEDAR CREEK WRCP
PIEZOMETER NO. B 315P
LOCATION Wantagh NY
PIEZOMETER LOCATION _____
DATE OF INSTALLATION 2-18-85
☐ SEE SKETCH ON BACK
RES. ENG. G.C. BRAUN



PIEZOMETER TYPE _____

INTAKE POINT

depth to bottom, ft = 30
depth to top, ft = 25
length, ft = 5 = L
diameter, in = 1 1/4, ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = _____
diameter, in = ____, ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. +15.5

PIEZOMETER NO. B-315P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-316P

SURFACE ELEV. +13.7

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0830	1D	0.0	5-4	Top: Topsoil			10	
		2.0	3-4	Bot: Gray medium to fine sand, trace silt (SP)	F		18	
							13	
							15	
2-14-85						5	18	
	2D	5.0	2-1	Top: Do 1D, Bottom (SP)				
		7.0	25-75	Bot: Gray-white fine to coarse sand, some gravel and concrete fragments (SP)		7		End of boring @ 7.0'
1030								Hole abandoned. Hit obstruction @ 7.0'.
						10		
						15		
						20		
						25		
						30		
						35		
						40		
						45		
						50		

BORING NO. B-316P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-316P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300, AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 7.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS HOLE WAS ABANDONED DUE TO UNDERGROUND UTILITIES
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-14-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6102
BORING NO. B-316P(A)
SURFACE ELEV. +13.7

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1030				0'-10' NO SAMPLES TAKEN. SEE LOG FOR BORING NO. B-316P.				0-5', casing blows not recorded.
						5		
							17	
							21	
					F		24	
							30	
						10	32	
	1D	10.0	13-20				20	
		12.0	18-20				26	
							29	
						14	48	
						15	36	
	2D	15.0	2-2	Top:Gry org silty clay,sm Pt(OH-Pt)	O		22	
		17.0	4-4	Bot: Gray m-f sand, sm org silt(SM)			20	
	3D	17.0	4-5	Gray medium to fine sand, trace			24	
		19.0	8-9	gravel, silt (SP)	S&O		23	
						20	30	
	4D	20.0	3-5	Light gray silty fine to medium		21	24	
		22.0	7-11	sand, trace organic silt (SM)			29	
							41	
							52	
						25	80	
	5D	25.0	13-10	Gray medium to fine sand (SP)			31	
		27.0	18-10				37	
							43	
					S1		54	
						30	61	
	6D	30.0	4-6	Do 5D (SP)			37	
		32.0	8-8				49	
							60	
							69	
						35	71	
	7D	35.0	3-3	Do 5D (SP)			45	
		37.0	9-7				39	
							49	
							51	
						40	60	
	8D	40.0	4-8	Do 5D, trace coarse sand				End of boring
1400		42.0	9-11	(SP)		42		@ 42.0'.
						45		
						50		

THURSDAY, 2-14-85 - 29°F

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-316P(A)
LOCATION WANTAGH, NEW YORK
BORING LOCATION OFFSET 20' SOUTHWEST OF B-316P
SURFACE ELEVATION +13.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 40.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-14-85	1400	42.0	40.0	12.0	AT COMPLETION
2-15-85	0800			11.0'	PIEZOMETER READING
2-19-85	1305			11.2'	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 34.5' , TOP ELEV. +14.2
INTAKE POINT: TYPE PVC-SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. -25.3
FILTER: MATERIAL SAND , OD 3.0" , LENGTH , BOT. ELEV. -28.3

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 35.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-14-85

NOTES:

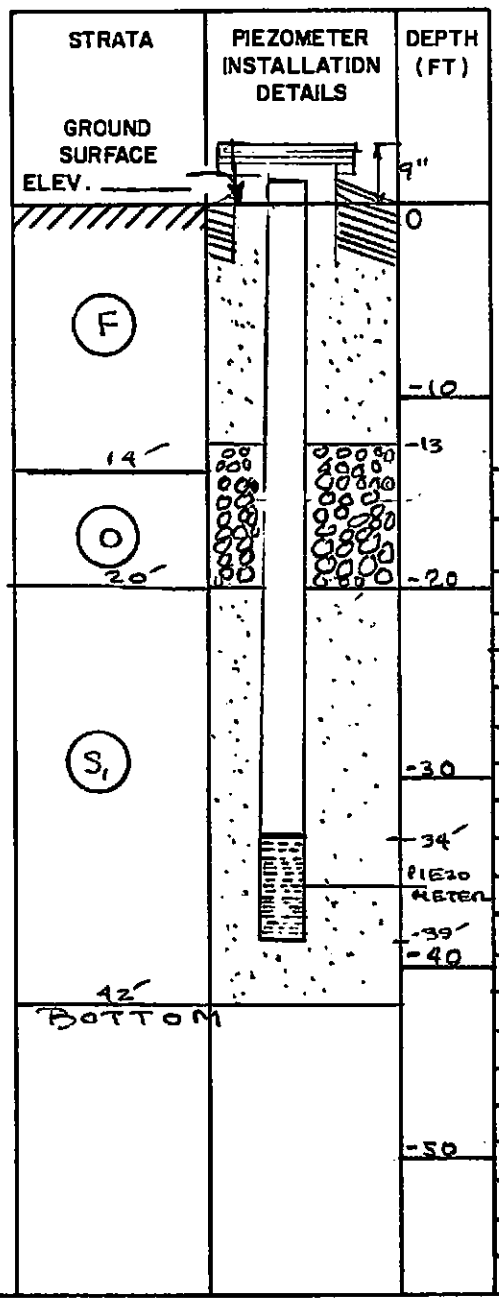
1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, rscovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

SHEET 3 OF 3
FILE NO. 6102
SUBCODE

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
CONSULTING ENGINEERS

PIEZOMETER RECORD

PROJECT CEDARCREEK WPCP EXPANSION PIEZOMETER NO. 316 P(A)
LOCATION WANTAGH, N.Y.
PIEZOMETER LOCATION NORTH SIDE OF THE PUMPING WELL DATE OF INSTALLATION 2-14-85
☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE



PIEZOMETER TYPE PVC.

INTAKE POINT
depth to bottom, ft = 39.0'
depth to top, ft = 34.0
length, ft = 5.0 = L
diameter, in = 1¼, ft = ____ = 2R

STANDPIPE/RISER
elevation of rim, ft = +14.20
diameter, in = 1¼, ft = ____ = 2r

READING TIME		DEPTH - RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
2-15	0800	11.0' (G.S.)	+2.70'	
PUMPED IN WATER FOR 2 MIN.				COULD NOT FILL.
2-19	1305	11.2'	+2.5	

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. +13.70

PIEZOMETER NO. 316P(A)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6102
BORING NO. B-317UP
SURFACE ELEV. +16.1

PROJECT CEDAR CREEK WWTP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN. MUKHERJEE

DAILY PROGRESS

1415 2-14-85
1500
0800
FRIDAY, 2-15-85 - CLOUDY, 29°F
1500

SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1D	0.0 2.0	6-8 8-12	Top: Topsoil Bot: Gray medium to fine sand, trace silt (SP-SM)			15 27 39 40	
2D	5.0 7.0	18-27 30-41	Gray medium to fine sand, some organic silt (SM)	F	5	55 27 46 97 119	
3D	10.0 12.0	8-15 27-39	Gray medium to fine sand (SP)		10	205 58 76 102	
4U 5U	15.0 17.0 17.0 19.0	P=24" R=21" P=24 R=21"	Stiff gray organic silty clay, trace fine sand (OH) Top: Do 4U (OH) Bot: Gray brown coarse to fine sand, trace organic silt (SP)	0 S&O	14.5 15 18 19	155 145 49 54 66 73	
6D	20.0 22.0	9-14 18-23	Gray brown medium to fine sand (SP)	S1	20 25	85 59 89 97 127 175	
7D	25.0 27.0	10-17 21-25	Gray brown fine to medium sand, trace coarse sand (SP)		30	68 93 124 143 151	
8D	30.0 32.0	13-15 19-17	Gray brown fine to medium sand (SP)		35	68 79 94 134 155	
9D	35.0 37.0	11-15 17-21	Do 8D (SP)		37		End of boring @ 37.0'
					40		
					45		
					50		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-317 UP
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +16.1 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 35.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 3/4
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-15-85	1445	37.0	35.0	8.0	
2-19-85	1310			14.0	PIEZOMETER READING

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 29.5' , TOP ELEV. +16.6
INTAKE POINT: TYPE PVC SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. -18.0
FILTER: MATERIAL SAND , OD 4.0" , LENGTH , BOT. ELEV. -20.9

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 17.0'. NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 20.0'. NO. OF 3" UNDISTURBED SAMPLES 2
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-17-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

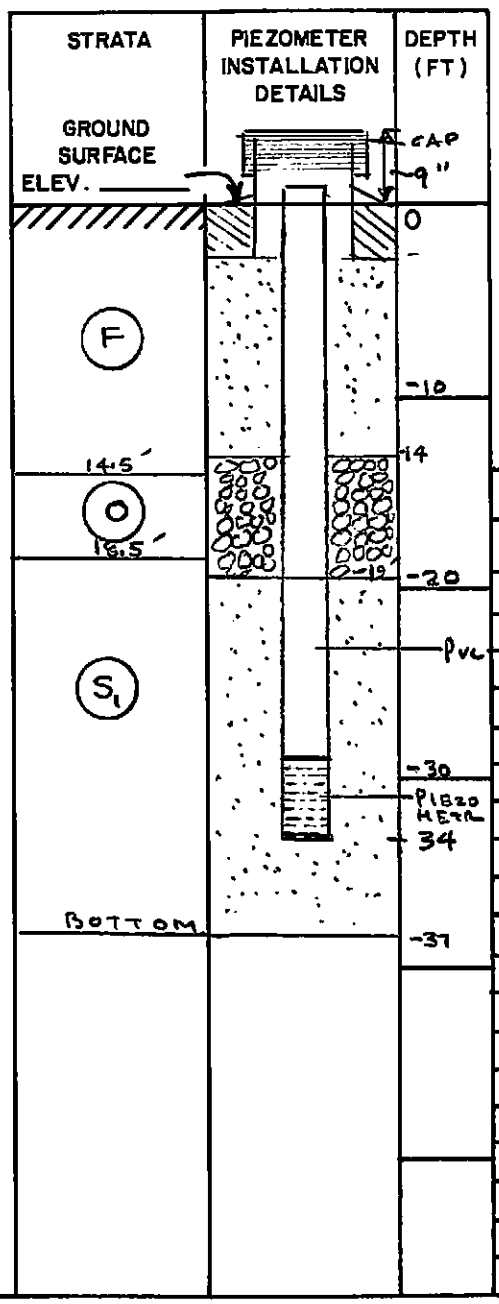
PROJECT CEDARCREEK WPCP EXPANSION PIEZOMETER NO. 317 UP

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION _____ DATE OF INSTALLATION 2-15-85

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE

PIEZOMETER TYPE Pvc



INTAKE POINT

depth to bottom, ft = -34.0

depth to top, ft = -29.0

length, ft = 5.0 = L

diameter, in = 1 1/4", ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = +16.60

diameter, in = 1 1/4", ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
2-15	1400	8' (6.5)	+8.10'	
COULD NOT FILL TUBE PIEZOMETER.				
2-19	1310	14.0'	+2.0'	

Sand Bentonite

Gravel Grout

GROUND SURFACE ELEV. +16.10

PIEZOMETER NO. 317 UP

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-318P

SURFACE ELEV. +18.0

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. GERALD C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0835 MONDAY 2-18-85 SUNNY, 35°F	1D	0.0 2.0	PUSH	Brown fine to medium sand, some silt, trace clay layers, gravel (SM)	(F)	5		
	2D	5.0 7.0	1-2 2-2	White fine to medium sand, trace coarse sand, gravel (SP)		8		End of boring @ 8.0'.
0900						10		Hole abandoned. Hit obstruction @ 8.0'.
						15		
						20		
						25		
						30		
						35		
						40		
						45		
						50		

BORING NO. B-318P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-318P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +18.0 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 8 . NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS HIT OBSTRUCTION - ELECTRIC UTILITY
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-18-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-318P(A)

SURFACE ELEV. +18.0

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. GERALD C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0910							5	
							11	
							18	
							23	
				0'-10' NO SAMPLES TAKEN. SEE LOG FOR BORING NO. B-318P.		5	17	
							10	
							14	
							31	
							30	
						10	33	
	1D	10.0 12.0	3-3 3-3	White fine to medium sand, trace shells (SP)			10	
							14	
					F		14	
							20	
						15	23	
	2D	15.0 17.0	2-2 3-4	Brown fine to medium sand, trace coarse sand, silt (SP)			12	
							13	
							14	
							14	
						20	20	
	3D	20.0 22.0	1-1 3-2	Do 2D, trace shells (SP)			13	
							14	
							10	
							18	
						25	21	
	4D	25.0 27.0	1-1 2-2	Gray white fine to medium sand, trace coarse sand, shells (SP)			21	
						27	23	
							30	
					S1		44	
						30	51	
	5D	30.0 32.0	4-8 7-10	Tan coarse to fine sand (SP)				End of boring @ 32.0'.
1045						32		
						35		
						40		
						45		
						50		

MONDAY, 2-18-85 - SUNNY, 35°F

BORING NO. B-318P(A)

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-318P(A)
LOCATION WANTAGH, NEW YORK
BORING LOCATION OFFSET 20' ± EAST OF B-318P
SURFACE ELEVATION +18.0 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4, DEPTH FROM 0.0' TO 30.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300, AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC, ID 1.25", LENGTH 26.5', TOP ELEV.
INTAKE POINT: TYPE PVC SLOTTED, OD 1.5", LENGTH 2.5', TIP ELEV. -11.0
FILTER: MATERIAL SAND, OD 4", LENGTH , BOT. ELEV. -14.0

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 24'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS JR.
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 2-18-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

SHEET 3 OF 3
FILE NO. 4102
SUBCODE

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

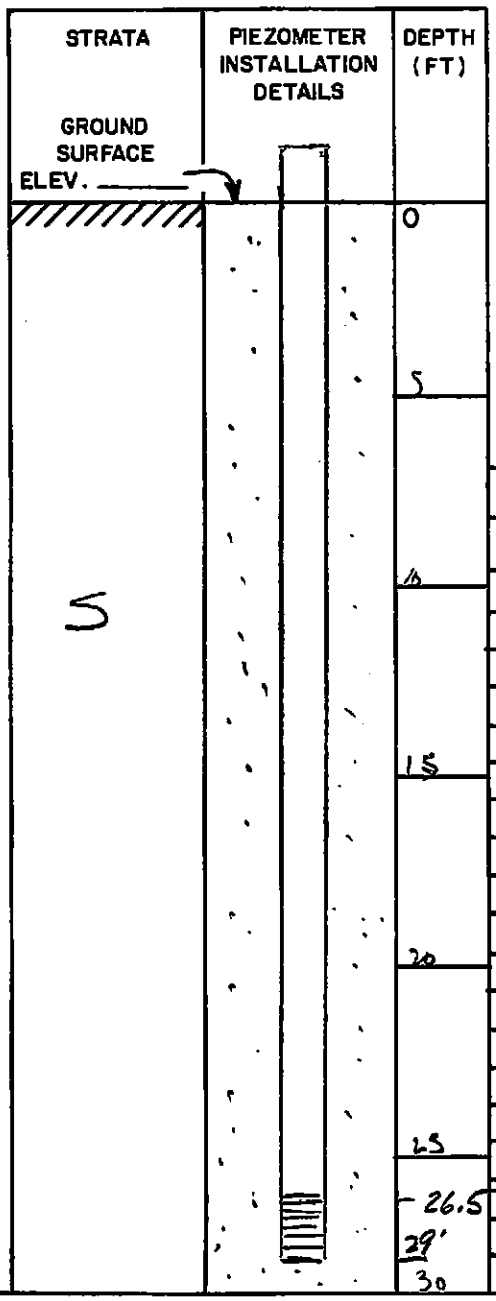
PROJECT CEDAR CREEK WPCP — PIEZOMETER NO. B-318P(A)

LOCATION

PIEZOMETER LOCATION — DATE OF INSTALLATION 2-18-83

☐ SEE SKETCH ON BACK — RES. ENG. G.C. BRAUN

PIEZOMETER TYPE PVC



INTAKE POINT

depth to bottom, ft = 29

depth to top, ft = 26 1/2

length, ft = 2 1/2 = L

diameter, in = 1 1/4, ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = _____

diameter, in = ____, ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			

Sand Bentonite

Gravel Grout

GROUND SURFACE ELEV. +18.0

PIEZOMETER NO. B-318P(A)

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-319P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0 0' TO 20.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 1/4
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-19-85	1330	-	13.0'	11.4'	PIEZOMETER READING

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED, SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 8.5' , TOP ELEV. +14.3
INTAKE POINT: TYPE PVC-SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. + 0.8
FILTER: MATERIAL SAND , OD 3.0" , LENGTH 12.0' , BOT. ELEV. - 0.2

PAY QUANTITIES
2½" DIA. DRY SAMPLE BORING, LIN. FT. 22.0 . NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-15-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

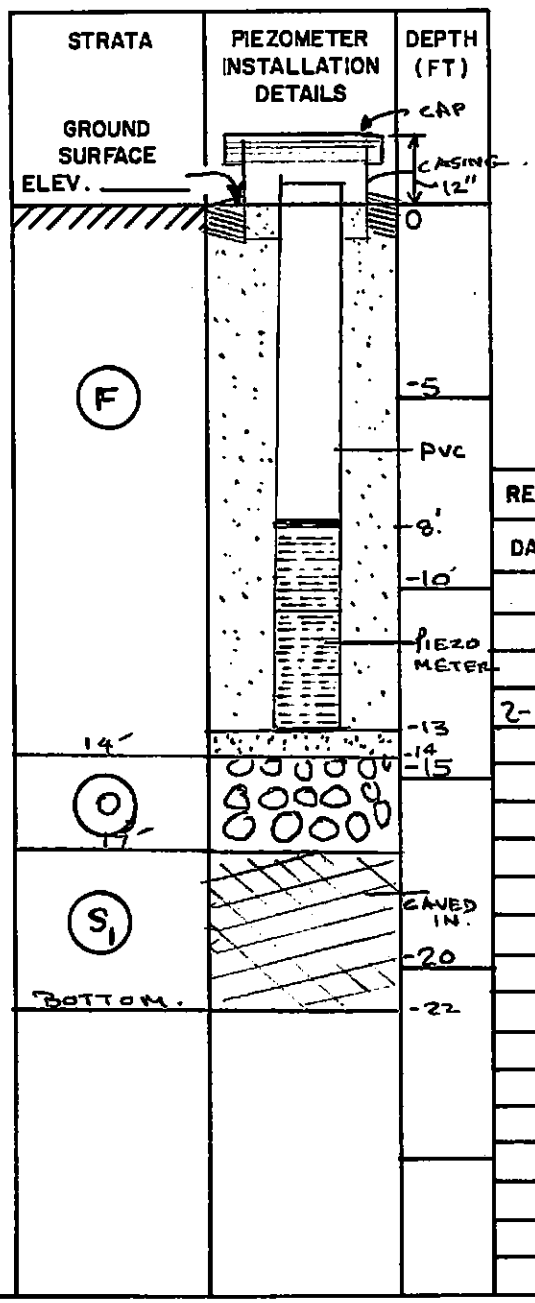
PROJECT CEDAR CREEK WPCP EXPANSION — PIEZOMETER NO. 319 P

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION — DATE OF INSTALLATION 2-15-85

☐ SEE SKETCH ON BACK — RES. ENG. B. MUKHERJEE.

PIEZOMETER TYPE PVC.



INTAKE POINT

depth to bottom, ft = -13.0

depth to top, ft = -8.0

length, ft = 5.0 = L

diameter, in = 1 1/4", ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = +14.25

diameter, in = 1 1/4", ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
FILL THE PIEZOMETER TO THE TOP.				
W.T. DROPS TO 11.6' IN 1 MIN.				
2-19	1315	11.4'	+2.35'	

Sand ▨ Bentonite

Gravel ▨ Grout

GROUND SURFACE ELEV. +13.75'

PIEZOMETER NO. 319 P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-319P

SURFACE ELEV. +13.8

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1300	1D	0.0	4-4	Top: Topsoil			41	
		2.0	8-9	Bot: Brown medium to fine sand, some silt (SM)			40	
							38	
							54	
						5	53	
	2D	5.0	11-10	Light gray medium to fine sand			20	
		7.0	9-6	(SP)	F		26	
							29	
							30	
						10	33	
2-15-85	3D	10.0	7-9	Do 2D (SP)			14	
		12.0	16-17				11	
							26	
						14	20	
						15	13	
	4D	15.0	3-3	Medium gray organic silt, some			21	
		17.0	2-3	fine sand (OH)	O	17	24	
	5D	17.0	2-3	Gray medium to fine sand, some			29	
		19.0	5-6	silt, trace organic silt (SM)	S&O		43	
						20	48	
	6D	20.0	10-18	Brown medium to fine sand, trace				
		22.0	21-24	coarse sand, silt (SP)	S1	22		End of boring @ 22.0'.
1500								
						25		
						30		
						35		
						40		
						45		
						50		

BORING NO. B-319P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-320P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.6 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0, DEPTH FROM 0.0' TO 30.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 15/16"
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300, AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-15-85	1200	32.0'	30.0'	12.5'	
2-19-85	1320			11.5'	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC, ID 1.25", LENGTH 24.5', TOP ELEV. +14.1
INTAKE POINT: TYPE PVC-SLOTTED, OD 1.5", LENGTH 5.0', TIP ELEV. -15.4
FILTER: MATERIAL SAND, OD 3.0", LENGTH 16.0', BOT. ELEV. -18.4

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 32.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-15-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
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6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

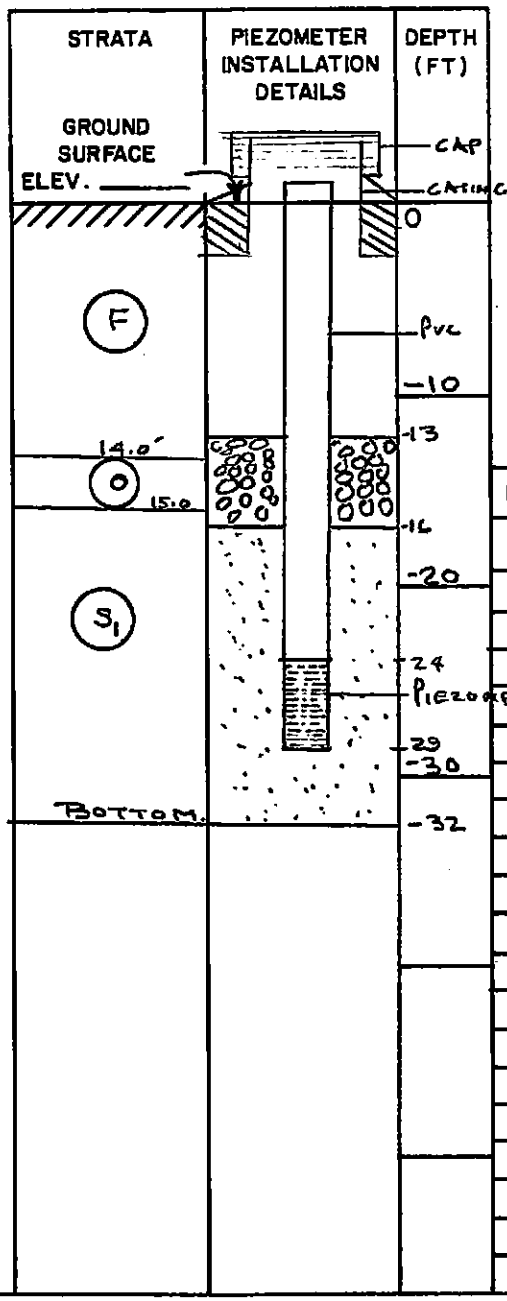
PROJECT CEDAR CREEK WPCP. EXPANSION PIEZOMETER NO. 320P

LOCATION WANTAGH, NY.

PIEZOMETER LOCATION DATE OF INSTALLATION 2-15-85

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE

PIEZOMETER TYPE PVC



INTAKE POINT

depth to bottom, ft = 29.0'
depth to top, ft = 24.0
length, ft = 5.0' = L
diameter, in = 1 1/4", ft = = 2R

STANDPIPE/RISER

elevation of rim, ft = 14.10
diameter, in = 1 1/4", ft = = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
COULD NOT FILL UP THE PIEZOMETER				
2-19	1320	11.5'	+2.1'	

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. 13.60

PIEZOMETER NO. 320P

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-321

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

SURFACE ELEV. +13.8

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0800	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand(SP)				
				No sample taken at 5.0'. Roller bitted to 10.0' to check for utilities.	F	5		5'-52', used mud.
	2D	10.0 12.0	10-26 23-20	Gray fine to medium sand (SP)		10 14		
THURSDAY, 2-28-85 - SUNNY, 24°F	3D	15.0 17.0	1-1 2-2	Medium dark gray organic silt and peat (OH & Pt)	O	15 17		Note: Boring was relocated twice because of obstruction (Underground utility)
	4D	20.0 22.0	6-4 20-21	Brown fine to medium sand, trace coarse sand (SP)		20		
	5D	25.0 27.0	5-9 12-8	Gray brown fine to medum sand, trace coarse sand (SP)		25		
	6D	30.0 32.0	4-5 8-9	Gray brown fine to coarse sand (SP)	S_1	30		
	7D	35.0 37.0	4-7 10-9	Gray brown fine to coarse sand (SP)		35		
	8D	40.0 42.0	5-6 9-9	Gray brown fine to medium sand (SP)		40		
	9D	45.0 47.0	5-9 10-14	Gray fine to coarse sand (SP)		45 49		
1130	10D	50.0 52.0	3-4 7-8	Stiff gray silty clay, trace fine sand (CL)	C	50 52		End of boring @ 52.0'.

BORING NO. B-321

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-321
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE
TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-28-85	1130	52.0'	5.0'	10.0'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES
2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JOE IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-28-85

NOTES:
1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102
BORING NO. B-322
SURFACE ELEV. +15.4

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1045	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Brown silty fine to coarse sand, trace gravel (SM)		5		
	2D	5.0 7.0	7-7 10-13	Gray fine to medium sand, trace silt (SP)	F	10		5'-52', used mud.
	3D	10.0 12.0	5-7 9-4	Gray fine to medium sand (SP)		15		
	4D	15.0 17.0	1-1 1-1	Medium dark gray organic silt and peat (OH & Pt)	O	18		
						20		
WEDNESDAY, 2-27-85	5D	20.0 22.0	5-4 5-3	Gray brown fine to medium sand, some silt, trace coarse sand (SM)	S&O	23		
						25		
	6D	25.0 27.0	6-6 8-10	Gray fine to coarse sand, trace gravel, silt (SP)		30		
	7D	30.0 32.0	7-13 12-8	Gray fine to coarse sand, trace silt (SP)		35		
	8D	35.0 37.0	5-6 7-11	Gray fine to coarse sand, trace silt (SP)	S_1	40		
	9D	40.0 42.0	5-6 8-6	Gray fine to medium sand, trace coarse sand (SP)		45		
	10D	45.0 47.0	7-10 15-9	Do 9D (SP)		49.5		
	11D	50.0 52.0	6-9 11-9	Stiff gray silty clay (CL)	C	50 52		End of boring @ 52.0'.
1230								

BORING NO. B-322

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-322
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +15.4 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS RW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-27-85	1230	52.0	5.0	7.5'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JOE IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-27-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. [illegible]

BORING No. B-322

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-323

SURFACE ELEV. +14.5

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1030	1D	0.0 2.0	4-7 7-9	Top: Topsoil Bot: Gray fine to medium sand(SP)				
						5		
	2D	5.0 7.0	4-3 5-7	Gray fine to medium sand, trace gravel (SP)				5'-52', used mud.
					F			
						10		
	3D	10.0 12.0	2-5 15-21	Gray fine to medium sand, trace shells (SP)				
						15		
	4D	15.0 17.0	10-6 3-5	Top: Do 3D (SP) Bot: Medium gray organic silt and peat (OH & Pt)		16		
					0	18		
						20		
	5D	20.0 22.0	7-7 8-7	Gray fine to coarse sand, trace silt (SP-SM)				
						25		
	6D	25.0 27.0	7-12 20-25	Gray fine to medium sand (SP)				
						30		
	7D	30.0 32.0	9-14 17-21	Gray fine to medium sand, trace coarse sand (SP)				
					S_1	35		
	8D	35.0 37.0	6-7 9-14	Brown fine to medium sand (SP)				
						40		
	9D	40.0 42.0	6-7 9-9	Brown fine to medium sand, trace coarse sand (SP)				
						45		
	10D	45.0 47.0	3-4 15-17	Gray fine to medium sand, trace gravel (SP)				
						50		
1330	11D	50.0 52.0	14-20 21-30	Gray fine to medium sand (SP)		52		End of boring @ 52.0'.

TUESDAY, 2-26-85 - CLOUDY 44°F-48°F

BORING NO. B-323

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-323
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.5 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-26-85	1330	52.0'	5.0'	7.0	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS JOHN IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-26-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-324

SURFACE ELEV. +14.8

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1330 TUESDAY, 2-26-85 - OCC.DRIZZLE, 45°F	1D	0.0 2.0	PUSH	Topsoil				
	2D	5.0 7.0	9-9 11-12	Brown fine to medium sand, trace silt, gravel (SP-SM)		5		5'-52', used mud.
	3D	10.0 12.0	5-7 8-8	Gray fine to medium sand, trace silt (SP)	F	10		
	4D	15.0 17.0	11-10 7-3	Do 3D (SP)		15		
						17.5		
1515	5D	20.0 22.0	1-1 1-1	Medium dark gray organic silt, some peat (OH & Pt)	O	20		
0730	6D	25.0 27.0	1-1 2-2	Do 5D (OH & Pt)		25 27		
WEDNESDAY, 2-27-85 CLOUDY, 45°F	7D	30.0 32.0	15-14 16-16	Gray brown fine to medium sand, some organic silt (SM)	S&O	30		
	8D	35.0 37.0	5-6 10-9	Do 7D (SM)		35		
	9D	40.0 42.0	7-8 11-14	Do 7D (SM)		40 42		
	10D	45.0 47.0	14-14 14-16	Gray fine to coarse sand, some silt (SM)	S_1	45		
						50		
1000	11D	50.0 52.0	15-13 19-21	Gray fine to medium sand, trace silt (SP-SM)		52		End of boring @ 52.0'

BORING NO. B-324

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-324
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0 TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-27-85	1000	52.0'	5.0'	4.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JOE IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-27-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-325P

SURFACE ELEV. +14.5

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0730	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand (SP)			10 11 12 12	
						5	13	
	2D	5.0 7.0	4-4 5-5	Do 1D Bottom (SP)	F		9 10 11 12	
						10	12	
	3D	10.0 12.0	3-2 4-4	Do 1D Bottom (SP)			8 10 18 24	
						15	26	
	4D	15.0 17.0	1-1 1-1	Medium gray peat (Pt)	O	17	7 8 10 23	
					S&O	20	24	
	5D	20.0 22.0	3-6 11-13	Top: Gray silty medium to fine sand, trace clay (SM) Bot: Brown fine to medium sand, trace silt (SP-SM)		21	23 27 30 70	
						25	78	
	6D	25.0 27.0	6-8 10-13	Gray brown medium to fine sand, trace silt (SP)	S_1		24 30 41 54	
						30	63	
	7D	30.0 32.0	5-7 7-6	Do 6D, trace gravel (SP)			42 41 59 48	
						35	56	
1030	8D	35.0 37.0	4-6 6-7	Gray fine to medium sand, trace coarse sand (SP)		37		End of boring @ 37.0'.
						40		
						45		
						50		

FRIDAY, 2-22-85 - CLOUDY, 40°F

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-325P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.5 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0, DEPTH FROM 0.0' TO 35.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 1/4"
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-22-85	1400			12.5'	PIEZOMETER READING

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 28.8' , TOP ELEV. +15.0
INTAKE POINT: TYPE PVC SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. -18.8
FILTER: MATERIAL SAND , OD 3.0" , LENGTH 16.0' , BOT. ELEV. -22.5

PAY QUANTITIES
2½" DIA. DRY SAMPLE BORING, LIN. FT. 37.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-22-85

NOTES:
1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

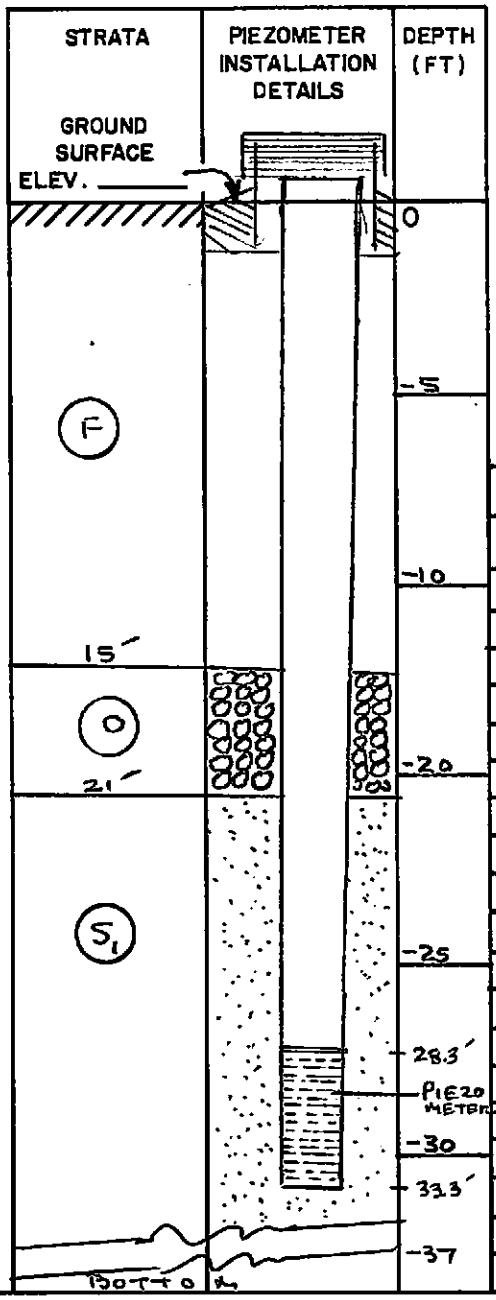
PROJECT CEDARCREEK WPCP EXPANSION. PIEZOMETER NO. 325 P

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION _____ DATE OF INSTALLATION 2-22-85

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE

PIEZOMETER TYPE PVC (SLOTTED)



INTAKE POINT

depth to bottom, ft = 33.3
depth to top, ft = 28.3
length, ft = 5.0 = L
diameter, in = 1¼, ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = +15.0
diameter, in = 1¼, ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
2-22	1400	12'6" (G.S.)	+2.0	
	MIN			
2-22	0	6'0"		
	1	11'0"		
	2	–		
	3	–		
	4	–		
	5	12'6"		

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. +14.50

PIEZOMETER NO. 325 P

SHEET 1 OF 3
FILE NO. 6102
BORING NO. B-326
SURFACE ELEV. +14.7

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1300	1D	0.0 2.0	PUSHED	Top: Topsoil Bot: Gray fine to medium sand (SP)				
	2D	5.0 7.0	12-17 24-16	Gray fine to medium sand (SP)		5		5'-79.5', used mud.
	3D	10.0 12.0	7-8 13-10	Do 2D (SP)	F	10		
	4D	15.0 17.0	10-12 17-18	Do 2D (SP)		15		
						18		
	5D	20.0 22.0	1-1 1-2	Medium gray organic silt, trace peat (OH)	O	20		
						23		
	6D	25.0 27.0	2-4 5-9	Gray fine to medium sand, trace silt (SP-SM)		25		
	7D	30.0 32.0	7-6 10-13	Gray fine to medium sand, trace silt (SP)	S_1	30		
1530	8D	35.0 37.0	6-7 8-8	Do 7D, trace gravel (SP)		35		
0800						40		
	9D	40.0 42.0	6-7 7-8	Gray fine to coarse sand, trace gravel, silt (SP)		45		
	10D	45.0 47.0	6-8 7-9	Gray fine to medium sand (SP)		49.5		
	11D	50.0 52.0	11-7 6-5	Stiff gray silty clay, trace fine sand (CL)	C	50		

MONDAY, 2-25-85 - PARTLY SUNNY, 48°F

TUESDAY, 2-26-85 - SHOWERS

BORING NO. B-326

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-326

SURFACE ELEV. +14.7

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
						55		
	12D	55.0 57.0	3-4 4-5	Do 11D (CL)				
						60		
	13D	60.0 62.0	4-4 6-9	Do 11D (CL)	C			
						65		
	14D	65.0 67.0	4-4 10-10	Do 11D (CL)				
2-26-85						70		
	15D	70.0 72.0	5-7 7-10	Gray silty fine to medium sand (SM)				
					S_2	75		
	16D	75.0 77.0	8-15 27-65	Gray fine to medium sand, some silt (SM)				
	17D	78.0 79.5	34-55 100	Gray medium to fine sand, trace silt (SP-SM)		79.5		End of boring @ 79.5'.
1200						80		
						85		
						90		
						95		
						100		

BORING NO. B-326

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-326
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW, D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER , U-SAMPLER
CORE BARREL , CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-26-85	1145	79.5	5.0'	13.5'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 79.5. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JOE IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-26-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (ROD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK RES. ENGR.

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1400 TUESDAY, 2-26-85 OCC DRIZZLE, 45°	1D	0.0 2.0	5-7 6-7	Top: Topsoil Bot: Brown fine to medium sand, trace silt, gravel (SP-SM)		5		
	2D	5.0 7.0	5-10 12-1B	Gray fine to medum sand (SP)	F	10		5'-80', used mud.
	3D	10.0 12.0	4-15 21-27	Do 2D (SP)		14 15		
	4D	15.0 17.0	4-8 6-5	Top: Medium gray organic silt (OH) Bot: Gray shells				
1515	5D	20.0 22.0	2-4 4-5	Gray-white shells, some fine sand	O	20		
7300	6D	25.0 27.0	2-3 3-4	Medium dark gray organic silt and peat (OH & Pt)		25 29		
WEDNESDAY, 2-27-85 PARTLY SUNNY 45°	7D	30.0 32.0	10-12 12-15	Brown fine to medium sand, trace silt, gravel (SP-SM)		30 35		
	8D	35.0 37.0	12-18 13-13	Gray fine to coarse sand, trace silt, shells (SP-SM)				
	9D	40.0 42.0	14-11 10-12	Gray brown fine to medium sand, trace silt (SP-SM)	S_1	40 45		
	10D	45.0 47.0	10-10 12-19	Gray fine to medium sand (SP)		49.5 50		
	11D	50.0 52.0	10-6 8-9	Stiff gray silty clay, some fine sand layers (CL)	C			

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-327

SURFACE ELEV. +13.9

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
WEDNESDAY, 2-27-85 PARTLY SUNNY, 45°	12D	55.0 57.0	10-12 9-8	Do 11D (CL)		55		
	13D	60.0 62.0	4-14 19-21	Hard gray silty clay, trace fine sand (CL)	C	60		
	14D	65.0 67.0	6-8 9-10	Stiff gray silty clay, trace fine sand (CL)		65		
	15D	70.0 72.0	11-15 17-25	Gray fine sand, some silt (SM)		68 70		
	16D	75.0 77.0	20-26 34-44	Gray fine sand, some silty clay (SM & CL)	S_2	75		
	17D	78.0 80.0	11-22 29-33	Do 16D (SM & CL)		80		End of boring @ 80.0'.
1200						85		
						90		
						95		
						100		

BORING NO. B-327

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-327

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +13.9 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0 TO 5.0'

DIAMETER, INCHES , DEPTH FROM TO

☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8

TYPE OF DRILLING MUD REVERT

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES

SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-27-85	1200	80.0'	5.0'	8.0'	MUD LEVEL

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON

STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.

INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.

FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 80.0 . NO. OF 2" SHELBY TUBE SAMPLES

DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER SAL DAMICO HELPERS JOHN IMPARATO

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-27-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run. Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-327

APPENDIX B

MRCE Reclassification of Samples from 1983 Borings

NOTE

1983 borings (200-series) were made in August and September, 1983. Samples were reclassified by MRCE in February 1985, about 18 months after the borings were made. Measured water contents are probably lower than in-situ values due to the age of the samples.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/6/85

CHECK BY ___ DATE ___

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-201	S-1	0	2	14-7-11-12		Tan medium to fine sand, trace silt (SP)
	S-2	5	7	3-3-6-6		Brown medium to fine sand, trace silt (SP)
	S-3	10	12	2-3-3-3		NO RECOVERY
	S-4	15	17	2-1-2-1		NO RECOVERY
	S-5	20	22	8-2-1-1		Gray coarse to fine sand, trace gravel (WASH) (SP)
	S-6	25	27	1-1-18-14		Gray coarse to fine sand, trace gravel, silt, shells (SP)
	S-7	38.5	40	20-45-50		Tan coarse to fine sand, trace silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CM DATE 2/4/85

CHECK BY____DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-202	S-1	0	2	2-4-3-6		Tan fine to coarse sand, trace shells, silt (SP)
	S-2	3	5	7-10-8-10		Tan fine to coarse sand, trace shells, silt (SP)
	S-3	5	7	7-6-10-12		Tan fine to coarse sand, trace silt, shells (SP)
	S-4	7	9	2-5-7-6		Tan fine to medium sand, trace coarse sand, silt (SP)
	S-5	9	11	3-5-6-9		Gray fine to medium sand, trace silt (SP)
	S-6	11	13	7-12-16-22		Gray fine to coarse sand, trace silt, shells (SP)
	S-7	13	15	17-27-26-28		Gray fine to coarse sand, trace silt, shells (SP)
	S-8	15	17	15-27-48-60		Tan fine to coarse sand, trace gravel, silt (SP)
	S-9	17	19	18-29-35-42		Gray fine to medium sand, trace gravel, silt (SP)
	S-10	19	21	14-16-33-46		Gray fine to medium sand, trace gravel, silt (SP)
	S-11	21	23	12-35-43-52		Gray fine to medium sand, trace coarse sand, silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/4/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-202	S-12	23	25	11-19-13-17		Brown fine to medium sand, trace gravel, silt (SP)
	S-13	25	27	4-6-4-7		Brown fine to medium sand, trace gravel, silt (SP)
	S-14	27	29	4-14-23-45		Brown fine to medium sand, trace gravel, silt (SP)
	S-15	30	32	16-33-31-30		Brown fine to medium sand, trace gravel, silt (SP)
	S-16	35	37	3-3-3-4		Brown fine to coarse sand, trace gravel, shells, silt (SP)
	S-17	40	40.9	30-75/4"		Brown coarse to fine sand, trace gravel, silt (SP)
	S-18	45	47	17-24-22-28		Brown fine to medium sand, trace silt (SP)
	S-19	50	52	7-7-9-12		Gray silty clay and silt layers, trace fine sand layers (CL+ML)
	S-20	55	57	11-16-20-27		Gray silty clay, trace silty fine sand layers (CL)
	S-21	60	62	9-14-18-22		Gray silty clay, trace silt layers (CL)
	S-22	65	67	8-13-13-20		Gray silty clay, trace silt layers (CL)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/4/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-202A	S-1	30	32	15-26-25-19		Brown fine to medium sand, trace gravel, silt (SP)
	S-2	32	34	7-10-10-8		Brown fine to medium sand, trace gravel, silt (SP)
	S-3	34	36	3-3-4-4		Brown fine to medium sand, trace coarse sand, silt (SP)
	S-4L	36	38	WR		NO RECOVERY
	S-5A	38	40	WR-WR-10-19		Tan fine to coarse sand, trace shells, gravel, silt (SP)
	S-5B	38	40	WR-WR-10-19		Brown fine to coarse sand, trace gravel, silt (SP)
	S-6	40	42	12-50-60/3"		Brown fine to coarse sand, trace gravel, silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-203	S-1	0	2	6-18-24-32		Brown coarse to fine sand, trace silt, shells (SP)
	S-2	2	4	28-22-30-44		Tan coarse to fine sand, trace silt (SP)
	S-3	4	6	14-21-40-21		Brown medium to fine sand, trace silt, brown silty clay pockets, gravel (SP)
	S-4	6	8	9-10-17-13		Brown medium to fine sand, trace gravel, silt (SP)
	S-5	8	10	7-11-8-7		Tan coarse to fine sand, some gravel, trace silt, shells (SP)
	S-6	10	12	4-4-4-4		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-7A	12	14	3-3-9-5		Brown coarse to fine sand, some gravel, trace silt, shells (SP)
	S-7B	12	14	3-3-9-5		Brown organic silty clay, trace organic fibers, some coarse to fine sand, trace gravel (CL+SP)
	S-8	14	16	3-5-2-2		Tan medium to fine sand, trace brown silty clay pockets, gravel (SP)
	S-9A	16	18	5-7-6-7	56.6	Gray silty clay (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-203	S-9B	16	18	5-7-6-7	160.2	Dark brown peat (Pt)
	S-10A	18	20	1-2-2-2	162.0	Dark gray organic silty clay, trace organic fibers (OH)
	S-10B	18	20	1-2-2-2	134.0	Black organic silty clay, trace organic fibers (OH)
	S-11	20	22	2-4-4-10		Black organic silty clay, trace organic fibers, some black silty fine to medium sand (OL)
	S-12	22	24	8-14-14-20		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-13	25	27	9-11-12-15		Brown coarse to fine sand, trace gravel, silt (SP)
	S-14	30	32	7-8-15-19		Brown coarse to fine sand, trace gravel, silt (SP)
	S-15	35	37	8-17-22-34		Brown coarse to fine sand, trace silt, black silty clay layers (SP)
	S-16	45	47	15-28-33-27		Brown coarse to fine sand, trace gravel, silt (SP)
	S-17	50	52	10-12-15-19		Gray silty clay, some silty fine sand layers (CL)
	S-18	55	57	4-14-16-25		Dark gray silty clay, trace silty fine sand layers (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CSM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-203	S-19	60	62	6-11-13-15		Dark gray silty clay, trace silty fine sand seams (CL)
	S-20A	65	67	20-18-25-22		Dark gray silty clay (CL)
	S-20B	65	67	20-18-25-22		Brown medium to fine sand, trace silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CTM DATE 2/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-204	S-1	1	3	12-17-24-35		Tan fine to coarse sand, trace silt, shells (SP)
	S-2	3	5	8-19-19-14		Tan fine to coarse sand, trace silt, shells (SP)
	S-3	5	7	4-8-10-8		Brown fine to coarse sand, trace silt, gravel (SP)
	S-4	7	9	9-9-11-14		Tan fine to coarse sand, trace silt (SP)
	S-5	9	11	2-2-3-3		Brown fine to coarse sand, trace gravel, silt (SP)
	S-6	11	13	2-2-3-4		Brown fine to coarse sand, trace gravel, silt (petroleum odor) (SP
	S-7	13	15	2-1-2-3		NO RECOVERY
	S-8	15	17	4-6-6-6		NO SAMPLE REMAINS
	S-9	17	19	1-2-2-1		Brown fine to coarse sand, trace silt, gravel (SP)
	S-10	19	21	WR-3-9-14		Tan fine to coarse sandy silt (ML)
	S-11	21	23	7-10-12-18		Brown coarse to fine sand, trace gravel, silt, gray clay lumps (SP)
	S-12	25	27	8-15-17-20		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CJM DATE 2/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-204	S-13	30	32	10-10-9-12		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-14	35	37	8-10-10-12		Brown coarse to fine sand, trace gravel, silt (SP)
	S-15	40	42	9-16-21-20		Brown coarse to fine sand, trace gravel, silt (SP)
	S-16	45	47	7-12-20-20		Brown fine to coarse sand, trace gravel, silt (SP)
	S-17	50	52	5-7-10-13		Dark gray silty clay, trace silty fine sand seams (CL)
	S-18	55	57	9-13-20-17		Dark gray silty clay, trace silty fine sand seams (CL)
	S-19	60	62	6-10-11-12		Dark gray silty clay, trace silt pockets (CL)
	S-20A	65	67	5-28-22-22		Dark gray silty clay, trace silt pockets, silty fine sand seams (CL)
	S-20B	65	67	5-28-22-22	–	Brown medium to fine sand, trace silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CSM DATE 2/5/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-205	S-1	0	2	7-7-10-12		Tan fine to medium sand, trace gravel, silt, shells (SP)
	S-2	2	4	4-13-13-20		Tan fine to medium sand, trace silt (SP)
	S-3	4	6	8-7-13-13		Tan fine to medium sand, trace silt, shells (SP)
	S-4	6	8	11-14-25-42		Tan fine to medium sand, trace gravel, silt (SP)
	S-5	8	10	17-35-40-29		Tan fine to medium sand, trace coarse sand, silt (SP)
	S-6	10	12	14-26-23-25		Gray fine to medium sand, trace coarse sand, silt (SP)
	S-7	12	14	11-13-10-9		Tan fine to medium sand, trace silt (SP)
	S-8	14	16	3-5-16-15		Gray fine to medium sand, trace coarse sand, silt, wood (SP)
	S-9	16	18	16-25-22-15		Tan fine to medium sand, trace coarse sand, silt, shells (SP)
	S-10	18	20	3-2-3-4	45.5	Dark gray silty clay (CL)
	U-1	20	22	Rec = 22"		
	S-11	22	24	4-9-12-15		Brown fine to coarse sand, trace gravel, silt, shells (SP)

B-205

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CSM DATE 2/5/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-205	S-12	30	32	9-14-17-17		Brown coarse to fine sand, trace gravel, silt (SP)
	S-13	35	37	11-21-19-18		Tan fine to coarse sand, trace gravel, silt (SP)
	S-14	40	42	5-13-11-14		Brown fine to coarse sand, trace silt (SP)
	S-15	45	47	7-17-25-20		Brown fine to medium sand, trace gravel, silt (SP)
	S-16	50	52	9-17-25-17		Brown fine to coarse sand, trace gravel, silt (SP)
	S-17	55	57	7-9-13-20		Dark gray silty clay, trace silty fine sand seams (CL)
	S-18	65	67	7-14-17-19		Dark gray silty clay, trace silty fine sand seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-206	S-1	0	2	3-17-24-70		Brown coarse to fine sand, trace silt, gravel (SP)
	S-2	5	7	13-48-90		Brown coarse to fine sand, trace silt, shells (SP)
	S-3	10	12	22-60-50/3"		Brown coarse to fine sand, trace silt, gravel (SP)
	S-4A	15	17	3-4-7-8		Gray fine to medium sand, trace silt, black silty clay pockets (SP)
	S-4B	15	17	3-4-7-8	129.6	Dark brown peat (Pt)
	S-5	17	19	2-3-5-8	75.3	Black organic silty clay, trace organic fibers (OH)
	S-6	20	22	3-5-4-4	82.3	Dark gray organic silty clay, trace organic fibers (OH)
	S-7	22	24	7-8-4-18	131.9	Dark brown organic silty clay, trace organic fibers (OH)
	S-8A	25	27	7-24-30-35		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8B	25	27	7-24-30-35		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-9	30	32	15-24-21-24		NO SAMPLE REMAINS

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-206	S-10	35	37	9-15-12-21		Tan coarse to fine sand, some gravel (WASH) (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-207	S-1	0	2	3-6-11-21		Brown coarse to fine sand, trace gravel, silt (SP)
	S-2	5	7	12-21-25-21		Gray medium to fine sand, trace silt (SP)
	S-3	10	12	11-12-14-16		Gray medium to fine sand, trace silt (SP)
	S-4	15	17	12-12-14-9		Gray medium to fine sand, trace silt (SP)
	S-5	18	20	2-3-3-4	73.1	Dark gray organic silty clay, trace organic fibers (OH)
	U-1	20	22	Rec=22"		
	S-6A	22	24	1-3-6-7	106.3	Black organic silty clay, trace organic fibers (OH)
	S-6B	22	24	1-3-6-7		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-7	24	26	5-4-7-11		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	30	32	15-15-18-20		Brown coarse to fine sand, trace gravel, silt (SP)
	S-9	35	37	12-14-14-14		Brown coarse to fine sand, trace gravel, silt (SP)

SHEET NO.____ OF ____

FILE 6102

MADE BY CJM DATE 2/11/85

CHECK BY____ DATE ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-207	S-10	40	42	10-12-14-13		Brown coarse to fine sand, trace gravel, silt (SP)
	S-11	45	47	9-12-14-15		Brown coarse to fine sand, trace gravel, silt (SP)
	S-12	50	52	12-18-21-21		Brown coarse to fine sand, trace gravel, silt (SP)
	U-2	60	62	Rec = 24"		
	S-13	62	64	8-13-20-22		Gray silty clay, trace silty fine sand seams (CL)
	U-3A	70	70.5	Rec = 6"		Gray silty clay (CL)
	U-3B	70	70.5	Rec = 6"		Greenish brown coarse to fine sand, trace silt (SP)
	S-14	80	82	12-14-21-21		Gray medium to fine sand, trace silt (SP)
	S-15	90	92	13-17-19-20		Gray medium to fine sand, trace silt, black silt layers (SM)
	S-16A	100	102	15-32-31-30		Black lignite
	S-16B	100	102	15-32-31-30		Gray medium to fine sand, trace silt, black silt layers (SP)
	S-17	115	116	75-50/2"		Brown medium to fine sand, trace silt, lignite (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CJM DATE 2/4/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-208	S-1	1	3	18-23-21-23		Brown fine to medium sand, trace coarse sand, silt, shells (SP)
	S-2	3	5	22-29-40-41		Brown fine to medium sand, trace coarse sand, silt, shells (SP)
	S-3	5	7	8-10-12-21		Brown fine to medium sand, some silt, trace coarse sand (SM)
	S-4	7	9	33-44-32-44		Brown fine to medium sand, some silt, trace coarse sand, shells (SM)
	S-5	9	11	9-9-6-6		Brown fine to medium sand, trace coarse sand, silt (SP)
	S-6	11	13	4-11-26-27		Brown and gray fine to medium sand, trace silt (SP)
	S-7	13	15	6-2-3-3		Gray fine sand, trace gray clayey silt layers (SP)
	U-1	15	17	Rec=24"		
	U-2	17	19	Rec=20"		
	S-8	19	21	5-2-2-2	45.3	Gray silty clay, trace shells (CL)
	U-3	21	23	Rec=24"		
	S-9	23	25	1-1-1-2	37.9	Gray silty clay (CL)
	S-10	25	27	Push		Brown coarse to fine sand, trace gravel (SP)
	S-11	30	32	10-12-14-15		Brown fine to coarse sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CM DATE 2/4/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-208	S-12	35	37	11-13-16-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	40	42	10-16-12-16		Brown fine to medium sand, trace silt (SP)
	S-14	45	47	9-14-16-25		Brown fine to coarse sand, trace silt (SP)
	S-15	50	52	6-9-12-15		Gray silty clay, trace silty fine sand seams (CL)
	S-16	55	57	9-16-16-21		Gray silty clay, trace silty fine sand seams, shell (CL)
	S-17	60	62	7-15-17-20		Gray silty clay, trace silty fine sand seams (CL)
	S-18	65	66	16-61		Gray fine to medium sand, some silt (SM)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/5/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-209	S-1	0	2	5-9-11-17		Brown fine to medium sand, trace silt, gravel (SP)
	S-2	5	7	1-2-2-1		Brown fine to medium sand, trace silt, shells (SP)
	S-3	10	12	8-19-30-35		Gray fine to medium sand, trace coarse sand, shells, silt (SP)
	S-4	15	17	3-5-4-5		Tan fine to coarse sand, trace shells, silt (SP)
	S-5B	18	20	2-3-12-17		Gray fine to coarse sand, trace silt (SP)
	S-5A	18	20	2-3-12-17		Gray fine sand, trace silt (SP)
	S-6A	20	22	5-2-3-6	60.1	Dark gray silty clay (CL)
	S-6B	20	22	5-2-3-6	91.0	Dark brown peat (PT)
	U-1	22	22.5	Rec = 6"		Dark gray silty clay, some peat layers (CL+PT)
	S-7	22.5	24.5	2-3-4-5	89.1	Black silty clay, some peat layers (CL+PT)
	U-2	24.5	26.5	Rec = 24"		
	S-8	26.5	28.5	3-6-7-8		Brown fine to coarse sand, trace gravel, silt (SP)
	S-9	35	37	7-11-11-14		Brown fine to medium sand, trace coarse sand, silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/5/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-209	S-10	40	42	10-10-10-16		Brown fine to coarse sand, trace gravel, silt (SP)
	S-11	45	47	10-14-16-18		Brown fine to medium sand, trace coarse sand, silt (SP)
	S-12	50	52	6-12-15-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	55	57	12-14-14-15		Brown fine to coarse sand, trace silt and gray silty clay (SP+CL)
	S-14	60	62	10-14-17-21		Dark gray silty clay and fine to coarse sand and gravel (CL+SP)
	S-15	65	67	9-8-15-20		Dark gray silty clay (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-210	S-1	0	2	7-8-9-12		Tan fine to coarse sand, trace shells, silt (SP)
	S-2	2	4	6-11-19-21		Tan fine to coarse sand, trace silt, shells (SP)
	S-3	4	6	9-13-14-15		Brown fine to coarse sand, trace silt, shells (SP)
	S-4	6	8	14-16-19-26		Tan fine to coarse sand, trace silt (SP)
	S-5	8	10	5-6-9-10		Tan fine to coarse sand, trace silt, shells (SP)
	S-6	10	12	12-13-13-14		Tan fine to coarse sand, trace silt, shells (SP)
	S-7	12	14	5-6-6-6		Gray medium to fine sand, trace silt, shells (SP)
	S-8	14	16	7-11-13-15		Gray fine to coarse sand, trace silt, shells (SP)
	S-9	16	18	9-10-12-14		Brown fine to coarse sand, trace gravel, silt, shells (SP)
	S-10	18	20	10-11-15-18		Tan fine to coarse sand, trace gravel, silt, shells (SP)
	S-11	20	22	5-5-5-7		Gray medium to fine sand, trace silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-210	S-12	22	24	10-10-16-17		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	25	27	4-3-2-3		Gray silty fine to coarse sand, some gravel (SM)
	S-14	27	29	2-5-10-11		Gray silty fine to coarse sand (SM)
	S-15	29	31	6-11-16-19		Brown fine to coarse sand, trace gravel, silt (SP)
	S-16	35	37	7-10-12-16		Brown fine to coarse sand, trace silt (SP)
	S-17	40	42	7-8-7-8		Brown coarse to fine sand, trace gravel, silt (SP)
	S-18	45	47	8-9-10-13		Brown medium to fine sand, trace silt (SP)
	S-19	50	52	12-15-16-21		Tan fine to coarse sand, trace gravel, silt (SP)
	U-1	55	57	No Recovery		
	S-20	57	59	8-15-17-24		Dark gray silty clay, trace silty fine sand seams (CL)
	U-2	60	62	No Recovery		
	S-21	65	67	13-18-23-23		Gray silty clay, trace silty fine sand layers and seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-211	S-1	0	2	13-14-18-14		Brown fine to coarse sand, trace silt, shells (SP)
	S-2	5	7	20-21-20-21		Brown fine to coarse sand, trace silt, shells (SP)
	S-3	10	12	20-18-30-50		Brown fine to coarse sand, some silt (SM)
	S-4	15	16.5	15-27-65		Tan fine to medium sand, trace silt (SP)
	S-5	20	22	2-5-10-13	186.1	Dark brown peat (PT)
	S-6	22	24	6-18-21-14		Brown coarse to fine sand, some silt (SM)
	S-7	25	27	19-28-38-43		Brown coarse to fine sand, trace silt, gravel (SP)
	S-8	30	32	14-16-30-38		Brown coarse to fine sand, trace silt (SP)
	S-9	35	37	18-20-23-20		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CTM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-212	S-1	0	2	20-10-10-12		Brown fine to coarse sand, trace silt, shells (SP)
	S-2	5	7	21-25-80		Gray fine to coarse sand, trace silt (SP)
	S-3	10	12	12-4-5-12		Gray fine to medium sand, trace silt (SP)
	S-4	15	17	30-25-35-36		Gray fine to medium sand, trace silt (SP)
	S-5A	20	22	11-11-14-12		Brown coarse to fine sand, some silt, trace gravel, roots (SM)
	S-5B	20	22	11-11-14-12		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	22	24	9-15-37-60		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-7	25	26.5	40-45-75		Brown coarse to fine sand, trace silt (SP)
	S-8	30	32	12-14-20-22		Brown coarse to fine sand, trace silt (SP)
	S-9	35	37	11-18-20-21		Brown coarse to fine sand, trace silt (SP)
	S-10	40	42	15-15-18-17		Brown coarse to fine sand, trace silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CSM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-212	S-11	45	47	25-20-50-55		Brown fine to medium sand, trace silt (SP)
	S-12	50	52	17-16-15-16		Tan medium to fine sand, trace silt (SP)
	S-13	55	57	15-15-22-21		Dark gray silty clay, trace silty fine sand seams (CL)
	S-14	60	62	8-12-20-22		Gray silty clay, trace silty fine sand seams (CL)
	S-15	65	67	12-12-20-20		Dark gray silty clay, trace silty fine sand seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/5/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-213	S-1	0	2	7-12-12-14		Brown fine to medium sand, trace silt, shells (SP)
	S-2	5	7	16-26-27-35		Gray fine to medium sand, trace silt (SP)
	S-3	10	12	8-20-29-41		Gray fine to medium sand, trace silt (SP)
	S-4	15	17	7-2-3-3		Gray fine sand, some black silty clay layers (SP+CL)
	S-5	17	19	10-11-11-7		Gray fine sand, some black silty clay layers (SP+CL)
	S-6	19	21	WR-2-2-2	54.0	Black silty clay, trace shells, peat layers (CL)
	U-1	21	23	Rec=12"		
	U-2	23	23.5	No Recovery		
	S-7	23.5	25	2-2-5	79.0	Black organic silty clay (OH)
	S-8	25	27	6-10-4-2		Dark gray fine to coarse sand, trace gravel, silt (SP)
	S-9	30	32	10-14-17-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-10	35	37	7-12-14-17		Brown coarse to fine sand, trace gravel, silt (SP)
	S-11	40	42	6-14-14-15		Brown fine to coarse sand, trace silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/5/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-213	S-12	45	47	11-23-23-26		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	50	52	8-10-8-9		Gray silty clay, trace fine sand seams (CL)
	S-14	55	57	7-12-13-16		Gray silty clay, trace fine sand seams (CL)
	S-15	60	62	10-13-13-18		Gray silty clay, trace silt seams, gravel (CL)
	S-16	65	67	10-10-15-30		Gray silty clay, trace silt seams, fine sand seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/1/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-214	S-1	0	2	6-18-12-11		Brown fine to medium sand, trace silt, gravel (SP)
	S-2	5	7	15-24-28-31		Gray fine to medium sand (SP)
	S-3	10	12	9-18-36-42		Gray fine to medium sand, trace shells (SP)
	S-4	15	17	1-1-2-2	130.2	Dark brown peat (PT)
	S-5	17	19	6-9-11-14		Gray fine to coarse sand, trace silt, gravel, roots (SP)
	S-6	20	22	3-8-13-13		Brown fine to coarse sand, trace gravel, silt (SP)
	S-7	25	27	15-24-27-29		Brown fine to medium sand, trace gravel, silt (SP)
	S-8	30	32	7-11-10-12		Brown fine to coarse sand, trace gravel, silt (SP)
	S-9	35	37	9-14-15-13		Brown fine to coarse sand, trace gravel, silt (SP)
	S-10	40	42	7-14-16-19		Brown fine to coarse sand, trace gravel (SP)
	S-11	45	47	8-12-10-19		Brown fine to medium sand, trace gravel (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CM DATE 2/1/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-214	S-12	50	52	9-11-8-13		Gray silt, trace fine sand (ML)
	S-13	55	57	10-11-16-22		Green gray clayey silt, trace fine sand, fine sand layers (ML)
	S-14	60	62	6-9-12-17		Gray silty clay, trace fine sand, silt layers (CL)
	S-15	65	67	8-9-15-16		Gray silty clay, some silty fine sand layers (CL+SM)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CTM DATE 2/8/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-215	S-1	0.5	2	23-18-24		Brown fine to medium sand, trace silt (SP)
	S-2	2	3.5	35-46-60		Brown fine to coarse sand, trace gravel, silt, shells (SP)
	S-3	4	5.5	16-24-63		Tan medium to fine sand, trace silt, shells (SP)
	S-4	6	7	15-64		Brown coarse to fine sand, trace silt (SP)
	S-5	10	11	18-81		Gray fine to coarse sand, trace silt (SP)
	S-6	12	13	24-76		Tan fine to coarse sand, trace silt (SP)
	S-7	14	15.1	31-53-40/1"		Tan fine to medium sand, trace silt (SP)
	S-8	16	18	3-3-4-3	97.9	Dark brown organic silty clay, trace peat pockets and layers (OH)
	S-9	18	20	5-5-9-16		Brown coarse to fine sand, some silt, trace gravel, roots (SM)
	S-10	20	22	10-8-12-10		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-11	25	27	15-17-27-31		Brown coarse to fine sand, trace silt, gravel (SP)

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CONSULTING ENGINEERS

FILE 6102

MADE BY SM DATE 2/8/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-215	S-12	30	32	12-15-15-24		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	35	37	12-18-27-27		Brown coarse to fine sand, trace gravel, silt (SP)
	S-14	40	42	11-16-20-19		Brown coarse to fine sand, trace gravel, silt (SP)
	S-15	45	47	33-27-16-14		Tan medium to fine sand, trace silt (SP)
	S-16	50	52	22-27-33-23		Brown fine to coarse sand, trace silt (SP)
	S-17	55	57	10-16-18-24		Gray silty clay, trace silty fine sand seams (CL)
	S-18	60	62	13-14-26-31		Gray silty clay, trace silty fine sand seams (CL)
	S-19	65	67	13-21-31-31		Grey silty clay, trace silty fine sand seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CSM DATE 2/5/85

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CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-216	S-1	0	2	12-15-15-17		Brown fine to coarse sand, trace gravel, silt (SP)
	S-2	2	4	12-16-27-30		Brown fine to coarse sand, trace silt (SP)
	S-3	4	6	4-3-4-5		Brown fine to coarse sand, trace silt, shells (SP)
	S-4	6	8	4-8-16-21		Brown fine to coarse sand, trace silt, shells (SP)
	S-5	8	10	11-20-30-35		Tan fine to coarse sand, trace silt (SP)
	S-6	10	12	13-30-48-54		Tan fine to medium sand, trace silt, shells (SP)
	S-7	12	13.5	21-44-56		Tan fine to medium sand, trace silt (SP)
	S-8	14	16	15-22-24-38		Tan fine to medium sand, trace silt (SP)
	S-9	16	18	8-12-5-5		Gray fine to medium sand, trace silt, shells (SP)
	S-10A	18	20	4-7-13-13	99.6	Black peat (PT)
	S-10B	18	20	4-7-13-13		Brown fine to coarse sand, some silt, trace roots (SM)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CTM DATE 2/5/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-216	S-11A	20	22	1-5-6-12		Brown fine to coarse sand, some silt, trace gravel, roots (SM)
	S-11B	20	22	1-5-6-12		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-12	25	27	9-15-15-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	30	32	8-9-12-14		Brown fine to coarse sand, trace gravel, silt (SP)
	S-14	35	37	5-10-12-15		Brown fine to coarse sand, trace gravel, silt (SP)
	S-15	40	42	6-11-11-13		Brown coarse to fine sand, trace gravel, silt (SP)
	S-16	45	47	6-11-12-14		Tan fine to coarse sand, trace silt (SP)
	S-17	50	52	6-16-18-24		Tan fine to coarse sand, trace gravel, silt (SP)
	U-1	55	57	Rec=12"		
	S-18	57	59	6-9-11-22		Dark gray silty clay, trace silty fine sand seams (CL)
	S-19	65	67	5-11-13-17		Dark gray silty clay, trace silty fine sand seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/1/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-217	S-1	0	2	9-11-18-15		Brown fine to coarse sand, some silt, gravel (SM)
	S-2	2	4	21-25-41-50		Brown fine to medium sand, trace gravel, silt (SP)
	S-3	4	5.5	29-38-52		Brown fine to medium sand, trace silt (SP)
	S-4	6	7	40-61		White fine to medium sand, trace silt (SP)
	S-5	8	10	12-26-34-54		Tan fine to medium sand, trace coarse sand (SP)
	S-6	10	12	15-36-52-77		Tan fine to medium sand, trace coarse sand, silt (SP)
	S-7	12	14	13-40-43-45		Tan fine to medium sand, trace silt, shells (SP)
	S-8	14	16	12-22-29-33		Tan fine to medium sand, trace coarse sand (SP)
	S-9	16	18	11-16-11-6		Gray fine to medium sand, trace silt, gravel (SP)
	S-10	18	20	4-6-10-17		Brown silty fine to coarse sand, trace roots (peat?), gravel (SM)
	S-11	20	22	5-12-19-21		Brown fine to coarse sand, trace gravel, silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/5/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-217	S-12	25	27	10-13-13-15		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	30	32	8-11-11-9		Brown coarse to fine sand, trace gravel, silt (SP)
	S-14	35	37	3-7-8-8		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY SJM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-218	S-1	0	2	10-18-18-18		Brown medium to fine sand, some gray silt layers, trace shells (SP)
	S-2	5	7	31-37-55		Brown medium to fine sand, trace silt (SP)
	S-3	11	12	37-70		Gray medium to fine sand, trace silt (SP)
	S-4A	16	18	3-5-9-15	17.9	Black silty clay, trace roots, fine sand (OH)
	S-4B	16	18	3-5-9-15		Brown silty coarse to fine sand, trace gravel, roots (SM)
	S-4C	16	18	3-5-9-15		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-5	21	22.5	14-33-50		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	26	28			Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	31	33	10-47-31-40		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CSM DATE 2/8/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-219	S-1	0	2	9-15-21-23		Brown fine to medium sand, trace silt (SP)
	S-2	5	6.5	22-38-50		Gray fine to medium sand, trace silt (SP)
	S-3	10	11.3	27-48-75/4"		Gray fine to medium sand, trace silt (SP)
	U-1	15	17	Rec = 24"		
	S-4	17	19	2-4-13-18		Brown coarse to fine sand, trace gravel, silt, roots (SP)
	S-5	20	22	7-10-14-26		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	25	26.5	26-30-55		Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	30	31.5	40-41-60		Brown coarse to fine sand, trace silt (SP)
	S-8	35	37	24-22-22-23		Brown coarse to fine sand, trace gravel, silt (SP)
	S-9	40	42	10-12-22-25		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	45	47	20-27-26-27		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CSM DATE 2/8/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-219	S-11	50	51.5	18-28-45		Gray medium to fine sand, trace silt (SP)
	S-12	55	57	9-13-14-17		Gray silty clay, trace silty fine sand seams (CL)
	S-13	60	62	9-13-22-25		Gray silty clay, trace silty fine sand seams (CL)
	S-14	65	67	16-20-25-28		Dark gray silty clay, trace silty fine sand seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CSM DATE 2/1/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-220	S-1	1	3	23-33-41-42		Brown fine to coarse sand, trace silt (SP)
	S-2	3	5	38-53-57-62		Brown fine to coarse sand, trace silt (SP)
	S-3	5	7	7-10-10-11		Tan fine to medium sand, trace gravel, silt, shells (SP)
	S-4	7	9	9-15-26-40		Brown fine to medium sand, trace silt, shells (SP)
	S-5	9	11	15-24-27-26		Gray fine to medium sand, trace silt (SP)
	S-6	11	13	8-8-3-3		Gray fine to medium sand, trace silt (SP)
	S-7	13	15	2-3-8-15	102.0	Dark brown peat, some organic silty clay layers (PT)
	S-8	15	17	2-4-6-9		Brown fine to medium sand, trace coarse sand, silt, roots (SP)
	S-9	17	19	9-9-10-12		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10A	19	21	6-3-4-21		Gray clayey fine to coarse sand, trace gravel (SC)
	S-10B	19	21	6-3-4-21		Brown coarse to fine sand, some clay, trace gravel (SC)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/1/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-220	S-11	21	23	10-20-22-26		Brown medium to fine sand, trace gravel, silt (SP)
	S-12	25	27	10-17-14-15		Brown fine to coarse sand, trace silt, gravel (SP)
	S-13	30	32	7-13-18-19		Brown medium to fine sand, trace gravel, silt (SP)
	S-14	35	37	6-8-11-14		Brown fine to coarse sand, trace gravel, silt (SP)
	S-15	40	42	8-16-16-20		Brown medium to fine sand, trace coarse sand, silt (SP)
	S-16	45	47	9-18-21-18		Brown fine to medium sand, trace coarse sand, silt (SP)
	S-17	50	52	6-11-12-16		Gray silty clay, trace silt seams (CL)
	S-18	55	57	7-10-18-17		Gray silty clay, some silt layers, trace silty fine sand seams (CL)
	S-19	60	62	7-11-13-17		Gray silty clay, trace silt seams (CL)
	S-20	65	67	13-21-17-14		Brown fine sand, some silt (SM)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-221	S-1	0	2	3-5-12-11		Brown coarse to fine sand, trace gravel, silt (SP)
	S-2	6	8	3-7-10-6		Brown medium to fine sand, trace silt (SP)
	S-3	8	10	10-23-42-38		Gray fine to medium sand, trace silt, shells (SP)
	S-4	11	12.5	28-58-62		Gray fine to medium sand, trace silt (SP)
	S-5	15	17	4-4-6-7		Tan silty coarse to fine sand, trace roots (SM)
	S-6	17	19	8-15-22-50		Brown coarse to fine sand, trace silt, gravel (SP)
	S-7	20	21.5	40-56-49		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	25	27	21-32-31-30		Brown coarse to fine sand, trace silt (SP)
	S-9	30	32	9-12-13-15		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	35	37	11-15-15-14		Brown coarse to fine sand, trace gravel, silt (SP)
	S-11	40	42	14-19-18-19		Brown coarse to fine sand, trace silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CSM DATE 2/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-221	S-12	45	47	20-21-33-37		Tan coarse to fine sand, trace gravel, silt (SP)
	S-13	50	52	9-12-14-20		Gray silty clay, trace silty fine sand seams (CL)
	S-14	55	57	11-18-20-27		Dark gray silty clay, trace silty fine sand seams (CL)
	S-15	65	67	12-21-22-23		Dark gray silty clay, trace silty fine sand seams (CL)

B-221

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-222	S-1	0	2	17-14-18-15		Brown coarse to fine sand, trace silt (SP)
	S-2	5	7	6-11-17-23		Tan medium to fine sand, trace silt, shells (SP)
	S-3	10	12	8-14-18-21		Tan medium to fine sand, trace silt (SP)
	S-4	12	14	4-1-3-3	104.6	Dark brown organic silty clay, trace organic fibers (OH)
	U-1	14	16	Rec=24"		
	S-5	16	18	3-4-7-11		Gray silt, some fine to coarse sand (ML)
	S-6	20	22	9-12-16-16		Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	25	27	7-12-17-17		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	30	32	6-5-6-10		Brown coarse to fine sand, trace gravel, silt (SP)
	S-9	35	37	4-3-4-3		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	40	42	6-8-5-7		Tan coarse to fine sand, trace silt (SP)
	S-11	45	47	11-17-21-19		Brown coarse to fine sand, trace gravel, silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CSM DATE 2/11/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-222	S-12	50	52	7-7-10-12		Dark gray silty clay, trace silty fine sand seams (CL)
	U-2	55	57	Rec=24"		
	S-13	66.5	67	10-13-19		Gray fine sand, some silt (SM)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CTM DATE 2/8/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-223	S-1	0	2	9-20-18-27		Tan fine to coarse sand, trace silt (SP)
	S-2	5	7	24-24-20-18		Tan fine to coarse sand, trace silt (SP)
	S-3	10	11.5	31-39-41		Gray medium to fine sand, trace silt (SP)
	U-1	14	16	Rec=12"		
	U-2	16	18	Rec=24"		
	S-4	20	21.5	27-55-66		Brown coarse to fine sand, trace gravel, silt (SP)
	S-5	25	27	18-19-22-20		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	30	32	15-20-12-14		Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	35	37	21-17-16-18		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	40	42	15-15-29-27		Brown medium to fine sand, trace silt (SP)
	S-9	45	47	32-29-26-21		Tan fine to coarse sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/8/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-223	S-10	50	52	10-11-15-16		Dark gray silty clay, trace silty fine sand seams. (CL)
	S-11	55	57	14-16-26-24		Dark gray silty clay, some silty fine sand layers (CL)
	S-12	65	67	13-36-37-39		Brown fine sand, some silt, trace gray silty clay layers (SM)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CSM DATE 2/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-224	S-1	0	2	9-12-19-10		Gray fine to medium sand, trace silt (SP)
	S-2	5	7	20-22-31-32		Gray coarse to fine sand, trace silt, shells (SP)
	S-3	10	11.5	22-51-40		Gray medium to fine sand, trace silt (SP)
	S-4	15	17	1-2-3-3	109.5	Dark brown organic silty clay, trace roots (OH)
	S-5	17	19	8-7-5-4		Brown coarse to fine sand, some silt (SM)
	S-6A	19	20	3-4-21-25		Brown silty fine to coarse sand (SM)
	S-6B	19	21	3-4-21-25		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-7	25	27	8-9-12-9		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	30	32	8-8-8-8		Tan coarse to fine sand, trace gravel, silt (SP)
	S-9	35	37	8-12-15-16		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	40	42	15-22-17-16		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CTM DATE 6/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-224	S-11	45	47	12-14-40-46		Gray silty clay, trace silty fine sand seams (CL)
	S-12	50	52	10-14-23-28		Gray silty clay, trace silty fine sand seams (CL)
	S-13	55	57	8-14-20-24		Dark gray silty clay, trace silty fine sand seams (CL)
	S-14	60	62	16-16-19-24		Gray silty clay, trace silty fine sand seams (CL)
	S-15	65	66.5	25-46-60		Brown silty fine sand (SM)

SHEET NO.____ OF ____

FILE ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

MADE BY CJM DATE 6/8/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-225	S-1	0	2	11-7-12-17		Tan fine to coarse sand, trace silt (SP)
	S-2	5	6.5	35-64-75		Brown coarse to fine sand, trace gravel, silt, black clay pockets (SP)
	S-3	10	12	58-60-18-15		Gray fine to medium sand, trace silt (SP)
	S-4	15	17	4-5-6-6	159.4	Dark brown organic silty clay, trace organic fibers (OH)
	S-5	17	19	7-9-7-5		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-6	20	22	33-34-36-37		Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	25	27	13-34-23-20		NO RECOVERY
	S-8	30	32	11-11-15-11		Brown medium to fine sand, trace silt (SP)
	S-9	35	37	23-24-26-16		Brown coarse to fine sand, trace silt (WASH) (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY JM DATE 2/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-226	S-1	0	2	10-8-8-12		Tan medium to fine sand, trace silt (SP)
	S-2	5	7	10-12-19-17		Tan fine to coarse sand, trace silt (SP)
	S-3	10	12	7-14-26-31		Gray fine to medium sand, trace silt (SP)
	S-4	12	14	21-31-28-19		Gray fine to medium sand, trace silt (SP)
	S-5	14	16	2-1-3-2	55.0	Dark gray silty clay, trace organic fibers (CL)
	S-6A	16	18	2-2-2-3	68.8	Dark gray silty clay, trace fine sand seams, organic fibers (CL)
	S-6B	16	18	2-2-2-3		Dark gray fine to coarse sand, some silt, trace roots (SM)
	S-7	18	20	2-4-6-7		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-8	20	22	6-3-9-10		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-9	25	27	10-13-14-15		Brown fine to coarse sand, trace silt (SP)
	S-10	30	32	8-8-10-11		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CJM DATE 2/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-226	S-11	35	37	12-15-15-15		Brown coarse to fine sand, trace gravel, silt (SP)
	S-12	40	42	10-14-15-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	45	47	14-14-11-13		Gray fine to coarse sand, trace gravel, silt (SP)
	S-14	50	52	6-8-10-13		Dark gray silty clay, trace silty fine sand seams (CL)
	U-1	55	57	Rec=6"		Dark gray silty clay, trace silty fine sand seams (CL)
	S-15	60	62	10-11-15-15		Dark gray silty clay, trace silty fine sand seams (CL)
	S-16	70	72	31-28-27		Brown fine to coarse sand, trace gravel, silt, shells (SP)
	S-17	80	82	24-28-34		Gray fine to medium sand, trace silt, gray clay layers (SP)
	S-18	90	92	32-36-34		Gray fine to coarse sand, trace silt, black silt layers (SP)
	S-19	100	101	5-9-90		Tan coarse to fine sand, trace silt, gray clay pockets (SP)
	S-20	110	111.5	18-29-36		Gray silty clay, trace silty fine sand seams

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CSM DATE 2/7/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-226	S-21	120	121.5	42-53-54		Gray medium to fine sand, trace silt, black silt pockets (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-227	S-1	0	2	4-12-13-15		Brown fine to coarse sand, trace silt (SP)
	S-2	2	4	8-11-11-19		Brown fine to coarse sand, trace silt, shells (SP)
	S-3	4	6	4-4-4-5		Tan fine to coarse sand, trace silt, shells (SP)
	S-4	6	8	9-9-9-12		Tan fine to coarse sand, trace silt, shells (SP)
	S-5	8	10	3-5-5-6		Tan fine to coarse sand, trace silt, shells (SP)
	S-6	10	12	5-5-7-6		Tan fine to coarse sand, trace silt, shells (SP)
	S-7	12	14	1-1-1-2		Tan fine to coarse sand, trace silt, gravel (SP)
	S-8	14	16	1-1-4-4		Brown fine to coarse sand, trace silt, shells (SP)
	S-9	16	18	3-1-2-3		Brown fine to coarse sand, trace silt (SP)
	S-10	18	20	4-7-8-10		Brown coarse to fine sand, some silt, trace gravel, black silt layers (SM)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-227	S-11	20	22	8-10-12-24		Brown coarse to fine sand, trace silt, gravel (SP)
	S-12	25	27	11-14-18-18		Brown coarse to fine sand, trace silt, gravel (SP)
	S-13	30	32	7-10-10-9		Tan coarse to fine sand, trace silt, gravel (SP)
	S-14	35	37	9-13-11-11		Tan coarse to fine sand, some gravel, trace silt (WASH) (SP)
	S-15	40	42	7-9-8-13		Brown coarse to fine sand, trace silt, black silt pockets (SP)
	S-16	45	47	6-12-20-20		Tan fine to coarse sand, trace silt (SP)
	S-17	50	52	8-11-13-18		Dark gray silty clay, trace silty fine sand seams (CL)
	S-18	55	57	10-12-16-20		Dark gray silty clay, trace silty fine sand seams (CL)
	S-19	60	62	8-13-16-20		Dark gray silty clay, trace silty fine sand seams (CL)
	S-20A	65	67	4-33-25-25		Dark gray silty clay, trace silty fine sand seams (CL)
	S-20B	65	67	4-33-25-25		Gray medium to fine sand, trace silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CJM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-228	S-1	0	2	10-14-17-30		Brown fine to coarse sand, trace silt, shells (SP)
	S-2	5	7	14-30-31-50		Tan medium to fine sand, trace silt, brown silt pockets (SP)
	S-3	10	12	4-2-2-2	18.8	Brown organic silty coarse to fine sand, trace roots (SM)
	S-4	12	14	3-5-8-23		Brown coarse to fine sand, some silt, trace roots (SM)
	S-5	15	17	26-32-50		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	20	22	8-16-22-22		Brown coarse to fine sand, trace silt (SP)
	S-7	25	27	6-12-13-12		Brown coarse to fine sand, trace silt (SP)
	S-8	30	32	18-22-25-27		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-9	35	37	10-17-10-9		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	40	42	12-12-19-23		Brown coarse to fine sand, trace gravel, silt, gray silty clay pockets (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CM DATE 2/6/85

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-228	S-11	45	47	15-16-18-22		Dark gray silty clay, trace silt seams (CL)
	S-12	50	52	10-14-19-27		Dark gray silty clay, trace silty fine to medium sand seams (CL)
	S-13	55	57	8-14-18-23		Dark gray silty clay, trace silty fine sand seams (CL)
	S-14	60	62	10-13-16-25		Gray silty clay, trace silty fine sand seams (CL)
	S-15	65	67	22-42-55		Brown fine to medium sand, trace silt (SP)

NASSAU COUNTY, NEW YORK
DEPARTMENT OF PUBLIC WORKS

SUBSURFACE INFORMATION

FOR

CEDAR CREEK WATER POLLUTION CONTROL PLANT

TOWN OF HEMPSTEAD, NEW YORK

1987

LUDWIG C. HASL, P.E.
COMMISSIONER OF PUBLIC WORKS

JOHN F. CARUSO
DEPUTY COMMISSIONER

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

INDEX

DIVISION 1 - BORING LOGS

	Consultant/Date	Boring Numbers
SECTION 1		
	W.M. WALSH COMPANY, INC. 11/66	B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-8, B-9, B-10, B-11, B-12, B-13, B-14, B-15, B-16, B-17, B-18, B-19, B-20, B-21, B-22, B-23, B-24, B-25, B-26, B-27, B-28, B-29, B-30, B-31, B-32
SECTION 2		
	CONVERSE CONSULTANTS, INC. 5/83	B-101, B-102, B-103
SECTION 3		
	CONVERSE CONSULTANTS, INC. 9/83	B-206A, B-218A
SECTION 4		
	MUESER RUTLEDGE 2/85 (RECLASSIFICATION OF SAMPLES FROM 1983 BORING, CONVERSE CONSULTANTS)	B-201, B-202, B-202A, B-203, B-204, B-205, B-206, B-207, B-208, B-209, B-210, B-211, B-212, B-213, B-214, B-215, B-216, B-217, B-218, B-219, B-220, B-221, B-222, B-223, B-224, B-225, B-226, B-227,B-228

DIVISION 1 (Continued)

SECTION 5

MUESER RUTLEDGE
2/85 — B-301, B-302P, B-303, B-304, B-305, B-306, B-307, B-308, B-309, B-310, B-311, B-312U, B-313U, B-314U, B-315P, B-316P(A), B-317UP, B-318PA, B-319P, B-320P, B-321, B-322, B-323, B-324, B-325P, B326, B-327

SECTION 6

MUESER RUTLEDGE
6/85 — B-328UP, B-329U

SECTION 7

MUESER RUTLEDGE
10/85 — B-1(MR), B-2(MR), B-3(MR)

SECTION 8

MUESER RUTLEDGE
6/86 — B-401P, B-402, B-403, B-404U, B-404UA, B-405P, B-406U, B-407, B-408U, B-409U

SECTION 9

MUESER RUTLEDGE
1/87 — B-501, B-502, B-503, B-504, B-505

SECTION 10

MUESER RUTLEDGE
2/87 — D-1, D-2, D-3, D-4, D-5

INDEX
(Continued)

DIVISION 2 - GROUNDWATER ANALYSIS

DIVISION 3 - PUMPING TEST DRAWDOWN & RECOVERY DATA

DIVISION 4 - BORING LOCATION PLANS

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau County, New York

TEST BORING DATA — TEST HOLE NO. 3-1

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Schutte | Inspector T. Mueller | Date Started 11/23/66 | Completed 11/29

MHW El. | MLW El. | El. of Ground Water tidal | Length of Casing Driven

Ground Line Elevation 1.4'

Blows on Spoon (0/6 | 6/12 | 12/18)

Depth in Feet	Blows Per Foot of Casing Penetration	Sample Number	Blows on Spoon 0/6	6/12	12/18	Materials Encountered
0		1	PUSHED			Very Soft Meadow Mat & Organic Silt
		2	"	"	"	
		3	"		"	
		4	"		"	
5						
		5		"		"
		6	"		"	
		7	1	1	2	
10	13 18* 23 26					Medium -Br- Med to coarse sand some gravel
	31					
15	23 21 31 38	8	8	10	14	
	41					
20	35 37 30	9	7	9	11	
	34 45					
25	20 28 25 41	10	8	7	15	Medium Br.-Br. Fine to Med sand
	58 21 43 58	11	7	10	12	
30	63 69 31					
35	47 49 46	12	4	8	9	
	57					
40	33 57 63 21	13	7	4	9	Stiff to very stiff dark gray silty clay lenses. Fine sand
	82					
45	33 57	14	10	9	11	
	11 6"	15	10	10		
50					11	Bottom of Boring 50'

Fill in with Black Drawing Ink

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	18"
2	1'6"-3"	18	18
3	3'-4'6"	18	18
4	4'6"-6"	18	18
5	6'0"-7'6"	18	18
6	7'6"-9'	18	18
7	9'-10'6"	18	18
8	15'-16'6"	18	14
9	20-21'6"	18"	12"
10	25'-26'6"	18"	10"
11	30-31'6"	18"	13"
12	35-36'6"	18"	10"
13	40-41'6"	18"	10"
14	45-46'6"	18"	9"
15	48'6"-50'	18"	7"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Nassau County, New York

TEST BORING DATA — TEST HOLE NO. B-2

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector | Date Started 11/29/66 | Completed 11/30/

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 2.0'

Blows on Spoon (0/6, 6/12, 12/18)

Materials Encountered

Very Soft Meadow Mat. Black & Gray Organic Silt — 1 Pushed; 2 " "; 3 "; 4 "; 5 "; 6 "

Med. Gray Med. to fine sand. Some silty & gravel — 7: 3 5 9

Medium-Brown Fine to red sand. Tr. gravel. — 8: 7 5 6; 9: 5 6 6

Run up 5' @25' — 10: 4 6 5

Very Stiff Dark Gray Silty Clay Lenses fine e sand. — 11: 5 7 7; 12: 4 6 7; 13: 7 9 10; 14: 8 10 12

Bottom of Boring — 15: 9 11 14

Depth in Feet — Blows Per Foot of Casing Penetration — Sample Number

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	2"
2	1'6"-3"	18"	5"
3	3'-4'6"	18"	2"
4	4'6"-6'	18"	2"
5	6'10"-7'6"	" "	3
6	7'6"-9'	"	6"
7	9'-10'6"	"	12"
8	15'-16'6"	"	5"
9	20'-21'6"	"	9"
10	25'-26'6"	"	12"
11	30'-31'6"	"	8"
12	35'-36'6"	"	10"
13	40'-41'6"	"	18"
14	45'-46'6"	"	18"
15	48'6"-50'	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Fee Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Wantagh, Water Plant — North Bergen, New Jersey — Nassau County, N.Y.

TEST BORING DATA — TEST HOLE NO. B-3

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: H. Schotte | Inspector T. Mueller | Date Started 11/22/66 | Completed 11/23/

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 1.0'

Depth in Feet	Blows Per Foot of Casing Penetration	Sample Number	Blows on Spoon (0/6, 6/12, 12/18)	Materials Encountered
0		1	Pushed	Very Soft Meadow Mat
		2	" "	
		3	1 1 1	Very Soft Gray Organic Silt
5		4	PUSHED	
		5	" "	
		6	" "	
10		7	" " "	
		8	1 1 2	Medium to loose, brown coarse sand
	14			
15	10	9	9 14 18	
	24			
	30			
	27			
	25			
20	10	10	3 5 9	
	15			
	27			
	33			
25	34			
	12	11	2 4 4	8" Run up of sand
	16			
	24			Medium-Gray Coarse to Med Sand. Tr. of gravel
30	31			
	28	12	3 10 11	
	30			
	37			
	37			
35	42			Run up 10'
	31	13	7 11 13	
	47			
	46			
	48			
	52			
40	38	14	7 9 11	Very Stiff Dark Gray Silty Clay Lenses Fine Sand
	47			
	63			
	87			
45	81			
	81	15	6 11 17	
	89			
	97			
	43-6"	16	9 14 19	
50				Bottom of Boring 50'

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon 1	3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0-1'6"	18"	18"
2	1'6"-3'	"	18"
3	3'-4'6"	18"	18"
4	4'6"-6'	"	17
5	6'-7'6"	"	14"
6	7'6"-9'	"	10
7	9'-10'6"	"	11"
8	10'6"-12'	"	12"
9	15'-16'6"	"	16"
10	20'-21'6"	"	13"
11	25'-26'6"	"	4"
12	30'-31'6"	"	12"
13	35'-36'6"	"	8"
14	40'-41'6"	"	16"
15	45'-46'6"	"	12"
16	48'6"-50'	"	17

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Nassau County, N.Y.

TEST BORING DATA — TEST HOLE NO. B-4

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: F. Imperato — Inspector T. Mueller — Date Started 12/1/66 — Completed 12/1/66

MHW El. — MLW El. — El. of Ground Water Tidal — Length of Casing Driven

Ground Line Elevation 2.0'

Materials Encountered

Very Soft Meadow Mat and organic silt

Medium- Brown fine to fine sand Tr. gravel. Tr. silt.

Dk. gray silty clay 39'6"-40'

Depth in Feet

Blows Per Foot of Casing Penetration

Sample Number

Sample No.	Blows on Spoon 0/6	6/12	12/18	Blows Per Foot
1	PUSHED			
2	"	"		
3	"	"		
4	"	"		
5	"	"		
6	"	"		
7	1	3	5	8
8	6	8	12	20
9	4	4	6	10
10	3	5	6	11
11	5	5	7	12
12	5	6	9	15
13	7	5	8	13

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	2"
2	1'6"-3'	"	2"
3	3'-4'6"	"	2"
4	4'6"-6'	"	3"
5	6'-7'6"	"	3"
6	7'6"-9'	"	3"
7	9'-10'6"	"	6"
8	15'-16'6"	"	10"
9	20'-21'6"	"	12"
10	25'-26'6"	"	9"
11	30'-31'6"	"	10"
12	35'-36'6"	"	12"
13	38'6"-40'	"	11"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant Sheet 1 of 2 Nassau County, N.Y.

TEST BORING DATA - TEST HOLE NO. B 5

Bridge Rt. Sec. Sta. Offset Lt. Rt.

Borings made by: J. Sciamorelli Inspector M. Mueller Date Started 11/29/66 Completed 11/30/66

MHW El. MLW El. El. of Ground Water Tidal Length of Casing Driven

Ground Line Elevation 1.9'

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
	P P P P	Very soft Meadow Mat & organic silt.	1		1	
			2		1	
5	P P P	Very soft fray organic silt.	3		1	
			4		1	
	P P P		5		1	
10	1 1 1	very soft peat 11'6"	6		1	
			7		2	
	7 16 10 13	Medium- gray fine to Med. sand tr. grave. tr. silt	8	5	8	8
15			9	6	6	9
	19 19 20 10 12		10	5	7	7
20						
	15 12 14 19 19 21		11	5	5	6
25						
30	14 20 20 19	Medium- Gray Coarse to Med. sand tr. gravel	12	6	8	9
	20 16 23 23 25 24	Medium- Gray fine sand sand Run up 7'@ 35'				
35						
40	21 35 39 41	Very tiff dark gray silty clay, Lenses fine sand.	14	6	10	13
45	35 58 67 79		15	7	9	12
50	93	Continued on sheet 2	16	8	12	15

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24 "
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0-1'6"	18"	2"
2	2'-3'6"	"	2"
3	5'-5'8"	"	2"
4	6'-7'6"	"	2"
5	8'-9'6"	"	5"
6	10'-11'6"	"	6"
7	11'6"-13'	"	10"
8	13'-14'6"	"	5"
9	15'-16'6"	"	8"
10	20-21'6"	"	10"
11	25-26'6"	"	8
12	30-31'6"	"	10"
13	35-36'6"	"	4"
14	40-41'6"	"	13"
15	45'-46'6"	"	11"
16	50'-51'6"	"	5"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.

Wantagh Water Plant Sheet 2 of 2 North Bergen, New Jersey Nassau County, N.Y.

TEST BORING DATA - TEST HOLE NO. B-5

Bridge Rt. Sec. Sta. Offset Lt. Rt.

Borings made by: J. Sciamorelli Inspector Date Started 11/29/66 Completed 11/30/6

MHW El. MLW El. El. of Ground Water Tidal Length of Casing Driven

Ground Line Elevation 1-10"

Inside Dia. of Casing

" " " Spoon

Weight of Hammer on Casing

" " " " Spoon

Drop of Hammer on Casing

" " " " Spoon

Depth in Feet	Blows Per Foot of Casing Penetration	Sample Number	Blows on Spoon 0/6	6/12	12/18	Materials Encountered
5	41 60 69 80 89	17	6	9	14	Very Stiff Dark Gray Silt, Clay Lenses Fine sand.
60 TO	36 47 58 67 78	18	7	10	16	Medium - Gray fine sand trace silt.
65	41 52 60 73 70	19	8	8	13	
79	44 61 76 81 89	20	6	9	15	Medoum-Gray fine sand trace silt.
75	49 66 79 75 82	21	9	14	18	Sand Run up 15' @75' dense
80	25 46 69 72 41	22	25	31	62	Dense-gray fine silty sand Bottom of boring 80'
35						
40						
45						
50						

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
17	55-56'6"	18"	13"
18	60-61'6"	"	8"
19	65-66'6"	"	13"
20	70-71'6"	"	11 "
21	75-76'6"	"	7"
22	78'6"-80'	"	11"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.

Wantagh Water Plant — North Bergen, New Jersey — Nassau County, New York

TEST BORING DATA — TEST HOLE NO. B-6

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J Sciamorelli | Inspector T. Mueller | Date Started 12/1/66 | Completed 12/1/66

MHW El. | MLW El. | El. of Ground Water | Length of Casing Driven

Ground Line Elevation 1.62

Materials Encountered

Very soft meadow mat & georg. Silt

Medium-gr. med. sand to silt

Med -Gr. coarse to med sand

Med-gray fine to med. sand

Run up 8' @ 35'

Medium-Gray fine sand Trace Silt

Very Stiff dark gray silt clay lenses fine sand

6" Bottom of Boring 50'

Fill in with Black Drawing Ink

Depth in Feet

Blows Per Foot of Casing Penetration

Sample Number

Sample No.	Blows on Spoon 0/6	6/12	12/18
1		1	
2		1	
3		1	
4		1	
5		1	
6	2	2	2
7	3	9	12
8	4	5	5
9	5	5	6
10	4	4	6
11	5	4	5
12	6	6	7
13	8	10	13
14	9	12	15
15	8	11	16

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0-1'6"	18"	2"
2	2-3'6"	18"	3"
3	4-5'6"	"	5"
4	6-7'6"	"	3"
5	8-9'6"	"	2"
6	10-11'6"	"	5"
7	11'6"-13'	"	5"
8	15-16'6"	"	3"
9	20-21'6"	"	4"
10	25-26'6"	"	3"
11	30-31'6"	"	7"
12	35-36'6"	"	5"
13	40-41'6"	"	9"
14	45-46'6"	"	11"
15	48'6"-50'	"	10"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau, New York

TEST BORING DATA — TEST HOLE NO. B-7

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector T. Mueller | Date Started 11/21/66 | Completed 11/21/66

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 2.8'

Materials Encountered

Very Soft Meadow Mat & dry silt.

13'6"

Med.-br. Med Sand & gravel. Tr. silt.

19'0"

Medium gr. med. to fine sand, tr. silt & gravel

Stiff Dk. gr. silty clay Lensed fine sand

Bottom of Boring 50'

Fill in with Black Drawing Ink

Blows per Foot of Drive Penetration

Sample Number	Blows on Spoon 0/6	6/12	12/18
1	PUSHED		
2	"	"	
3	"	"	
4	"	"	
5	"	"	
6	"	"	
7	"	"	
8	"	"	
9	1	1	1
10	4	9	11
11	4	6	7
12	5	5	6
13	5	6	8
14	6	7	7
15	5	7	7
16	6	5	6
17	7	6	7

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation-bottom of Spoon	Total Penetration	Length of Sample
U1A Tube	4'6'	24"	24"
1	1'6"-3'0"	18"	6"
2	3'-4'6"	18"	10"
4	4'6"-6'	"	10"
5	6-7'6"	"	7"
6	7'6"-9'	"	6"
7	9'-10'6"	"	6"
8	10'6"-12'	"	9"
9	2'-13'6"	"	5
101	13'6"-15'	"	7"
11	20-21'6"	"	9"
12	25'-26'6"	"	12"
13	30-31'6"	"	9"
14	35'-36'6"	"	
15	40-41'6"	"	
16	45'-46'6"	"	
17	48'6"-50'	"	

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

Shelby Tube taken 4'-6' Rec. 24"

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Nassau Co, N.Y.

~~Sheet 1 of 2~~

TEST BORING DATA — TEST HOLE NO. B-8

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: F. Imperato — Inspector T. Mueller — Date Started 11/22/66 — Completed 11/23/

MHW El. — MLW El. — El. of Ground Water Tidal — Length of Casing Driven

Ground Line Elevation 3.0'

Materials Encountered

Very soft meadow mat & organic silt

14'0"

Medium- br. Med. to coarse sand. some gravel Tr. silt

Coarse to Medium- Gr. fine to med. sand tr. silt & gravel

continued on sheet #2

Fill in with Black Drawing Ink

Sample Number	Blows on Spoon 0/6	6/12	12/18
1	PUSHED		
2		1	17
3	11		19
4	15		21
5	11		13
6	8		11
7	13		19
8	18		22
9	11		17
10	3	7	9
11			
12			
13			
14			
15			
16			
17			
18			
19			
20	11	4	4

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
U-1A		10-12'	24"
1	0-1'6"	18"	7"
2	1'6"-3'	"	5"
3	3-4'6"	"	7"
4	4'6"-6'	"	6"
5	6'-7'6"	"	6"
6	7'6"-9'	"	8"
7	9'-10'6"	"	5"
8	10'6"-12'	"	5"
9	12'-13'6"	"	7"
10	13'6"-15'	"	9"
11	20-21'6"	"	5"
12	25'-26'6"	"	6"
13	30'-31'6"	"	8"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour
14	35-36'6"		12"	
15	40-41'6"		18"	
16	45'-46'6"		18"	
17	50-51'6"		18"	

Type of Core Drill

Core Diameter

Note: Shelby tube sample taken 10'-12'- Rec. 24"

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Sheet 2 of 2 — Nassau Co. N. Y.

TEST BORING DATA — TEST HOLE NO. B 8

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector | Date Started 11/22/66 | Completed 11/23/

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation

Materials Encountered: Loose to Med gray med. to fine sand. trace silt & gravel

Dense gray fine sand trace silt

Dense gray med. to fine sand, trace silty clay

Bottom of Boring 80'

Depth in Feet | Blows Per Foot of Casing Penetration | Sample Number | Blows on Spoon (0/6, 6/12, 12/18)

Depth in Feet	Blows Per Foot of Casing Penetration	Sample Number	Blows on Spoon (0/6, 6/12, 12/18)
55	63, 90, 123, 164, 159, 121	18	8, 11, 13
60	151, 140, 179, 186, 114, 139	19	7, 16, 19
65	160, 145, 140, 97, 136, 152	20	9, 15, 18
70	177, 169, 140, 143, 141, 169	21	7, 14, 18
25	184, 117, 156, 173, 79, 6	22	12, 21, 26
80	30	23	10, 19, 29
35			
40			
45			
50			

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8 "
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
18	55'-56'6"	18"	18"
19	60-61'6"	18"	18"
20	65-66'6"	"	18"
21	70-71'6"	"	18"
22	75'-76'6"	"	18"
23	78'6"-80'	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

Fill in with Black Drawing Ink

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North Bergen, New Jersey

Wantagh Water Plant — Nassau County, New Yor

TEST BORING DATA — TEST HOLE NO. B-9

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector T. Mueller | Date Started 11/17/66 | Completed 11/1

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 2.5'

Depth in Feet	Blows Per Foot of Casing Penetration	Sample Number	Blows on Spoon 0/6 6/12 12/18	Materials Encountered
	1 1 1 1 1	1	PUSHED	Very Soft Meadow Mat & organic silt
		2	" "	
		3	" "	
5		4	" "	
	1 1 1 2	5	" "	soft gray organid silt Some fibers
	6 5 9 16 20	6	" "	
10		7	1 1 2	Medium-Br. coarse to med. sand & shells. trace gravel
	26 19 24 21	8	6 10 12	
15				
	27 26 20 21	9	6 6 7	Medium- gr-br. Med to fine sand. some gravel trace silt
20	21 20 23 19			
	19 18 19 20	10	7 6 8	Medium br. med. to fine sand. trace gravel
25				
	22 24 23 26	11	5 6 8	
30				
	25 31 37 18	12	6 8 13	Medium-gr- br. Med. to fine sand. some gravel. Trace silt.
35		13	7 9 11	Very stiff dk.gr.silty clay lenses fine sand
40				Bottom of Boring 40'
45				
50				

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	6"
2	1'6"-3"	"	5"
~~13~~	5'-7'	24"	24"
~~5~~	3'-4'6"	18"	7"
4	4'6"-6'	"	7"
5	6-7'6"	"	3"
~~6~~	7'6"-9'	"	8"
7	9-10'6"	"	5
8	15'-16'6"	"	10'
9	20-21'6"	"	9
10	25-26'6"	"	9
11	30-31'6"	"	8
12	35-36'6"	"	18
13	38'6"-40'	"	18

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Fee Per Hour

Type of Core Drill

Core Diameter

Note: tube sample taken aside of Boring @ 5 to 7' Rec.24"

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Sheet 1 of 2 — Nassau Co., New York

TEST BORING DATA — TEST HOLE NO. B 10

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: F. Imperato — Inspector T. Mueller — Date Started 11/11/66 — Completed 11/1

MHW El. — MLW El. — El. of Ground Water Tidal — Length of Casing Driven

Ground Line Elevation

Material Description

Very soft

very soft saturated black organic silt

Loose gray fine to med sand. Tr. silt & gravel

Loose to med. br. to med. to fine sand. some gravel trace silt

Very stiff gray silty clay lenses fine gray sand

Continued on sheet #2

Fill in with Black Drawing Ink

Depth in Feet — Blows Per Foot Casing Penetration — Sample Number — Blows on Spoon (0 / 6 / 12 / 18)

Sample	0–6	6–12	12–18
1	PUSH		
TUBE			
2	Pushed		
3	1		2
			3
4	4	4	5
5	4	5	5
6	3	2	3
7	2	4	7
8	4	5	5
9	3	5	6
10	9	13	12
11	7	10	11
12	6	8	8

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8 "
Weight of Hammer on Casing 300 300 lbs.
" " " " Spoon 140 lbs
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length Sampl
1	0–1'0"	12"	7"
Tube	1–3'	24"	24
2	3–4'6"	18"	6"
3	4'6"–6'	"	5"
4	10–11'6"	"	4"
5	15–16'6"	"	15"
6	20–21'6"	"	10"
7	25'–26'6"	"	4"
8	30–31'6"	"	10"
9	35'–36'6"	"	7"
10	40–41'6"	"	18"
11	45–46'6"	"	18"
12	50'–51'6"	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Per H

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B 10

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector | Date Started 11/11/66 | Completed 11/14/66

MHW El. | MLW El. | El. of Ground Water | Length of Casing Driven

Ground Line Elevation

Blows per Foot of Casing Penetration

Depth in Feet

Sample Number

Blows on Spoon 0/6	6/12	12/18
13	17	25 25
6	9	22
14 Trapped		
15	6	9 22

93
83
87
110
205
108
111
123
121
113

55 ft

Materials Encountered Very stiff gray silty clay lenses fine gray sand

Dense Gray Med. sand trace clay

60 ft

Very loose gray fine to med. sand. some gravel. Water bearing. Stiff gr. sandy clay.free gravel(moist) Med. fine to med. sand Layered with Blk. Sandy silt.

65 ft

Bottom of boring 65'

Note: Rod dropped to 62½ after washing to 60' No blow count sample trapped in rod. water came out of casing between 60' & 62½'

20 25 30 35 40 45 50

Fill in with Black Drawing Ink

Inside Dia. of Casing
" " " Spoon
Weight of Hammer on Casing
" " " " Spoon
Drop of Hammer on Casing
" " " " Spoon

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
13	55'-56'6"	18"	13"
14	60-61'6"	18"	trapped sample
15	63'6"-65'	18"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill
Core Diameter

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.

Wantagh Water Plant — North Bergen, New Jersey — Nassau Co. New York

Sheet 1 of 2

TEST BORING DATA — TEST HOLE NO. B-11

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector | Date Started 11/9/66 | Completed 11/10/66

MHW El. | MLW El. | El. of Ground Water | Length of Casing Driven

Ground Line Elevation 2.5'

Materials Encountered

Very Soft Meadow Mat. organic silt

Very loose gray-br. med. to coarse sand. some gravel. Tr. silt.

Loose gray med. to fine sand. Tr. silt & gravel

Loose to Med. brown gray Med. to fine sand trace silt & gravel.

Very stiff gray silty clay lenses of fine sand

Continued on sheet 2

Fill in with Black Drawing Ink

Sample Number	Blows on Spoon 0/6	6/12	12/16
1	PUSHED		
1A			
2	PUSHED		
3	PUSHED		
4	PUSHED		
X			
5	PUSHED		
6	1	1	2
7	2	2	2
8	3	4	5
10	4	6	7
11	3	7	7
12	8	9	11
13	10	11	13

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8 "
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-2'6"	pushed 18"	10"
U-1A Tube	1'6"-3'6"	pushed 16"	
2	3'6"-5'	18"	15"
3	5'-6'6"	"	8"
4	6'6"-8'	"	5"
5	8'-9'6"	"	4"
6	9'6"-11'	"	6"
7	15-16'6"	"	12"
8	20-21'6"	"	15"
9	25'-26'6"	"	13"
10	30-31'6"	"	5"
11	35'-36'6"	"	4"
12	40-41'6"	"	18"
13	45-46'6"	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

...ntagh Water ...lant — Sheet 2 of 2

W. H. WALSH COMPANY, INC. North Bergen, New Jersey

Nassau co. New York

TEST BORING DATA — TEST HOLE NO. B-11

Rge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector | Date Started 11-9-66 | Completed 11-10

MHW El. | MLW El. | El. of Ground Water | Length of Casing Driven

Ground Line Elevation

Materials Encountered

very stiff Gray silty clay lneses fine sand

Dense-Gray fine sand tr. of silt.

Dense-Gray, wet sand trace silt.

Note- When casing pulled back to 50' water flowed up 4' above ground washing up sand. Run all night, Shoved down noon.

Depth in Feet: 55, 60, 65, 70, 80, 35, 40, 45, 50

Blows Per Foot of Casing Penetration

Sample Number	Blows on Spoon 0/6	6/12	12/18	
14	9	7	14	
15	8	16	16	
16	8	15	50	
17	16	47	68	
18	24	37	39	
19	14	28	32	
	20	21	39	41

Inside Dia. of Casing 1 3/8"
" " " Spoon 3"
Weight of Hammer on Casing 140#
" " " " Spoon 24#
Drop of Hammer on Casing 30"
" " " " Spoon

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
14	50'-51'6"	18"	18"
15	55'-56'6"	"	9"
16	60'-61'6"	"	8"
17	65'-66'6"	"	18"
18	70'-71'6"	"	18"
19	75'-76'6"	"	14"
20	78'6"-80'	"	15"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau County, New York

TEST BORING DATA — TEST HOLE NO. B 12

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector | Date Started 11/10/66 | Completed 11/

MHW El. | MLW El. | El. of Ground Water | Length of Casing Driven

Ground Line Elevation 2.4'

Depth in Feet | Blows Per Foot of Casing Penetration | Sample Number | Blows on Spoon (0/6, 6/12, 12/18)

Depth	Blows	Sample	0/6	6/12	12/18	Materials Encountered
	1	1	PUSHED			Very soft Meadow Mat. Blk. organic silt
	1	1A	PUSHED			
	1	2	PUSHED			
	1					
5	1	3	PUSHED			
	1	4	"		"	
	1					
	1	5	"		"	
	1					
10	2	6	1	3	3	
	12					Loose gray coarse fine sand & gravel. Trace silt, and gravel
	21					
	23					
	19					
15	17					
	11	7	4	5	4	Loose gray med. to fine sand & Gravel. Trace silt.
	13					
	15					
	15					
20	16	8	3	5	4	
	13					
	16					
	15					
	12					Medium Gray Med. to fine sand. Trace silt and gravel
25	16	9	5	5	7	
	15					
	21					
	26					
	25					
30	22					
	21	11	5	7	8	
	24					
	27					
	26					
35	26					
	25					
	39					
	43					
6"	25					Very stiff dk. gray silty clay, lenses fine sand
40		12	9	8	10	
45						
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8"
Weight of Hammer on Casing	300
" " " " Spoon	140
Drop of Hammer on Casing	24
" " " " Spoon	30

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length Sample
1	0'-1'	12" Pushed	8"
~~2~~ Tube	1'-3'	24"	14"
2	3'-4'6"	"	10"
3	4'6" -6'		10"
4	6-7'6"		6"
5	7'6" -9'		9"
6	9'-10'6"		6"
7	15-16'6"		3"
8	20-21'6"		4"
9	25-26'6"		5"
10	30-31'6"		10"
11	35-36'6"		12"
12	38'6"-40'		18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Per H

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B-13

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: R. Imperato | Inspector | Date Started 11/14/66 | Completed 11/15/66

MHW El. | MLW El. | El. of Ground Water tidal | Length of Casing Driven

Ground Line Elevation 2.6'

Depth in Feet	Blows per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
	1 1	Very soft meadow mat	1	PUSHED		
	5 2	Soft Meadow Mat. organic silt. mixed fine sand	2	1	3	2
5	12 10	Loose-Br. Med. sand. some gravel. Tr. silt.	3	2	2	3
	13 24 22		4	3	4	4
10	21 13 15 21	Loose-br. med. to fine sand, some fine gravel. trace silt.	5	4	5	6
	16 17					
15	14 16	Loose	6	3	4	4
	12 17 19					
20	16 20 19	Med.	7	4	6	7
	22 26 15	Loose	8	3	5	5
25	18 27 23					
30	22 20 26	Medium-br. Med. to fine sand	9	4	6	7
	29 28 31					
35	29 43 51	Medium- Gray-Brown Med. to fine sand. tr. gravel. Tr. clay	10	6	9	10
	29		11	7	11	13
40		very stiff gr.silty clay lenses fine sand Bottom of boring 40'				
45						
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½
" " " Spoon	1 3/8"
Weight of Hammer on Casing	300 lbs
" " " " Spoon	140 lbs
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	8"
2	1'6"-3'	"	5"
3	3'-4'6"	"	5"
4	5'-6'6"	"	6"
5	10-11'6"	"	5"
6	15-16'6"	"	7"
7	20-21'6"	"	6"
8	25-26'6"	"	5"
9	30-31'6"	"	10"
10	35-36'6"	"	15"
11	38'6"-40'	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B- 14

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato | Inspector T. Mueller | Date Started 11/4/66 | Completed 11/7/6

MHW El. | MLW El. | El. of Ground Water tidal | Length of Casing Driven

Ground Line Elevation 2.5'

Depth in Feet | Blows per Foot of Casing Penetration | Sample Number | Blows on Spoon (0/6, 6/12, 12/18)

Depth	Blows per Foot	Sample	0/6	6/12	12/18	Materials Encountered
1	1	1		1	1	Soft Meadow mat & organic silt
	3		1			
	7	2	2	4	3	Dense. Fine to Med. Br. sand. Tr. silt and fine gravel
5	10					
	9	3	8	14	17	
	19					
	26					Med. to loose br. Med s sand Tr. gravel & silt
	28					
10	27					
	22	4	9	13	15	
	28					
	31					
	34					
15	33					
	23	5	4	5	7	
	26					
	27					
	24					
20	21					Loose Med. to coarse Br. sand & gravel
	17	6	4	5	5	
	23					
	26					
	25					
25	23					Loose fine to med. sand. Tr. silt & gravel
	21	7	3	3	3	
	26					
	28					
	27					
30	28					Loose to med. brown fine to med. sand. some gravel Trace silt
	17	8	3	4	4	
	20					
	22					
	24					
35	21					
	43	9	4	3	4	
	98					
	81					
	85					
	83					Bottom of Boring 40'0"
40						
		10	7	8	7	Stiff gr. silty clay with sand lenses
						Pay 40'
45						
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'6"-2'	18"	13"
1A-Tube	0'6"-2'5"	Pressed	16"
2	2'-3'5"	18"	14"
3	5'-6'5"	18"	12"
4	10'-11'5"	"	12"
5	15'-16'5"	"	1"
6	20-21'5"	"	3"
7	25'-26'5"	"	4"
8	30-31'5"	"	4"
9	35-36'5"	"	12"
10	40-41'5"	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Sheet 1 of 2 — Nassau coutnty, N.Y.

TEST BORING DATA — TEST HOLE NO. B-15

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamarelli | Inspector | Date Started 11-7-66 | Completed 1-8-6

MHW El. | MLW El. | El. of Ground Water | Length of Casing Driven

Ground Line Elevation 2.63'

Depth in Feet	Blows Per Foot Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
	2	Materials Encountered	1		1	
	3	soft meadow mat and	1A	tube		
	3	organic silt				
	3	loose br. f. sand, trace	3	1	2	2
5	3	silt and vegetation				
	2	loose gr. med to fine sand	4	2	3	2
	4	trace silt and gravel				
	5					
	9					
	11	Dense br. fine to med. sand	5	15	17	23
10	17	trace silt and gravel				
	23					
	25					
	29					
	12		5	15	18	22
15	19					
	19					
	22					
	23					
	25	Loose br. coarse to	7	4	4	6
20	20	med. sand, trace silt				
	17					
	18					
	21					
	20	Note 4' running sand at	8	5	5	5
25	24	25' sample				
	21					
	21					
	25					
	17		9	4	4	4
30	21					
	21					
	19	Loose br. Med to fine				
	20	sand	10	3	4	4
35	15					
	18					
	21					
	37	Very stiff, dk gray,				
	42	silty clay, lenses fine	11	10	14	19
40	51	sand				
	43					
	47					
	53					
	58		12	5	7	11
45	43					
	59					
	71					
	83					
	89					
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300#
" " " " Spoon 140#
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'5"	18"	12"
12U Tube	1.'5"-3".5"	24"	23"
3	3'5"-5'.0"		8"
4	5'-6'5"		18"
5	10'-11'5"		18"
6	15'-16'5"		12"
7	20'-21'5"		13"
8	25'-26'5"		9"
9	30'-31'5"		8"
10	35'-36'5"		16"
11	40'-41'5"		14"
12	45'-46'5"		18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Sheet 2 of 2 — North Bergen, New Jersey — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B 15

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: J. Sciaorelli — Inspector — Date Started 11/7/66 — Completed 11/8/66

MHW El. — MLW El. — El. of Ground Water — Length of Casing Driven

Ground Line Elevation

Materials Encountered

See Page 1

Med to dense gray fine sand trace. silt

Dense gray coarse sand some silt.

Med gray coarse sand

Med-gray med. to fine sand

Bottom of Boring 80'0"

Note 15' Runing sand at 70' sample depth

Depth in Feet — Blows per Foot of Casing Penetration — Sample Number — Blows on Spoon (0/6, 6/12, 12/18)

Sample	0/6	6/12	12/18
13	6	9	12
14	6	11	16
15	5	7	11
16	10	15	21
17	8	10	11
18	9	9	12
19	6	9	11

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs
" " " " Spoon 140 lbs
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
13	50'-51'5"	18"	15"
14	55'-56'5"	"	13"
15	60'61'5"	"	15"
16	65'-66'5"	"	18"
17	70'71'5"	"	10"
18	75'76'5"	"	12"
19	78'5"-80'	"	13"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau County, New York

TEST BORING DATA — TEST HOLE NO. B 16

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamorelli | Inspector T. Mueller | Date Started 11/9/66 | Completed 11/9

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 2.5

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
2	2	Soft Meadow Mat & organic silt	1	1	2	2
3	3	Very loose br. fine sand tr. silt & gravel	2	1	1	1
4	6					
5	4	Medium-Brown fine to med. sand. Tr. silt & gravel.	3	9	15	14
	15					
	22					
	24					
10	20					
	9	Medium - Brown coarse sand some gravel.	4	7	7	9
	12					
	15					
	15					
15	17					
	11		5	6	8	10
	15					
	19					
	20					
	23					
20	13		6	5	8	9
	17	Medium- Br. Med. sand				
	15					
	15					
	16					
25	15	Loose to Med- Brown Med. sand. tr. gravel	7	6	6	8
	19					
	23					
	23					
	25					
30	19		8	5	5	7
	25					
	27					
	29	Medium-gray fine silty sand				
35	31					
	16		9	6	9	9
	23					
	23					
	10	6"				
		stiff gr.silt &clay tr.sand	10	10	11	11
40						
45						
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24 " 30"
" " " " Spoon	

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'5"	18"	8"
U-1A-Tube	1'-3'	24"	12"
2	2'-3'6"	18"	6"
3	5-6'6"	"	17"
4	10-11'6"	"	15"
5	15'-16'6"	"	12"
6	20-21'6"	"	10"
7	25-26'6"	"	8"
8	30-31'6"	"	11"
9	35-36'6"	"	9"
10	38'6"-40'	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Fee Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau County, N.Y.

TEST BORING DATA — TEST HOLE NO. B 17

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamorelli Inspector — Date Started 11/11/66 Completed 11/14/

MHW El. | MLW El. | El. of Ground Water | Length of Casing Driven

Ground Line Elevation 2.56'

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
0	1	Very soft	1		1	
	1	meadow mat & organic silt				
	1	Med. meadow mat & silt. black	2	2	2	4
	2	trace sand.	3	5	5	9
	5	Br. br. silty clay tr. sand				
5	11	Medium-Br. Med. sand tr.	4	6	8	11
	17	silt.				
	21					
	19					
	22					
10	15		5	7	10	9
	18	Medium -br. med sand				
	18	trace Gravel				
	22					
	21					
15	10	Med.	6	6	8	9
	14					
	17					
	19					
	16	Med.	7	5	6	7
20	10					
	12					
	13					
	13					
	13					
25	11	Loose runing	8	3	3	4
	13					
	14					
	21					
	19					
30	14	Loose running	9	22	3	
	21					
	27					
	29					
	31					
35	20	Medium-Gray fine silty	10	10	11	13
	29	sand. Tr. clay				
	38					
	41					
		Very stiff dk. gray silty clay				
40						
45						
50						

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs
" " " " Spoon	140 lbs
Drop of Hammer on Casing	24 2"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	6"
2	2'-3'6"	"	18"
3	3'6"-5'	"	4"
4	5-6'6"	"	6"
5	10-11'6"	"	13"
6	15'-16'6"	"	6"
7	20-21'6"	"	4"
8	25'-26'6"	"	3"
9	30'-31'6"	"	8"
10	35'-36'6"	"	10"
11	38'6"-40'	"	9"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B 18

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: F. Imperato — Inspector T. Mueller — Date Started 11/1/66 — Completed 11/3/

MHW El. — MLW El. — El. of Ground Water Tidal — Length of Casing Driven 50.0

Ground Line Elevation 2.0

Depth in Feet	Blows Per Foot of Spoon Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
	1	Soft br. meadow mat. Black organic silt.	1	1	1	1
	1		2	2	2	5*
	4		3	8	7	6
5	9	Brown Med. sand. some gravel. trace silt. Medium				
	12		4	5	5	6
	13					
	18					
	21					
10	20					
	7		5	4	4	6
	17					
	25					
	22	Brown med to fine sand trace gravel Medium				
15	18					
	11		6	4	5	6
	20					
	23					
	18					
	17					
20	13	Br. med. to fine sand trace gravel. Loose	7	3	4	4
	18					
	21					
	20					
25	21	Brown fine to med. sand. trace gravel loose				
	15		8	4	2	2
	19					
	26					
	27					
	27	Br. fine to med. sand tr. gravel. Medium				
30	22		9	5	8	17
	36					
	35					
	38					
	39	Gray fine silty sand trace gravel. dense				
35	34		10	8	14	32
	36					
	50					
	43					
	61	Gray silty clay with lenses of fine to med. brown sand. Medium				
40	43		11	8	9	10
	43					
	57					
	61					
45	75					
	71		12	12	10	13
	94					
	116					
	135					
50	157	Bottom of Boring 51.5*	13			
				13	12	14

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0 -1.5"	18"	16"
2	1'5"-3'	"	None
3	3'-4'5"	"	
4	5'-6'5"	"	
5	10'-11'5"	"	
6	15'-16'5"	"	
7	20'-21'5"	"	
8	25'-26'5"	"	
9	30'-31'5"	"	18"
10	35'-36'5"	"	18"
11	40'-41'5"	"	18"
12	45'-46'5"	"	18"
13	50'-51'5"	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill Sprague & Henwood

Core Diameter None

* No recovery Pay 50'

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. N.Y.

TEST BORING DATA — TEST HOLE NO. B 19

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamorelli Inspector — Date Started 10/10/66 — Completed 10/11/

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 1.7'

Depth in Feet	Blows Per Foot of Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
0	1 1 3	Soft Meadow mat & organic silt	1	1	1	1
	1 1 3	Loose- br. med to fine sand tr. silt, tr. gravel & veg.	2	2	2	2
5	3 13 19 25	Medium- br. fine to med. sand. tr. silt & tr. gravel	3	12	16	19
10	27 15 24 26 28		4	7	10	12
15	29 12 16 21 21	Loose br. med. sand. tr. gravel	5	3	3	4
20	23 14 21 28	Loose br. med. sand.	6	4	3	4
	22 26 19 23	Running sand @25'	7	3	3	4
25	28 36 31 20	Loose br. med. to fine sand.	8	3	3	3
30	26 29 30 33					
35	28 35 64 63		9	4	4	6
		6" very stiff dk. gr. silty clay	10	9	10	15
40						
45						
50						

Inside Dia. of Casing 2½"
" " " Spoon 1 1/8"
Weight of Hammer on Casing 300
" " " " Spoon 140
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	18"
2	2'3'6"	18"	7"
1A Tube	0'-2'	24"	21"
3	5'-6'6"	18"	9"
4	10'-11'6"	"	18"
5	15'-16'6"	"	12"
6	20-21'6"	"	5"
7	25'-26'6"	"	4"
8	30-31'6"	"	4"
9	35'-36'6"	"	8"
10	38'6"-40'	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill
Core Diameter

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. Neew York

sheet 1 of 2

TEST BORING DATA — TEST HOLE NO. B-20

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: F. Imperato — Inspector — Date Started 11/15/66 — Completed 11/16

MHW El. — MLW El. — El. of Ground Water Tidal — Length of Casing Driven

Ground Line Elevation 2.6'

Materials Encountered

Very soft m meadow mat & organic silt.

Medium br. fine sand little silt & gravel

Med. to loose Br. coarse to Med. sand some fine gravel

Med. to very loose br. coarse sand some fine gravel- Water Bearing

Running up 5'

Medium-br. fine to med. sand Tr. silt. Tr. fine gravel

Very stiff dk. gray silty clay with lenses of fine sand.

Continued on sheet 2

Fill in with Black Drawing Ink

Depth in Feet	Sample Number	Blows on Spoon 0/6	6/12	12/18
	1	Pushed		
	2	1	1	1
	3	4	6	9
5	4	7	9	12
10	5	5	6	5
15	6	4	4	4
20	7	3	5	6
25	8	4	2	2
30	9	6	8	11
35	10	7	9	11
40	11	6	8	13
45	12	7	12	15
50				

Blows Per Foot of Casing Penetration

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	12"
2	1'6"-3'	"	14"
3	3'-4'6"	"	10"
4	5'-6'6"	"	9"
5	10'-11'6"	"	7"
6	15'-16'6"	"	6"
7	20'-21'6"	"	8"
8	25'-26'6"	"	12"
9	30'-31'6"	"	12"
10	35'-36'6"	"	10"
11	40-41'6"	"	18"
12	45'-46'6"	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Sheet 2 of 2

TEST BORING DATA – TEST HOLE NO. B-20

Rge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: F. Imperato Inspector | Date Started 11/15/66 Completed 11/16/

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation

Elevation	Materials Encountered	Blows per Foot of Casing Penetration	Blows on Spoon 0/6	6/12	12/18	Sample Number
92	Very stiff gray silty clay with lenses fine sand					
138						
169						
241						
277						
74						
97						
71						
63						
61	Medium gray fine to med. sand, tr. clay					
42						
75						
69						
31-6"						
	Bottom of boring					

5			14	11	14	13
60			15	4	6	7
			16	5	8	10
65						

Depth in Feet: 20, 25, 30, 35, 40, 45, 50

			13	10	10	13

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8 "
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
13	50-51'6"	18"	18"
14	55-56'6"	"	12"
15	60-61'6"	"	14"
16	63'6"-65'	"	16"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B 21

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: J. Sciamorelli — Inspector T. Mueller — Date Started 11/27/66 — Completed 11/27

MHW El. — MLW El. — El. of Ground Water Tidal — Length of Casing Driven

Ground Line Elevation 2.0

Depth in Feet	Blows Per Foot	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
0	1	Materials Encountered Very soft meadow mat & organic silt	1		1	
	1	loose feilt y sand trace veg.	2	1	1	1
	2		3	2	2	2
5	2	very loose gr. fine to silty sand . tr. gravel	4	2	1	3
	3					
	4	Loose br. fine to med. sand. tr. silt & gravel				
	3					
10	5		5	3	4	3
	9					
	17	Medium-gr. coarse to med.				
	21	sand. tr. gravel				
	27					
15	12		6	7	9	13
	19					
	23					
	26					
	25					
20	12	Medium to loose gray	7	5	8	10
	17	med. sand				
	20					
	18					
25	13	Run up 50# @ 25'	8	4	5	5
	11					
	11					
	18					
	20					
30	11	loose gr. fine sand.	9	3	3	4
	14					
	19					
	19					
	20	Run up 8# @ 35'.				
35	17	Medium-gr. fine sand. tr. gravel	10	4	6	8
	29					
	51	Very stiff dr. gr. silt &				
	37-6"	fine sand. tr. clay (layers)	11	9	13	17
40						
45						
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs
" " " " Spoon	140 lbs
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	6"
2	2'-3'6"	"	4"
3	3'-6"-5'	"	3"
4	5'-6'6"	"	4"
5	10-11'6"	"	2"
6	15'16'6"	"	8"
7	20-21'6"	"	7"
8	25'-26'6"	"	9"
9	30-32'6"	"	4"
10	35'-36'5"	"	10"
11	38'6"-40'	"	12"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Fee Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — sheet 1 of 2 — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B-22

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamorelli | Inspector T. Mueller | Date Started 11/2/66 | Completed 11/4/

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation + 2.2'

Depth	Sample Number	Blows on Spoon 0/6	6/12	12/18	Description
0	1		1		very soft br. meadow mat.
1	2		1		black organic silt
2	3	2	3	3	Loose Med. to fine Br. sand. tr. silt. tr. gravel
5	4	7	5	5	
10	5	5	9	9	Medium " " "
15	6	7	10	11	
					Medium- Medv. fine br. sand some gravel
20	7	5	6	6	
25	8	4	5	5	
30	9	4	1	2	Loose fine to med. br. sand.
35	10	4	3	4	
					Loose gray fine silty sand
					Med. dk. gray silty clay thin layers fine sand
40	11	9	13	19	
45	12	7	9	14	
50					Continued sheet 2

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'5"	18"	14"
2	1'5"-2'5"	"	10"
3	2'5"-4'	"	16"
4	5'-6'5"	"	
5	10'-11'5"	"	
6	15'-16'5"	"	
7	20'-21'5"	"	
8	25'-26'5"	"	
9	30'-31'5"	"	
10	35'-36'5"	"	
11	40'-41'5"	"	
12	45'-46'5"	"	

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

Note: Lost sample at 30'-31'5"

DO NOT WRITE ON BACK OF SHEET

...T. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant sheet 2 of 2 Nassau Co. N.York

TEST BORING DATA - TEST HOLE NO. B-22

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamorelli Inspector T. Mueller Date Started 11/2/66 Completed 11/4/66

MHW El. MLW El. El. of Ground Water tidal Length of Casing Driven

Ground Line Elevation

Depth in Feet	Blows per Foot	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
0	39					
	61	Stiff dk. gray silty clay	13	7	10	15
	87	thin layers fine sand.				
	119					
5	95					
	53		14	6	9	12
	97					
	114	Medium, gray fine				
	121	running sand. trace silt				
60	97					
	63		15	7	10	19
	94					
	121					
	179					
65	193					
	73	Dense coarse gray sand	16	19	41	57
	139	trace silt				
	156					
	151					
	160					
70	81	Hard, dk. gray silty	17	16	25	42
	161	clay. Lenses of fine				
	189	gray sand.				
	171					
	165					
75	89		18	14	23	38
	139					
	153					
	170					
80	189					
		Bottom of Boring 81'5"	19	17	29	42
35						
40						
45						
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140" lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
13	50'-51'5"	18"	
14	55-56'5"	"	
15	60'-61'5"	"	
16	65-66'5"	"	
17	70'-71'5"	"	
18	75'-76'5"	"	
19	80'-81'5"	"	

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. N.Y.

TEST BORING DATA — TEST HOLE NO. B 23

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: J. Sciamorelli Inspector — Date Started 11/22/66 Completed 11/22

MHW El. — MLW El. — El. of Ground Water Tidal — Length of Casing Driven

Ground Line Elevation 2.1'

Depth in Feet — Blows Per Foot Penetration — Sample Number — Blows on Spoon (0/6, 6/12, 12/18)

Sample Number	0/6	6/12	12/18	Materials Encountered
1		1		Very soft meadow mat. & gray organic silt
2		1		
3	2	2	2	Soft gray org. silt. tr. sand & gravel
4	3	5	10	Medium Br. coarse to med. sand tr. gravel.
5	7	10	12	
6	5	8	9	
7	4	5	6	Loose Br. Med. sand
8	4	4	5	Run up 5'@25'
				Run up 6' @ 30'
9	3	4	4	Loose br. med. to fine sand.
10	4	5	5	
				Medium-gray fine silty sand
11	7	9	12	Very stiff dk. gray silty clay. lenses fine sand
12	8	11	14	
13	9	12	16	

37'-6"

50

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length Sample
1	0'-1'6"	18"	3"
2	2'-3'6"	"	5"
3	3'6"-5'	"	3"
4	5'-6'6"	"	9"
5	10-11'6"	"	4"
6	15'-16'6"	"	6"
7	20-21'6"	"	10"
8	25'-26'6"	"	4"
9	30-31'6"	"	3"
10	35'-35'6"	"	5"
11	40-41'6"	"	13"
12	45-46'6"	"	9"
13	48'6"-50'	"	12"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Fe Per Hou

Type of Core Drill

Core Diameter

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.

Wantagh Water Plant — North Bergen, New Jersey — Nassau Co, New York

TEST BORING DATA — TEST HOLE NO. B 24

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamorelli Inspector | Date Started 11/14/66 | Completed 11/

MHW El. | MLW El. | El. of Ground Water | Length of Casing Driven

Ground Line Elevation 1.92'

Depth in Feet	Blows Per Foot for Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
1	1	Very soft meadow mat. & organic silt	1	1	1	1
3	4	Loose br. fine to med. sand trace gravel	2	2	3	4
5	7	Medium- Br. fine to med. sand. tr. silt & gravel.	3	6	8	9
8	3					
3	10					
10	8	Med. br. coarse to med. sand. tr. silt & gravel	4	7	9	9
11	11					
12	12					
15	10		5	6	8	9
14	15					
16	16					
20	11	Br. fine to med. sand loose	6	2	3	5
11	12					
13	13					
25	9	Loose. Br. coarse to med. sand. tr. gravel	7	2	2	4
12	12					
13	12					
30	11	Medium br. Med. sand tr. gravel	8	3	5	6
15	19					
22	43					
35	31	Dry fine silty sand	9	10	12	15
53	52	Very stiff dk. gray silty clay. Layers fine sand.				
31			10	9	13	16
40		Bottom of Boring 40'0"				
45						
50						

Inside Dia. of Casing

" " " Spoon

Weight of Hammer on Casing

" " " " Spoon

Drop of Hammer on Casing

" " " " Spoon

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length o Sample
1	0'-1'6"	18"	13"
2	2'-3'6"	"	4"
3	5'-6'6"	"	5"
4	10-11'6"	"	11"
5	15-16'6"	"	6"
6	20-21'6"	"	3"
7	25'-26'6"	"	11"
8	30-31'6"	"	4"
9	35'-36'6"	"	10"
10	38'-6"-40'	"	17"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Fee Per Hour

Type of Core Drill

Core Diameter

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — Nassau Co. N.Y.

TEST BORING DATA — TEST HOLE NO. B 25

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: F. Imperato — Inspector T. Mueller — Date Started 11/16/66 — Completed 11/1

MHW El. — MLW El. — El. of Ground Water — Length of Casing Driven

Ground Line Elevation 2.0'

Depth in Feet	Blows Per Foot Standard Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
1	1	Very soft meadow mat.	1	PUSHED		
2	2	Soft to med. blk. organic silt some sand. tr.gravel	2	1	2	4
12	20		3	5	7	9
5	14	Medium-Br. Med. to fine sand. some gravel. tr. silt.	4	8	11	14
	16					
	19					
	23					
	21					
10	16		5	6	7	7
	19					
	18					
	17					
	18	Medium-br. Med. to fine sand. trace silt & gravel.				
15	17		6	5	7	8
	21					
	20					
	19					
	21					
20	19		7	5	6	6
	16					
	19					
	17					
	16					
25	17		8	4	5	6
	16					
	19					
	19					
	19					
30	32		9	6	6	8
	32					
	32					
	43					
	36					
35	29		10	4	6	7
	43					
	50	Very stiff dk. gray silty clay. lenses fine sand				
	24					
40		Bottom fo Boring. 40'	11	6	8	9
45						
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	4"
2	1-6"-3'	"	6"
3	3'-4'6"	"	10"
4	5'-6'6"	"	5"
5	10-11'6"	"	9"
6	15-16'6"	"	6"
7	20-21'6"	"	10"
8	25'-26'6"	"	5"
9	30-31'6"	"	18"
10	35'-36'6"	"	10"
11	38'6"-40"	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. N.Y.

TEST BORING DATA — TEST HOLE NO. B-26

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by J. Sciamorelli | Inspector | Date Started 11/15/66 | Completed 11/15

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 2.56'

Depth in Feet	Penetration in Inches	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
1	1	Very soft meadow mat & organic silt	1	1	1	1
1	3	Loose br. med. to fine sand tr. silt, tr. gravel	2	2	3	3
3	12	Med. Br. Med. to fine silty sand tr. gravel	3	7	7	9
5	13					
19	21					
23	27	Medium Br. coarse sand tr. gravel.	4	6	8	11
10	12					
22	24					
19	19					
15	11		5	3	3	4
15	17	Loose Br. Med. sand.				
20	20					
20	13		6	3	4	4
19	22					
23	22					
25	14		7	4	3	3
20	20					
20	21					
30	20					
16	23	Loose Br. fine to med. sand	8	3	4	4
29	31					
34	35					
22	47	Or fine silty sand (med.) Very stiff, dk. gray silty clay, lenses fine sand	9	6	9	11
59	34		10	9	11	14
40		Bottom of Boring 40'0"				
45						
50						

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs.
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	8"
2	2'-3'6"	"	10"
3	5'-6'6"	"	5"
4	10'-11'6"	"	13"
5	15'-16'6"	"	7"
6	20'-21'6"	"	5"
7	25'-26'6"	"	11"
8	30'-31'6"	"	5"
9	35'-36'6"	"	11"
10	38'6"-40'	"	14"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B 27

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: T. Sciarorelli | Inspector T. Mueller | Date Started 11/18/66 | Completed 11/18

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 2.2'

Depth in Feet	Blows Per Foot Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
1	1	Very soft Meadow mat & organic silt	1		1	
2	1	Very loose br. med. -fine sand. tr. silt & vegetation	2	1	1	2
3	6					
5	7	Medium Br. Med. to fine sand. Tr. silt & gravel.	3	5	6	6
	9					
	15					
	19					
	20					
10	12		4	6	8	9
	21					
	20	Loose Br. coarse sand tr. gravel				
	18					
15	19					
	13					
	19		5	4	4	5
	27					
	20					
20	21					
	17	Run up 6' @ 25'	6	3	5	5
	20					
	20					
25	19					
	13	Loose to Med. Br. Med. sand. trace gravel	7	2	2	3
	19					
	22					
	23					
30	25					
	15		8	4	7	7
	20					
	21					
	24					
35	25					
	20	Medium-Gr. fine silty sand	9	6	8	10
	39					
	47					
	30	6" Very stiff dk. gray silty clay lenses f. sand	10	9	11	13
40						
45						
50						

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	8"
2	2'-3'6"	"	5"
3	5'6"-6"	18"	7"
4	10-11'6"	"	5"
5	15-16'6"	"	4"
6	20-21'6"	"	6"
7	25'-26'6"	"	2"
8	30-31'6"	"	5"
9	35'-36'6"	"	9"
10	38'-40'	"	13"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Fee Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Wantagh Water Plant — North Bergen, New Jersey — sheet 1 of 2 — Nassau Co. N.Y.

TEST BORING DATA — TEST HOLE NO. B. 28

Bridge | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamorelli Inspector — Date Started 11/16/66 Completed 11/17

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation 2.56

Depth in Feet	Blows per 6" Casing Penetration	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
1	1	Very soft Meadow Mat.	1	1	2	1
3	2	Very loose dr. silty sand trace gravel	2	2	2	2
5	3		3	2	2	2
	9		4	2	1	3
	17	Medium-Br. coarse sand Trace gravel				
10	29					
	32					
	31		5	6	10	12
	12					
	13					
	20					
	27	Medium-Br. Med. sand trace gravel				
15	19		6	6	8	9
	10					
	18					
	19					
	19					
20	19		7	5	7	7
	17					
	11					
	20					
	19					
25	21	Sand Run up 5' @ 25'	8	6	6	8
	11					
	15					
	13					
	18	Loose br. fine sand				
30	20					
	13		9	3	3	4
	19					
	20					
	26					
35	28	Med. br. coarse sand some gravel	10	6	6	7
	27	Very stiff dark gray clay-lenses. fine sand				
	44					
	49					
	57					
40	31		11	7	9	11
	47					
	57					
	58					
	68					
45	71		12	8	11	14
	38					
	58					
	71					
	61					
50	58	Continued sheet 2				

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	11"
2	2-3'6"	"	8"
3	2-3'6"	"	9"
4	5-6'6"	"	5"
5	10-11'6"	"	10"
6	15-16'6"	"	7"
7	20-21'6"	"	6"
8	25-26'6"	"	9"
9	30-31'6"	"	4"
10	35-36'6"	"	10"
11	40-41'6"	"	13"
12	45'-46'6"	"	9"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

North Bergen, New Jersey

Sheet 2 of 2 Wantagh Water Plant — Nassau, County, New York

TEST BORING DATA — TEST HOLE NO. B 28

Rte | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: J. Sciamorelli Inspector T. Mueller Date Started 11/16/66 Completed 11/17/6

MHW El. | MLW El. | El. of Ground Water Tidal | Length of Casing Driven

Ground Line Elevation

Materials Encountered

Very stiff dk. gray silty clay Lenses fine sand

Dense to very dense Gr. fine silty sand. Run up 15' @65'

Bottom of Boring 65'0"

Note: Missed sample first attempt @ 60'

Depth in Feet	Blows Per Foot of Casing Penetration	Sample Number	Blows on Spoon 0/6	6/12	12/18
0	43				
	61				
	73				
	77				
	65				
5	51	14	9	13	17
	75				
	109				
	93				
	87				
10	61	15	7	19	29
	181				
	197				
	96-6"	16	11	29	63
15					
20					
25					
30					
35					
40					
45					
50					

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
13	50-51'6"	18	18"
14	55-56'6"	"	14"
15	60-61'6"	"	11"
16	63'6"-65'	"	10"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

... COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Col New York

TEST BORING DATA — TEST HOLE NO. B-29

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: H. Schotte — Inspector T. Mueller — Date Started 11/21/66 — Completed 11/21/66

MHW El. — MLW El. — El. of Ground Water Tidal — Length of Casing Driven

Ground Line Elevation 7.64'

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8"
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	18"
2	1'6"-3'	"	18"
3	5'-6'6"	"	9"
4	10'-11'6"	"	12"
5	15'-16'6"	"	6"
6	20-21'6"	"	10"
7	25'-26'6"	"	12"
8	30-31'-6"	"	10"
9	35'-36'6"	"	18"
10	38'6"-40'	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

Sample Number	Blows on Spoon 0/6	6/12	12/18	Blows Per Foot	Depth in Feet	Materials Encountered
1	1	1	1	2	0	Very soft meadow mat
2	1	2	2	3	1	Loose to dense-Br. organic silty sand. Trace gravel
3	3	2	2	4	5	
4	14	16	17	21	10	Medium Br. Coarse sand
5	5	6	9	15	15	
6	7	6	8	14	20	Medium-Br. med. sand
7	3	9	16	25	25	Medium Br. Fine sand
8	7	8	17	25	30	Run up 5' @ 25' " " little gravel Run up 10' @ 30'
9	6	10	9	16	35	Very stiff to hard. dk. gray silty clay lenses. fine sand.
10	15	15	16	30	40	Bottom of Boring 40'

Fill in with Black Drawing Ink

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B 30

Bridge H. Schotte | Rt. | Sec. | Sta. | Offset | Lt. Rt.

Borings made by: | Inspector | Date Started 11/15/66 Completed 11/16/

MHW El. | MLW El. | El. of Ground Water tidal | Length of Casing Driven

Ground Line Elevation 2.84'

Depth in Feet	Materials Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
1	very soft meadow mat.	1	1	1	1
2		2	3	4	3
4	very soft org. silty sand				
5					
9	Dense Br. Med. to coarse sand. tr. silt. tr. gravel	3	12	16	24
24					
46					
39					
33	Medium-Br. fine to Med. sand. Tr. silt. tr. gravel.				
29		4	5	5	8
18					
20					
34					
33					
34					
22		5	4	6	7
26					
29					
24					
27					
23	Med.-Br. Med. sand Tr. silt	6	5	7	9
25					
28					
30					
32					
25	Running 4' @25'				
24					
26		7	3	4	5
21	Medium-Br. Med. to coarse sand				
23					
28					
35					
38	6' Running sand	8	5	7	10
41					
40					
42					
32	Dense-Gray silty sand. fine to med.	9	17	19	18
48					
57					
22	Gray Med. gr. F-M silty sand	10	18	22	
	very stiff gr. silty clay				27

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½"
" " " Spoon	1 3/8 "
Weight of Hammer on Casing	300 lbs.
" " " " Spoon	140 lbs.
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	16"
2	1'6"-3'	"	16"
3	5'-6'6"	"	18"
4	10'-11'6"	"	17"
5	15'-16'6"	"	12"
6	20-21'6"	"	10"
7	25-26'6"	"	N.R. trap
8	30-31'6"	"	4"
9	35-36'6"	"	6"
10	38'6"-40'	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill _____

Core Diameter _____

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. N.Y.

TEST BORING DATA — TEST HOLE NO. B 31

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: H. Schotte — Inspector T. Mueller — Date Started 11/17/66 — Completed 11/

MHW El. — MLW El. — El. of Ground Water Tidla — Length of Casing Driven

Ground Line Elevation 2.5' meadow

Depth in Feet	Material's Encountered	Sample Number	Blows on Spoon 0/6	6/12	12/18
1	clay				
1	Very soft mat	1	1	2	1
1	Med. clay some sand & gravel				
3		2	2	3	5
10	Dense br. med. to coarse				
21	sand, trace gravel				
29					
46		3	13	18	23
42					
28	Dense Br. Med. sand				
29	trace gravel				
15					
26		4	12	15	21
28					
22					
31					
13					
21	Dense Br. Med. to coarse	5	10	13	19
25	sand Trace gravel				
30	(Running up 5')				
25	Medium Br. Med.-to fine		–		–
19	sand. (Run up 4')	6	4	6	8
20					
20					
23					
29					
21	Med. br. fine sand	7	3	7	7
25	Run up 8'				
21					
25	Medium Br. fine sand				
24					
28	Run up 6'	8	5	7	5
23					
19					
25					
31					
20	Dense - fine sand	9	13	18	19
37	Run up 5'				
45	Hard dk. gray silty clay				
21-6"	lenses fine sand	10	12	16	20
	Bottom of Boring 40'				

Fill in with Black Drawing Ink

Inside Dia. of Casing	2½
" " " Spoon	1 3/8"
Weight of Hammer on Casing	300
" " " " Spoon	140
Drop of Hammer on Casing	24"
" " " " Spoon	30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	18"
2	1'6"-3'	"	16"
3	5'-6'6"	"	7"
4	10-11'6"	"	6"
5	15-16'6"	"	6"
6	20-21'6"	"	10"
7	25'-26'6"	"	5"
8	30-31'6"	"	7"
9	35-36'6"	"	7"
10	38'6"-40'	"	17"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Fee Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

W. M. WALSH COMPANY, INC.
North Bergen, New Jersey

Wantagh Water Plant — Nassau Co. New York

TEST BORING DATA — TEST HOLE NO. B 32

Bridge — Rt. — Sec. — Sta. — Offset — Lt. Rt.

Borings made by: H. Schotte — Inspector — Date Started 11/18/66 — Completed 11/18/66

MHW El. — MLW El. — El. of Ground Water tidal — Length of Casing Driven

Ground Line Elevation 2.5'

Depth	Sample No.	Materials Encountered	Blows on Spoon 0/6	6/12	12/18
	1	Very soft meadow mat.	1	1	1
	1	soft organic silt			
	1	some sand	2	1	1
	2				
	3				
5	23	Medium -Br. Med. sand			
	35	trace gravel	3	10	10
	49				19
	54				
	55				
	42				
10	24	Dense- Br. coarse sand	4	13	21
	31	to med. tr. silt			23
	36				
	38	Run up 6'			
	29				
15	21		5	11	15
	33				17
	35				
	33				
	27				
20	16	Loose br.-coarse sand	6	2	4
	19				3
	26	Run up 7'			
	32				
	40	Medium-Br. Med. sand			
25	19	trace silt	7	5	6
	21	Run up 4'			9
	25				
	36				
	48				
30	22	Med. br. fine to coarse sand	8	8	11
	25	Br. silty sand-Med-			13
	36	Run up 7'			
	64				
	129	Very stiff organic			
35	47	silty clay-lenses fine	9	9	16
	69	sand.			19
	98				
	39		10	17	18
					15
40					
		Bottom of Boring 40'			
		Note: 30' to 31' sand run up 5'			
45					
50					

Fill in with Black Drawing Ink

Inside Dia. of Casing 2½"
" " " Spoon 1 3/8"
Weight of Hammer on Casing 300 lbs
" " " " Spoon 140 lbs.
Drop of Hammer on Casing 24"
" " " " Spoon 30"

DRY SAMPLE DATA

Sample No.	Elevation bottom of Spoon	Total Penetration	Length of Sample
1	0'-1'6"	18"	18"
2	1'6"-3'	"	18"
3	5'-6'6"	"	Trapped
4	10-11'6"	"	10"
5	15'-16'6"	"	8"
6	20-21'6"	"	4"
7	25-26'6"	"	9"
8	30-31'6"	"	12"
9	35'-36'6"	"	18"
10	38'6"-40'	"	18"

CORE DATA

Sample No.	Elevation Top	Elevation Bot.	Core Recovered	Boring Feet Per Hour

Type of Core Drill

Core Diameter

DO NOT WRITE ON BACK OF SHEET

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-1C
PROJECT	Cedar Creek Plant Modifications, Wantagh, N.Y.	SHT. NO. 1 OF 3
CLIENT	Charles R. Velzy Assoc. Inc.	PROJ. NO. 83-08139-0
BORING CONTRACTOR	Slacke Test Boring Co., Inc.	ELEVATION +14.7±
GROUND WATER		DATUM Site
		DATE START 5-19-83
		DATE FINISH 5-20-83
		DRILLER R. Nimmo
		CC REP. KJL

DATE	TIME	DEPTH	CASING		CAS.	SAMP.	CORE	TUBE
5-19-83	3:25	26.1	60'	TYPE	Cpld.	S.S.		
5-20-83	8:45	11.5	60'	DIA.	2½"	2"		
5-20-83	10:00	11.5	40'	WT.	300#	140#		
				FALL	24"	30"		

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
			2		TOPSOIL 0.5	
1		S-1	6		Gr mfS,t.~$	HSA to 16' then switched to casin
			12			
2			10			
			9			
3		S-2	15			
			22		do FILL (Gray Sand, SP)	
4			23			
			5			
5		S-3	11		do	
			16			
6			19			
			19			
7		S-4	15		do	
			16			
8			17			
			6			
9		S-5	11		do w/t.fG	
			12			
10			12			
			9			
11		S-6	13			
			18		Gr fS,t.$ w/shell fgmts.	
12			19			
			4		do	PP=1.5 tsf
13		S-7	2			
			1		Br Pt. fibrous	
14			3		Brown Peat, Pt 14.5	
			2			
15		S-8	2		Br cFS,1.0$ w rts	
			4			
16	10		6			
17	22					
18	33	S-9			Interbedded Brown Silty Sand and Gray Silty Clay, SM-OH/CL	
19	23					
20	21					
21	18	S-9	3		Gr$yC wlyrs mfS 21.0	PP=1.25 tsf
			3			
22	31		6			
			8		Br mfS,t.$	
23	35					

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-101
PROJECT Cedar Creek Plant Modifications, Wantagh, NY		SHT. NO. 2 OF 3
CLIENT CRVA		PROJ. NO. 83-08139-01

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
24	37					
25	38					
26	20	S-10	6 7		Br cfS,t.fG	
27	31		11 9			
28	33					
29	34					
30	36					
31	23	S-11	14 7 8		do	Rec=3"
32	40		10			
33	31				Brown-tan Sand, SP	
34	35					
35	43					
36	35	S-12	12			
37	50		11 11			N.R.-Sand in wash
38	49		8			
39	43					
40	44					
41	44	S-13	7 7		Tn cfS,t.fG	
42	51		9 8			
43	49					
44	58				43.5	
45	73					
46	56	S-14	18 15		Gr cfS, t.$,l.mfG/w. occ.lyrs. Gr $yC	
47	68		12 13			
48	77					
49	72					

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-101
PROJECT Cedar Creek Plant Modifications, Wantagh, NY		SHT. NO. 3 OF 3
CLIENT CRVA		PROJ. NO. 83-08139-01

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50	81	S-15	11		Gr vvd $yC w/prts mfS	PP=2.0-2.5 tsf
	87		13			
			17			
			15			
	82				Gray Silty Clay, varved, with frequent partings of Sand, CL	
	71					
55	70					
			5			
	90	S-16	9		do	PP >4.0 tsf
			16			
	86		18			
	96					
	77					
60	54					
			13			
		S-17	19			
			19		do	PP = 3.5 tsf
			16			
					End of Boring @ 62.0'	

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-102

PROJECT	Cedar Creek Plant Modifications, Wantagh, NY
CLIENT	Charles R. Velzy Assoc., Inc.
BORING CONTRACTOR	Slacke Test Boring Co., Inc.

SHT. NO. 1 OF 3
PROJ. NO. 83-08139-01
ELEVATION +14.7±
DATUM Site
DATE START 5-24-83
DATE FINISH 5-25-83
DRILLER R. Nimmo
CC REP. KJL

GROUND WATER					CAS.	SAMP.	CORE	TUBE
DATE	TIME	DEPTH	CASING	TYPE	Cpld	S.S.		
5-24-83	3:15	9.9	12	DIA.	4/2½"	2"		
				WT.	300#	140#		
				FALL	24"	30"		

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
			2		TOPSOIL 0.5	
1		S-1	7		Tn mfS, t⁻.$	
			8			
2			11			
			9			
3		S-2	15		Gr cfS, t⁻.$,1.⁻fG	
			20			
4			22			
			9			
5		S-3	18		do	
			25		FILL (Gray Sand, SP)	
6			28			
			24			
7		S-4	16		Gr mfS,t.⁻$	
	66		17			
8			13			
	170	S-5	7			
9			13		do w/t. shall fgmts	
	200		19			
10			19			
	100	S-6	36			@12', removed 4" dia. casing, and installed 2½" Rec=3"
11			18		do	
	115		23			
12			16			
	29	S-7	8			
13			7		do	
	11		8			
14			6		14.0	
			1		Black Organic Clayey	
15	10	S-8 A	2		Bk cfS, a.0$ w/Pt Sand with Peat, 15.0	
		B	8		Br cfS, 1.$, t.rts SM/OH-PT	
16	20		9			
17	35					
18	43				Brown tan Silty Sand,SM 18.5±	
19	46					
20	44					
			6			
21	30	S-9	9		Br cfS,t.$	
			9			
22	45		10			
23	51					

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-102
PROJECT Cedar Creek Plant Modifications, Wantagh, NY		SHT. NO. 2 OF 3
CLIENT CRVA		PROJ. NO. 83-08139-01

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
24	48					
25	45					
26	49	S-10	9 7		Tn cfS, t¯.$,t.fG	
27	54		7 9			
28	51					
29	56					
30	59					
31	34	S-11	11 8		do	
32	41		10 11			
33	52				Brown-tan Sand, SP	
34	54					
35	45					
36	40	S-12	7 9		do	
37	44		10 12			
38	59					
39	56					
40	46					
41	41	S-13	8 11		Tn cfS,t.¯$	
42	57		11 13			
43	55					
44	58					
45	61					
46	52	S-14	7 9		do	
47	68		11 11			
48	69				48.0±	
49	83					

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-102
PROJECT Cedar Creek Plant Modifications, Wantagh, N.Y.		SHT. NO. 3 OF 3
CLIENT CRVA		PROJ. NO. 83-08139-01

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50	79					
	63	S-15	6 8		Gr vvd SyC, w prt fS S	PP=2.75-3.0 tsf
	83		8 9			
	85				Gray varved Silty Clay with frequent partings of fine Sand and Silt, CL	
	73					
55	75					
	81	S-16	7 11		do	
	87		15 18			
	93					
	97					
60	91					
		S-17	6 8		do	PP> 4.5 tsf
			10 11			
					End of Boring @ 62.0'	

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B 103
PROJECT Cedar Creek Plant Modifications, Wantagh, NY		SHT. NO. 1 OF 3
CLIENT Charles R. Velzy Assoc. Inc.		PROJ. NO. 83-08139-01
BORING CONTRACTOR Slacke Test Boring Co., Inc.		ELEVATION +13.5±

GROUND WATER					CAS.	SAMP.	CORE	TUBE	
DATE	TIME	DEPTH	CASING	TYPE	cpld	S.S.			DATUM Site
5-23-83	3:10	24.5	60'	DIA.	2½"	2"			DATE START 5-20-83
5-24-83	8:30	10.5	60'	WT.	300#	140#			DATE FINISH 5-24-83
5-24-83	11.:00	7.7	0	FALL	24"	30"			DRILLER R. Nimmo
									CC REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
			3		TOPSOIL 0.5	
1	6	S-1	6		Gr mfS,t$	
	22		7			
2			9			
3	31					
	43					
4						
5	39					
			6			
6	4	S-2	10		Gr mfS,t¯$	
	18		11			
7			11		FILL (Gray Sand, SP)	
	24					
8						
	34					
9						
	43					
10						
			8			
11	19	S-3	14		Gr mf+S,t.¯$	
	69		19			
12			27			
	31		26			
13		S-4	46			
	85		45		do	
14			30			
	65					
15					15.0	
			5			
16	37	S-5	4		Gr 0$ w/shell fgmts	PP=1.5 tsf
	45		4			
17			6		Gray Organic Clay, OH	
	42		2			
18		S-6 A	3		do 18.0	PP=1.5 tsf
		B	5			
19	50		8		Gr.cfS, s.0$ wt.$t	
	52		5			
20		S-7	6		Gr cfS, 1.0$, t.fG	
	47		9			
21			4			
	50		18		Gray Silty Sand, SM/OH	
22		S-8	12			
	60		18		Gr cfS, 1.¯$ w/occ lyr gr cfs,s,$&C, s.¯fG	
23			26		(Gr cfS,1.¯$,s.¯fG mixed sample) 23.0	

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-103
PROJECT Cedar Creek Plant Modifications, Wantagh, NY		SHT. NO. 2 OF 3
CLIENT CRVA		PROJ. NO. 83-08139-01

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
24	85					
25	73		13		Tn cfS, t.$^{-}$$	
26	40	S-9	15			
27	50		17 16			
28	65					
29	66					
30	62		9			
31	38	S-10	10		do w occ. lyr (6"th.) cfS, a.$^{-}$fG	
32	48		12 10			
33	55					
34	60				Tan Sand, SP	
35	58					
36	43	S-11	12 11		Tn cfS, t.$, t.$^{+}$fG	
37	57		10 13			
38	63					
39	72					
40	68					
41	60	S-12	8 10		Tn cfS, t.$^{-}$$	
42	67		10 15			
43	76					
44	71					
45	86					
46	47	S-13	13 15		Tn cfS, t.$^{-}$$, t.fG	
47	68		18 19		47.0	
48	94					
49	97					

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-103
PROJECT Cedar Creek Plant Modifications, Wantagh, NY		SHT. NO. 3 OF 3
CLIENT CRVA		PROJ. NO. 83-08139-01

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50	99					
	80	S-14	7 9		Gr vvd $yC w prt $ &fS	PP=2.5-3.0 tsf
	76		9 12			
	83					
	87				Gray varved Silty Clay with frequent partings of Silt and fine Sand, CL	
55	103					
	98	S-15	5 8			PP=3.5-5.0 tsf
	70		15 13		do	
	108					
	97					
	111					
60			5			
		S-16	8		do	PP=3.5 tsf
			9 10			
					End of Boring @ 62.0'	

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-206
PROJECT CEDAR CREEK PLANT MODIFICATIONS & ADDITIONS		SHT. NO. 1 OF 1
CLIENT CHARLES R. VELZY ASSOC.		PROJ. NO. 83-08139-01
BORING CONTRACTOR WARREN GEORGE INC.		ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM USC & GS
DATE	TIME	DEPTH	CASING	TYPE	N.W.				DATE START 9-21-83
				DIA.	3"				DATE FINISH 9-21-83
				WT.	300 LB.				DRILLER M. IMPERATO
				FALL	24"				CC REP. S.K.

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
1					DROVE 3 INCH CASING 15 FEET TO RUN PERMEABILITY TEST IN FILL	
2						
3						
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15					15'0"	
16						
17						
18						
19						
20						
21						
22						
23						

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-218 A
PROJECT CEDAR CREEK PLANT MODIFICATIONS & ADDITIONS		SHT. NO. 1 OF 1
CLIENT CHARLES R. VELZY ASSOC.		PROJ. NO. 83-08139-01
BORING CONTRACTOR WARREN GEORGE INC.		ELEVATION 15.6

GROUND WATER					CAS.	SAMP.	CORE	TUBE	
DATE	TIME	DEPTH	CASING	TYPE	N.W.				DATUM USC & GS
				DIA.	3"				DATE START 8-25-83
				WT.	300 #				DATE FINISH 8-25-83
				FALL	24"				DRILLER M. IMPARATO
									CC REP. M. Bedian

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
1						Ran Permeability Test
2						
3						
4						
5					For Strata Description, See Boring B-218.	
6						
7						
8						
9						
10						
11						
12						
13						
14						
15					END of Boring @ 15'0"	
16						
17						
18						
19						
20						
21						
22						
23						

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

NOTE

1983 borings (200-series) were made in August and September, 1983. Samples were reclassified by MRCE in February 1985, about 18 months after the borings were made. Measured water contents are probably lower than in-situ values due to the age of the samples.

SHEET NO.____ OF __

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CJM DATE 2/6/8

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-201	S-1	0	2	14-7-11-12		Tan medium to fine sand, trace silt (SP)
	S-2	5	7	3-3-6-6		Brown medium to fine sand, trace silt (SP)
	S-3	10	12	2-3-3-3		NO RECOVERY
	S-4	15	17	2-1-2-1		NO RECOVERY
	S-5	20	22	8-2-1-1		Gray coarse to fine sand, trace gravel (WASH) (SP)
	S-6	25	27	1-1-18-14		Gray coarse to fine sand, trace gravel, silt, shells (SP)
	S-7	38.5	40	20-45-50		Tan coarse to fine sand, trace silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CJM DATE 2/71

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-204	S-1	1	3	12-17-24-35		Tan fine to coarse sand, trace silt, shells (SP)
	S-2	3	5	8-19-19-14		Tan fine to coarse sand, trace silt, shells (SP)
	S-3	5	7	4-8-10-8		Brown fine to coarse sand, trace silt, gravel (SP)
	S-4	7	9	9-9-11-14		Tan fine to coarse sand, trace silt (SP)
	S-5	9	11	2-2-3-3		Brown fine to coarse sand, trace gravel, silt (SP)
	S-6	11	13	2-2-3-4		Brown fine to coarse sand, trace gravel, silt (petroleum odor) (SP
	S-7	13	15	2-1-2-3		NO RECOVERY
	S-8	15	17	4-6-6-6		NO SAMPLE REMAINS
	S-9	17	19	1-2-2-1		Brown fine to coarse sand trace silt, gravel (SP)
	S-10	19	21	WR-3-9-14		Tan fine to coarse sandy silt (ML)
	S-11	21	23	7-10-12-18		Brown coarse to fine sand, trace gravel, silt, gray clay lumps (SP)
	S-12	25	27	8-15-17-20		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/7/

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-204	S-13	30	32	10-10-9-12		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-14	35	37	8-10-10-12		Brown coarse to fine sand, trace gravel, silt (SP)
	S-15	40	42	9-16-21-20		Brown coarse to fine sand, trace gravel, silt (SP)
	S-16	45	47	7-12-20-20		Brown fine to coarse sand, trace gravel, silt (SP)
	S-17	50	52	5-7-10-13		Dark gray silty clay, trace silty fine sand seams (CL)
	S-18	55	57	9-13-20-17		Dark gray silty clay, trace silty fine sand seams (CL)
	S-19	60	62	6-10-11-12		Dark gray silty clay, trace silt pockets (CL)
	S-20A	65	67	5-28-22-22		Dark gray silty clay, trace silt pockets, silty fine sand seams (CL)
	S-20B	65	67	5-28-22-22		Brown medium to fine sand, trace silt (SP)

B-204

SHEET NO.____ OF ___

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CM DATE 2/41

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-202	S-1	0	2	2-4-3-6		Tan fine to coarse sand, trace shells, silt (SP)
	S-2	3	5	7-10-8-10		Tan fine to coarse sand, trace shells, silt (SP)
	S-3	5	7	7-6-10-12		Tan fine to coarse sand, trace silt, shells (SP)
	S-4	7	9	2-5-7-6		Tan fine to medium sand, trace coarse sand, silt (SP)
	S-5	9	11	3-5-6-9		Gray fine to medium sand, trace silt (SP)
	S-6	11	13	7-12-16-22		Gray fine to coarse sand, trace silt, shells (SP)
	S-7	13	15	17-27-26-28		Gray fine to coarse sand, trace silt, shells (SP)
	S-8	15	17	15-27-48-60		Tan fine to coarse sand, trace gravel, silt (SP)
	S-9	17	19	18-29-35-42		Gray fine to medium sand, trace gravel, silt (SP)
	S-10	19	21	14-16-33-46		Gray fine to medium sand, trace gravel, silt (SP)
	S-11	21	23	12-35-43-52		Gray fine to medium sand, trace coarse sand, silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CTM DATE 2/4/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-202	S-12	23	25	11-19-13-17		Brown fine to medium sand, trace gravel, silt (SP)
	S-13	25	27	4-6-4-7		Brown fine to medium sand, trace gravel, silt (SP)
	S-14	27	29	4-14-23-45		Brown fine to medium sand, trace gravel, silt (SP)
	S-15	30	32	16-33-31-30		Brown fine to medium sand, trace gravel, silt (SP)
	S-16	35	37	3-3-3-4		Brown fine to coarse sand, trace gravel, shells, silt (SP)
	S-17	40	40.9	30-75/4"		Brown coarse to fine sand, trace gravel, silt (SP)
	S-18	45	47	17-24-22-28		Brown fine to medium sand, trace silt (SP)
	S-19	50	52	7-7-9-12		Gray silty clay and silt layers, trace fine sand layers (CL+ML)
	S-20	55	57	11-16-20-27		Gray silty clay, trace silty fine sand layers (CL)
	S-21	60	62	9-14-18-22		Gray silty clay, trace silt layers (CL)
	S-22	65	67	8-13-13-20		Gray silty clay, trace silt layers (CL)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/4/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-202A	S-1	30	32	15-26-25-19		Brown fine to medium sand, trace gravel, silt (SP)
	S-2	32	34	7-10-10-8		Brown fine to medium sand, trace gravel, silt (SP)
	S-3	34	36	3-3-4-4		Brown fine to medium sand, trace coarse sand, silt (SP)
	S-4L	36	38	WR		NO RECOVERY
	S-5A	38	40	WR-WR-10-19		Tan fine to coarse sand, trace shells, gravel, silt (SP)
	S-5B	38	40	WR-WR-10-19		Brown fine to coarse sand, trace gravel, silt (SP)
	S-6	40	42	12-50-60/3"		Brown fine to coarse sand, trace gravel, silt (SP)

B-202A

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/11

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-203	S-1	0	2	6-18-24-32		Brown coarse to fine sand, trace silt, shells (SP)
	S-2	2	4	28-22-30-44		Tan coarse to fine sand, trace silt (SP)
	S-3	4	6	14-21-40-21		Brown medium to fine sand, trace silt, brown silty clay pockets, gravel (SP)
	S-4	6	8	9-10-17-13		Brown medium to fine sand, trace gravel, silt (SP)
	S-5	8	10	7-11-8-7		Tan coarse to fine sand, some gravel, trace silt, shells (SP)
	S-6	10	12	4-4-4-4		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-7A	12	14	3-3-9-5		Brown coarse to fine sand, some gravel, trace silt, shells (SP)
	S-7B	12	14	3-3-9-5		Brown organic silty clay, trace organic fibers, some coarse to fine sand, trace gravel (CL+SP)
	S-8	14	16	3-5-2-2		Tan medium to fine sand, trace brown silty clay pockets, gravel (SP)
	S-9A	16	18	5-7-6-7	56.6	Gray silty clay (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/11

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-203	S-9B	16	18	5-7-6-7	160.2	Dark brown peat (Pt)
	S-10A	18	20	1-2-2-2	102.0	Dark gray organic silty clay, trace organic fibers (OH)
	S-10B	18	20	1-2-2-2	134.0	Black organic silty, clay, trace organic fibers (OH)
	S-11	20	22	2-4-4-10		Black organic silty clay, trace organic fibers, some black silty fine to medium sand (OL)
	S-12	22	24	8-14-14-20		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-13	25	27	9-11-12-15		Brown coarse to fine sand, trace gravel, silt (SP)
	S-14	30	32	7-8-15-19		Brown coarse to fine sand, trace gravel, silt (SP)
	S-15	35	37	8-17-22-34		Brown coarse to fine sand, trace silt, black silty clay layers (SP)
	S-16	45	47	15-28-33-27		Brown coarse to fine sand, trace gravel, silt (SP)
	S-17	50	52	10-12-15-19		Gray silty clay, some silty fine sand layers (CL)
	S-18	55	57	4-14-16-25		Dark gray silty clay, trace silty fine sand layers (CL)

B-203

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CSM DATE 2/11/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-203	S-19	60	62	6-11-13-15		Dark gray silty clay, trace silty fine sand seams (CL)
	S-20A	65	67	20-18-25-22		Dark gray silty clay (CL)
	S-20B	65	67	20-18-25-22		Brown medium to fine sand, trace silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CSM DATE 2/5/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-205	S-1	0	2	7-7-10-12		Tan fine to medium sand, trace gravel, silt, shells (SP)
	S-2	2	4	4-13-13-20		Tan fine to medium sand, trace silt (SP)
	S-3	4	6	8-7-13-13		Tan fine to medium sand, trace silt, shells (SP)
	S-4	6	8	11-14-25-42		Tan fine to medium sand, trace gravel, silt (SP)
	S-5	8	10	17-35-40-29		Tan fine to medium sand, trace coarse sand, silt (SP)
	S-6	10	12	14-26-23-25		Gray fine to medium sand, trace coarse sand, silt (SP)
	S-7	12	14	11-13-10-9		Tan fine to medium sand, trace silt (SP)
	S-8	14	16	3-5-16-15		Gray fine to medium sand, trace coarse sand, silt, wood (SP)
	S-9	16	18	16-25-22-15		Tan fine to medium sand, trace coarse sand, silt, shells (SP)
	S-10	18	20	3-2-3-4	45.5	Dark gray silty clay (CL)
	U-1	20	22	Rec = 22"		
	S-11	22	24	4-9-12-15		Brown fine to coarse sand, trace gravel, silt, shells (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CJM DATE 2/5/1

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-205	S-12	30	32	9-14-17-17		Brown coarse to fine sand, trace gravel, silt (SP)
	S-13	35	37	11-21-19-18		Tan fine to coarse sand, trace gravel, silt (SP)
	S-14	40	42	5-13-11-14		Brown fine to coarse sand, trace silt (SP)
	S-15	45	47	7-17-25-20		Brown fine to medium sand, trace gravel, silt (SP)
	S-16	50	52	9-17-25-17		Brown fine to coarse sand, trace gravel, silt (SP)
	S-17	55	57	7-9-13-20		Dark gray silty clay, trace silty fine sand seams (CL)
	S-18	65	67	7-14-17-19		Dark gray silty clay, trace silty fine sand seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6103

MADE BY CSM DATE 2/11

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-206	S-1	0	2	3-17-24-70		Brown coarse to fine sand, trace silt, gravel (SP)
	S-2	5	7	13-48-90		Brown coarse to fine sand, trace silt, shells (SP)
	S-3	10	12	22-60-50/3"		Brown coarse to fine sand, trace silt, gravel (SP)
	S-4A	15	17	3-4-7-8		Gray fine to medium sand, trace silt, black silty clay pockets (SP)
	S-4B	15	17	3-4-7-8	129.6	Dark brown peat (PT)
	S-5	17	19	2-3-5-8	75.3	Black organic silty clay, trace organic fibers (OH)
	S-6	20	22	3-5-4-4	82.3	Dark gray organic silty clay, trace organic fibers (OH)
	S-7	22	24	7-8-4-18	131.9	Dark brown organic silty clay, trace organic fibers (OH)
	S-8A	25	27	7-24-30-35		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8B	25	27	7-24-30-35		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-9	30	32	15-24-21-24		NO SAMPLE REMAINS

B-206

SHEET NO.____ OF__

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CJM DATE 2/11

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-206	S-10	35	37	9-15-12-21		Tan coarse to fine sand, some gravel (WASH) (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CM DATE 2/11

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-207	S-1	0	2	3-6-11-21		Brown coarse to fine sand, trace gravel, silt (SP)
	S-2	5	7	12-21-25-21		Gray medium to fine sand, trace silt (SP)
	S-3	10	12	11-12-14-16		Gray medium to fine sand, trace silt (SP)
	S-4	15	17	12-12-14-9		Gray medium to fine sand, trace silt (SP)
	S-5	18	20	2-3-3-4	73.1	Dark gray organic silty clay, trace organic fibers (OH)
	U-1	20	22	Rec=22"		
	S-6A	22	24	1-3-6-7	106.3	Black organic silty clay, trace organic fibers (OH)
	S-6B	22	24	1-3-6-7		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-7	24	26	5-4-7-11		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	30	32	15-15-18-20		Brown coarse to fine sand, trace gravel, silt (SP)
	S-9	35	37	12-14-14-14		Brown coarse to fine sand, trace gravel, silt (SP)

SHEET NO.____ OF__

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CJM DATE 2/11/

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-207	S-10	40	42	10-12-14-13		Brown coarse to fine sand, trace gravel, silt (SP)
	S-11	45	47	9-12-14-15		Brown coarse to fine sand, trace gravel, silt (SP)
	S-12	50	52	12-18-21-21		Brown coarse to fine sand, trace gravel, silt (SP)
	U-2	60	62	Rec = 24"		
	S-13	62	64	8-13-20-22		Gray silty clay, trace silty fine sand seams (CL)
	U-3A	70	70.5	Rec = 6"		Gray silty clay (CL)
	U-3B	70	70.5	Rec = 6"		Greenish brown coarse to fine sand, trace silt (SP)
	S-14	80	82	12-14-21-21		Gray medium to fine sand, trace silt (SP)
	S-15	90	92	13-17-19-20		Gray medium to fine sand, trace silt, black silt layers (SM)
	S-16A	100	102	15-32-31-30		Black lignite
	S-16B	100	102	15-32-31-30		Gray medium to fine sand, trace silt, black silt layers (SP)
	S-17	115	116	75-50/2"		Brown medium to fine sand, trace silt, lignite (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CJM DATE 2/4

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-208	S-1	1	3	18-23-21-23		Brown fine to medium sand, trace coarse sand, silt, shells (SP)
	S-2	3	5	22-29-40-41		Brown fine to medium sand, trace coarse sand, silt, shells (SP)
	S-3	5	7	8-10-12-21		Brown fine to medium sand, some silt, trace coarse sand (SM)
	S-4	7	9	33-44-33-44		Brown fine to medium sand, some silt, trace coarse sand, shells (SM)
	S-5	9	11	9-9-6-6		Brown fine to medium sand, trace coarse sand, silt (SP)
	S-6	11	13	4-11-26-27		Brown and gray fine to medium sand, trace silt (SP)
	S-7	13	15	6-2-3-3		Gray fine sand, trace gray clayey silt layers (SP)
	U-1	15	17	Rec=24"		
	U-2	17	19	Rec=20"		
	S-8	19	21	5-2-2-2	45.3	Gray silty clay, trace shells (CL)
	U-3	21	23	Rec=24"		
	S-9	23	25	1-1-1-2	37.9	Gray silty clay (CL)
	S-10	25	27	Push		Brown coarse to fine sand, trace gravel (SP)
	S-11	30	32	10-12-14-15		Brown fine to coarse sand, trace gravel, silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CM DATE 2/4/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-208	S-12	35	37	11-13-16-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	40	42	10-16-12-16		Brown fine to medium sand, trace silt (SP)
	S-14	45	47	9-14-16-25		Brown fine to coarse sand, trace silt (SP)
	S-15	50	52	6-9-12-15		Gray silty clay, trace silty fine sand seams (CL)
	S-16	55	57	9-16-16-21		Gray silty clay, trace silty fine sand seams, shell (CL)
	S-17	60	62	7-15-17-20		Gray silty clay, trace silty fine sand seams (CL)
	S-18	65	66	16-61		Gray fine to medium sand, some silt (SM)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CJM DATE 2/5/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-209	S-1	0	2	5-9-11-17		Brown fine to medium sand, trace silt, gravel (SP)
	S-2	5	7	1-2-2-1		Brown fine to medium sand, trace silt, shells (SP)
	S-3	10	12	8-19-30-35		Gray fine to medium sand, trace coarse sand, shells, silt (SP)
	S-4	15	17	3-5-4-5		Tan fine to coarse sand, trace shells, silt (SP)
	S-5A	18	20	2-3-12-17		Gray fine to coarse sand, trace silt (SP)
	S-5B	18	20	2-3-12-17		Gray fine sand, trace silt (SP)
	S-6A	20	22	5-2-3-6	100.1	Dark gray silty clay (CL)
	S-6B	20	22	5-2-3-6	91.0	Dark brown peat (PT)
	U-1	22	22.5	Rec = 6"		Dark gray silty clay, some peat layers (CL+PT)
	S-7	22.5	24.5	2-3-4-5	89.1	Black silty clay, some peat layers (CL+PT)
	U-2	24.5	26.5	Rec = 24"		
	S-8	26.5	28.5	3-6-7-8		Brown fine to coarse sand, trace gravel, silt (SP)
	S-9	35	37	7-11-11-14		Brown fine to medium sand, trace coarse sand, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/5/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-209	S-10	40	42	10-10-10-16		Brown fine to coarse sand, trace gravel, silt (SP)
	S-11	45	47	10-14-16-18		Brown fine to medium sand, trace coarse sand, silt (SP)
	S-12	50	52	6-12-15-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	55	57	12-14-14-15		Brown fine to coarse sand, trace silt and gray silty clay (SP+CL)
	S-14	60	62	10-14-17-21		Dark gray silty clay and fine to coarse sand and gravel (CL+SP)
	S-15	65	67	9-8-15-20		Dark gray silty clay (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/6/8

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-210	S-12	22	24	10-10-16-17		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	25	27	4-3-2-3		Gray silty fine to coarse sand, some gravel (SM)
	S-14	27	29	2-5-10-11		Gray silty fine to coarse sand (SM)
	S-15	29	31	6-11-16-19		Brown fine to coarse sand, trace gravel, silt (SP)
	S-16	35	37	7-10-12-16		Brown fine to coarse sand, trace silt (SP)
	S-17	40	42	7-8-7-8		Brown coarse to fine sand, trace gravel, silt (SP)
	S-18	45	47	8-9-10-13		Brown medium to fine sand, trace silt (SP)
	S-19	50	52	12-15-16-21		Tan fine to coarse sand, trace gravel, silt (SP)
	U-1	55	57	No Recovery		
	S-20	57	59	8-15-17-24		Dark gray silty clay, trace silty fine sand seams (CL)
	U-2	60	62	No Recovery		
	S-21	65	67	13-18-23-23		Gray silty clay, trace silty fine sand layers and seams (CL)

SHEET NO.____ OF __

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CJM DATE 2/6/19

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-210	S-1	0	2	7-8-9-12		Tan fine to coarse sand, trace shells, silt (SP)
	S-2	2	4	6-11-19-21		Tan fine to coarse sand, trace silt, shells (SP)
	S-3	4	6	9-13-14-15		Brown fine to coarse sand, trace silt, shells (SP)
	S-4	6	8	14-16-19-26		Tan fine to coarse sand, trace silt (SP)
	S-5	8	10	5-6-9-10		Tan fine to coarse sand, trace silt, shells (SP)
	S-6	10	12	12-13-13-14		Tan fine to coarse sand, trace silt, shells (SP)
	S-7	12	14	5-6-6-6		Gray medium to fine sand, trace silt, shells (SP)
	S-8	14	16	7-11-13-15		Gray fine to coarse sand, trace silt, shells (SP)
	S-9	16	18	4-10-12-14		Brown fine to coarse sand, trace gravel, silt, shells (SP)
	S-10	18	20	10-11-15-18		Tan fine to coarse sand, trace gravel, silt, shells (SP)
	S-11	20	22	5-5-5-7		Gray medium to fine sand, trace silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CM DATE 2/6/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-211	S-1	0	2	13-14-18-14		Brown fine to coarse sand, trace silt, shells (SP)
	S-2	5	7	20-21-20-21		Brown fine to coarse sand, trace silt, shells (SP)
	S-3	10	12	20-18-30-50		Brown fine to coarse sand, some silt (SM)
	S-4	15	16.5	15-27-65		Tan fine to medium sand, trace silt (SP)
	S-5	20	22	2-5-10-13	186.1	Dark brown peat (PT)
	S-6	22	24	6-8-21-14		Brown coarse to fine sand, some silt (SM)
	S-7	25	27	19-28-?-43		Brown coarse to fine sand, trace silt, gravel (SP)
	S-8	30	32	14-16-30-38		Brown coarse to fine sand, trace silt (SP)
	S-9	35	37	18-20-23-30		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CTM DATE 2/6/18

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-212	S-1	0	2	20-10-10-12		Brown fine to coarse sand, trace silt, shells (SP)
	S-2	5	7	21-25-80		Gray fine to coarse sand, trace silt (SP)
	S-3	10	12	12-4-5-12		Gray fine to medium sand, trace silt (SP)
	S-4	15	17	30-25-35-36		Gray fine to medium sand, trace silt (SP)
	S-5A	20	22	11-11-14-12		Brown coarse to fine sand, some silt, trace gravel, roots (SM)
	S-5B	20	22	11-11-14-12		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	22	24	9-15-37-60		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-7	25	26.5	40-45-75		Brown coarse to fine sand, trace silt (SP)
	S-8	30	32	12-14-20-22		Brown coarse to fine sand, trace silt (SP)
	S-9	35	37	11-18-20-21		Brown coarse to fine sand, trace silt (SP)
	S-10	40	42	15-15-18-17		Brown coarse to fine sand, trace silt (SP)

SHEET NO.____ OF __

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/6/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-212	S-11	45	47	25-20-50-55		Brown fine to medium sand, trace silt (SP)
	S-12	50	52	17-16-15-16		Tan medium to fine sand, trace silt (SP)
	S-13	55	57	15-15-22-21		Dark gray silty clay, trace silty fine sand seams (CL)
	S-14	60	62	8-12-20-22		Gray silty clay, trace silty fine sand seams (CL)
	S-15	65	67	12-12-20-20		Dark gray silty clay, trace silty fine sand seams (CL)

SHEET NO.____ OF__

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/5/

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-213	S-1	0	2	7-12-12-14		Brown fine to medium sand, trace silt, shells (SP)
	S-2	5	7	16-26-27-35		Gray fine to medium sand, trace silt (SP)
	S-3	10	12	8-20-29-41		Gray fine to medium sand, trace silt (SP)
	S-4	15	17	7-2-3-3		Gray fine sand, some black silty clay layers (SP+CL)
	S-5	17	19	10-11-11-7		Gray fine sand, some black silty clay layers (SP-CL)
	S-6	19	21	WR-2-2-2	54.0	Black silty clay, trace shells, peat layers (CL)
	U-1	21	23	Rec=12"		
	U-2	23	23.5	No Recovery		
	S-7	23.5	25	2-2-5	79.0	Black organic silty clay (OH)
	S-8	25	27	6-10-4-2		Dark gray fine to coarse sand, trace gravel, silt (SP)
	S-9	30	32	10-14-17-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-10	35	37	7-12-14-17		Brown coarse to fine sand, trace gravel, silt (SP)
	S-11	40	42	6-14-14-15		Brown fine to coarse sand, trace silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CSM DATE 2/5/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-213	S-12	45	47	11-23-23-26		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	50	52	8-10-8-9		Gray silty clay, trace fine sand seams (CL)
	S-14	55	57	7-12-13-16		Gray silty clay, trace fine sand seams (CL)
	S-15	60	62	10-13-13-18		Gray silty clay, trace silt seams, gravel (CL)
	S-16	65	67	10-10-15-30		Gray silty clay, trace silt seams fine sand seams (CL)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CJM DATE 2/11

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-214	S-1	0	2	6-18-12-11		Brown fine to medium sand, trace silt, gravel (SP)
	S-2	5	7	15-24-28-31		Gray fine to medium sand (SP)
	S-3	10	12	9-18-36-42		Gray fine to medium sand, trace shells (SP)
	S-4	15	17	1-1-2-2	130.2	Dark brown peat (Pt)
	S-5	17	19	6-9-11-14		Gray fine to coarse sand, trace silt, gravel, roots (SP)
	S-6	20	22	3-8-13-13		Brown fine to coarse sand, trace gravel, silt (SP)
	S-7	25	27	15-24-27-29		Brown fine to medium sand, trace gravel, silt (SP)
	S-8	30	32	7-11-10-12		Brown fine to coarse sand, trace gravel, silt (SP)
	S-9	35	37	9-14-15-13		Brown fine to coarse sand, trace gravel, silt (SP)
	S-10	40	42	7-14-16-19		Brown fine to coarse sand, trace gravel (SP)
	S-11	45	47	8-12-10-19		Brown fine to medium sand, trace gravel (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CTM DATE 2/1/8

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-214	S-12	50	52	9-11-8-13		Gray silt, trace fine sand (ML)
	S-13	55	57	10-11-16-22		Green gray clayey silt, trace fine sand, fine sand layers (ML)
	S-14	60	62	6-9-12-17		Gray silty clay, trace fine sand, silt layers (CL)
	S-15	65	67	8-9-15-16		Gray silty clay, some silty fine sand layers (CL+SM)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/8/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-215	S-1	0.5	2	23-18-24		Brown fine to medium sand, trace silt (SP)
	S-2	2	3.5	35-46-60		Brown fine to coarse sand, trace gravel, silt, shells (SP)
	S-3	4	5.5	16-24-63		Tan medium to fine sand, trace silt, shells (SP)
	S-4	6	7	15-64		Brown coarse to fine sand, trace silt (SP)
	S-5	10	11	18-81		Gray fine to coarse sand, trace silt (SP)
	S-6	12	13	24-76		Tan fine to coarse sand, trace silt (SP)
	S-7	14	15.1	31-53-40/1"		Tan fine to medium sand, trace silt (SP)
	S-8	16	18	3-3-4-3	97.9	Dark brown organic silty clay, trace peat pockets and layers (OH)
	S-9	18	20	5-5-9-16		Brown coarse to fine sand, some silt, trace gravel, roots (SM)
	S-10	20	22	10-8-12-10		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-11	25	27	15-17-27-31		Brown coarse to fine sand, trace silt, gravel (SP)

SHEET NO.____ OF__

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY SM DATE 2/81

CHECK BY____DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-215	S-12	30	32	12-15-15-24		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	35	37	12-18-27-27		Brown coarse to fine sand, trace gravel, silt (SP)
	S-14	40	42	11-16-20-19		Brown coarse to fine sand, trace gravel, silt (SP)
	S-15	45	47	33-27-16-14		Tan medium to fine sand, trace silt (SP)
	S-16	50	52	22-27-33-23		Brown fine to coarse sand, trace silt (SP)
	S-17	55	57	10-16-18-24		Gray silty clay, trace silty fine sand seams (CL)
	S-18	60	62	13-14-26-31		Gray silty clay, trace silty fine sand seams (CL)
	S-19	65	67	13-21-31-31		Gray silty clay, trace silty fine sand seams (CL)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CM DATE 2/5/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-216	S-1	0	2	12-15-15-17		Brown fine to coarse sand, trace gravel, silt (SP)
	S-2	2	4	12-16-27-30		Brown fine to coarse sand, trace silt (SP)
	S-3	4	6	4-3-4-5		Brown fine to coarse sand, trace silt, shells (SP)
	S-4	6	8	4-8-16-21		Brown fine to coarse sand, trace silt, shells (SP)
	S-5	8	10	11-20-30-35		Tan fine to coarse sand, trace silt (SP)
	S-6	10	12	13-30-48-54		Tan fine to medium sand, trace silt, shells (SP)
	S-7	12	13.5	21-44-56		Tan fine to medium sand, trace silt (SP)
	S-8	14	16	15-22-24-38		Tan fine to medium sand, trace silt (SP)
	S-9	16	18	2-12-5-5		Gray fine to medium sand, trace silt, shells (SP)
	S-10A	18	20	4-7-13-13	99.6	Black peat (PT)
	S-10B	18	20	4-7-13-13		Brown fine to coarse sand, some silt, trace roots (SM)

SHEET NO.____ OF ___

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/5/8

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-216	S-11A	20	22	1-5-6-12		Brown fine to coarse sand, some silt, trace gravel, roots (SM)
	S-11B	20	22	1-5-6-12		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-12	25	27	9-15-15-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	30	32	8-9-12-14		Brown fine to coarse sand, trace gravel, silt (SP)
	S-14	35	37	5-10-12-15		Brown fine to coarse sand, trace gravel, silt (SP)
	S-15	40	42	6-11-11-13		Brown coarse to fine sand, trace gravel, silt (SP)
	S-16	45	47	6-11-12-14		Tan fine to coarse sand, trace silt (SP)
	S-17	50	52	6-16-18-24		Tan fine to coarse sand, trace gravel, silt (SP)
	U-1	55	57	Rec=12"		
	S-18	57	59	6-9-11-22		Dark gray silty clay, trace silty fine sand seams (CL)
	S-19	65	67	5-11-13-17		Dark gray silty clay, trace silty fine sand seams (CL)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CJM DATE 2/1/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-217	S-1	0	2	9-11-18-15		Brown fine to coarse sand, some silt, gravel (SM)
	S-2	2	4	21-25-41-50		Brown fine to medium sand, trace gravel, silt (SP)
	S-3	4	5.5	29-38-52		Brown fine to medium sand, trace silt (SP)
	S-4	6	7	40-61		White fine to medium sand, trace silt (SP)
	S-5	8	10	12-26-34-54		Tan fine to medium sand trace coarse sand. (SP)
	S-6	10	12	15-36-52-77		Tan fine to medium sand, trace coarse sand, silt (SP)
	S-7	12	14	13-40-43-45		Tan fine to medium sand, trace silt, shells (SP)
	S-8	14	16	12-22-29-33		Tan fine to medium sand, trace coarse sand. (SP)
	S-9	16	18	11-16-11-6		Gray fine to medium sand, trace silt, gravel (SP)
	S-10	18	20	4-6-10-17		Brown silty fine to coarse sand, trace roots (peat?), gravel (SM)
	S-11	20	22	5-12-19-21		Brown fine to coarse sand, trace gravel, silt (SP)

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/5/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-217	S-12	25	27	10-13-13-15		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	30	32	8-11-11-9		Brown coarse to fine sand, trace gravel, silt (SP)
	S-14	35	37	3-7-8-8		Brown coarse to fine sand, trace gravel, silt (SP)

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 61C

MADE BY SJM DATE 2/11

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-218	S-1	0	2	10-18-18-18		Brown medium to fine sand, some gray silt layers, trace shells (SP)
	S-2	5	7	31-37-55		Brown medium to fine sand, trace silt (SP)
	S-3	11	12	37-70		Gray medium to fine sand, trace silt (SP)
	S-4A	16	18	3-5-9-15	17.9	Black silty clay, trace roots, fine sand (OH)
	S-4B	16	18	3-5-9-15		Brown silty coarse to fine sand, trace gravel, roots (SM)
	S-4C	16	18	3-5-9-15		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-5	21	22.5	14-33-50		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	26	28			Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	31	33	10-47-31-40		Brown coarse to fine sand, trace gravel, silt (SP)

B-218

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CSM DATE 2/81

CHECK BY ____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-219	S-1	0	2	9-15-21-23		Brown fine to medium sand, trace silt (SP)
	S-2	5	6.5	22-33-50		Gray fine to medium sand, trace silt (SP)
	S-3	10	11.3	27-48-75/4"		Gray fine to medium sand, trace silt (SP)
	U-1	15	17	Rec = 24"		
	S-4	17	19	2-4-13-18		Brown coarse to fine sand, trace gravel, silt, roots (SP)
	S-5	20	22	7-10-14-26		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	25	26.5	26-30-55		Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	30	31.5	40-41-60		Brown coarse to fine sand, trace silt (SP)
	S-8	35	37	24-22-22-23		Brown coarse to fine sand, trace gravel, silt (SP)
	S-9	40	42	10-12-22-25		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	45	47	20-27-26-27		Brown coarse to fine sand, trace gravel, silt (SP)

B-219

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CM DATE 2/8/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-219	S-11	50	51.5	18-28-45		Gray medium to fine sand, trace silt (SP)
	S-12	55	57	9-13-14-17		Gray silty clay, trace silty fine sand seams (CL)
	S-13	60	62	9-13-22-25		Gray silty clay, trace silty fine sand seams (CL)
	S-14	65	67	16-20-25-28		Dark gray silty clay, trace silty fine sand seams (CL)

B-219

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CSM DATE 2/1/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-220	S-1	1	3	23-33-41-42		Brown fine to coarse sand, trace silt (SP)
	S-2	3	5	38-53-57-68		Brown fine to coarse sand, trace silt (SP)
	S-3	5	7	7-10-10-11		Tan fine to medium sand, trace gravel, silt, shells (SP)
	S-4	7	9	9-15-26-40		Brown fine to medium sand, trace silt, shells (SP)
	S-5	9	11	15-24-27-26		Gray fine to medium sand, trace silt (SP)
	S-6	11	13	8-8-3-3		Gray fine to medium sand, trace silt (SP)
	S-7	13	15	2-3-8-15	102.0	Dark brown peat, some organic silty clay layers (PT)
	S-8	15	17	2-4-6-9		Brown fine to medium sand, trace coarse sand, silt, roots (SP)
	S-9	17	19	9-9-10-12		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10A	19	21	6-3-4-21		Gray clayey fine to coarse sand, trace gravel (SC)
	S-10B	19	21	6-3-4-21		Brown coarse to fine sand, some clay, trace gravel (SC)

B-220

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CM DATE 2/11

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-220	S-11	21	23	10-20-22-26		Brown medium to fine sand, trace gravel, silt (SP)
	S-12	25	27	10-17-14-15		Brown fine to coarse sand, trace silt, gravel (SP)
	S-13	30	32	7-13-18-19		Brown medium to fine sand, trace gravel, silt. (SP)
	S-14	35	37	6-8-11-14		Brown fine to coarse sand, trace gravel, silt (SP)
	S-15	40	42	8-16-16-20		Brown medium to fine sand, trace coarse sand, silt (SP)
	S-16	45	47	9-18-21-18		Brown fine to medium sand, trace coarse sand, silt (SP)
	S-17	50	52	6-11-12-16		Gray silty clay, trace silt seams (CL)
	S-18	55	57	7-10-18-17		Gray silty clay, some silt layers, trace silty fine sand seams (CL)
	S-19	60	62	7-11-13-17		Gray silty clay, trace silt seams (CL)
	S-20	65	67	13-21-17-14		Brown fine sand, some silt (SM)

B-220

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/7/

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-221	S-1	0	2	3-5-12-11		Brown coarse to fine sand, trace gravel, silt (SP)
	S-2	6	8	3-7-10-6		Brown medium to fine sand, trace silt (SP)
	S-3	8	10	10-23-42-38		Gray fine to medium sand, trace silt, shells (SP)
	S-4	11	12.5	28-58-62		Gray fine to medium sand, trace silt (SP)
	S-5	15	17	4-4-6-7		Tan silty coarse to fine sand, trace roots (SM)
	S-6	17	19	8-15-22-50		Brown coarse to fine sand, trace silt, gravel (SP)
	S-7	20	21.5	40-56-49		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	25	27	21-32-31-30		Brown coarse to fine sand, trace silt (SP)
	S-9	30	32	9-12-13-15		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	35	37	11-15-15-14		Brown coarse to fine sand, trace gravel, silt (SP)
	S-11	40	42	14-19-18-19		Brown coarse to fine sand, trace silt (SP)

B-221

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CJM DATE 2/71

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-221	S-12	45	47	20-21-33-37		Tan coarse to fine sand, trace gravel, silt (SP)
	S-13	50	52	9-12-14-20		Gray silty clay, trace silty fine sand seams (CL)
	S-14	55	57	11-18-20-27		Dark gray silty clay, trace silty fine sand seams (CL)
	S-15	65	67	12-21-22-23		Dark gray silty clay, trace silty fine sand seams (CL)

B-221

SHEET NO.____ OF__

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CM DATE 2/11

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-222	S-1	0	2	17-14-18-15		Brown coarse to fine sand, trace silt (SP)
	S-2	5	7	6-11-17-23		Tan medium to fine sand, trace silt, shells (SP)
	S-3	10	12	8-14-18-21		Tan medium to fine sand, trace silt (SP)
	S-4	12	14	4-1-3-3	104.6	Dark brown organic silty clay, trace organic fibers (OH)
	U-1	14	16	Rec=24"		
	S-5	16	18	3-4-7-11		Gray silt, some fine to coarse sand (ML)
	S-6	20	22	9-12-16-16		Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	25	27	7-12-17-17		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	30	32	6-5-6-10		Brown coarse to fine sand, trace gravel, silt (SP)
	S-9	35	37	4-3-4-3		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	40	42	6-8-5-7		Tan coarse to fine sand, trace silt (SP)
	S-11	45	47	11-17-21-19		Brown coarse to fine sand, trace gravel, silt (SP)

B-222

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CSM DATE 2/11

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-222	S-12	50	52	7-7-10-12		Dark gray silty clay, trace silty fine sand seams (CL)
	U-2	55	57	Rec=24"		
	S-13	66.5	67	10-13-19		Gray fine sand, some silt (SM)

B-222

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CTM DATE 2/81

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-223	S-1	0	2	9-20-18-27		Tan fine to coarse sand, trace silt (SP)
	S-2	5	7	24-24-20-18		Tan fine to coarse sand, trace silt (SP)
	S-3	10	11.5	31-39-41		Gray medium to fine sand, trace silt (SP)
	U-1	14	16	Rec = 12"		
	U-2	16	18	Rec = 24"		
	S-4	20	21.5	27-55-66		Brown coarse to fine sand, trace gravel, silt (SP)
	S-5	25	27	18-19-22-20		Brown coarse to fine sand, trace gravel, silt (SP)
	S-6	30	32	15-20-12-14		Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	35	37	21-17-16-18		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	40	42	15-15-29-27		Brown medium to fine sand, trace silt (SP)
	S-9	45	47	32-29-26-21		Tan fine to coarse sand, trace gravel, silt (SP)

B-223

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CJM DATE 2/8/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-223	S-10	50	52	10-11-15-16		Dark gray silty clay, trace silty fine sand seams. (CL)
	S-11	55	57	14-16-26-24		Dark gray silty clay, some silty fine sand layers (CL)
	S-12	65	67	13-36-37-39		Brown fine sand, some silt, trace gray silty clay layers (SM)

B-223

SHEET NO.____ OF__

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CSM DATE 2/7/

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-224	S-1	0	2	9-12-19-10		Gray fine to medium sand, trace silt (SP)
	S-2	5	7	20-22-31-32		Gray coarse to fine sand, trace silt, shells (SP)
	S-3	10	11.5	22-51-40		Gray medium to fine sand, trace silt (SP)
	S-4	15	17	1-2-3-3	109.5	Dark brown organic silty clay, trace roots (OH)
	S-5	17	19	8-7-5-4		Brown coarse to fine sand, some silt (SM)
	S-6A	19	20	3-4-21-25		Brown silty fine to coarse sand (SM)
	S-6B	19	21	3-4-21-25		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-7	25	27	8-9-12-9		Brown coarse to fine sand, trace gravel, silt (SP)
	S-8	30	32	8-8-8-8		Tan coarse to fine sand, trace gravel, silt (SP)
	S-9	35	37	8-12-15-16		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	40	42	15-22-17-16		Brown coarse to fine sand, trace gravel, silt (SP)

B-224

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CTM DATE 6/7

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-224	S-11	45	47	12-14-40-46		Gray silty clay, trace silty fine sand seams (CL)
	S-12	50	52	10-14-23-28		Gray silty clay, trace silty fine sand seams (CL)
	S-13	55	57	8-14-20-24		Dark gray silty clay, trace silty fine sand seams (CL)
	S-14	60	62	16-16-19-24		Gray silty clay, trace silty fine sand seams (CL)
	S-15	65	66.5	25-46-60		Brown silty fine sand (SM)

B-224

SHEET NO.____ OF__

FILE____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

MADE BY CJM DATE 6/8

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-225	S-1	0	2	11-7-12-17		Tan fine to coarse sand, trace silt (SP)
	S-2	5	6.5	35-64-75		Brown coarse to fine sand, trace gravel, silt, black clay pockets (SP)
	S-3	10	12	58-60-18-15		Gray fine to medium sand, trace silt (SP)
	S-4	15	17	4-5-6-6	159.4	Dark brown organic silty clay, trace organic fibers (OH)
	S-5	17	19	7-9-7-5		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-6	20	22	33-34-36-37		Brown coarse to fine sand, trace gravel, silt (SP)
	S-7	25	27	13-34-23-20		NO RECOVERY
	S-8	30	32	11-11-15-11		Brown medium to fine sand, trace silt (SP)
	S-9	35	37	23-24-26-16		Brown coarse to fine sand, trace silt (WASH) (SP)

B-225

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY SM DATE 2/7/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-226	S-1	0	2	10-8-8-12		Tan medium to fine sand, trace silt (SP)
	S-2	5	7	10-12-19-17		Tan fine to coarse sand, trace silt (SP)
	S-3	10	12	7-14-26-31		Gray fine to medium sand, trace silt (SP)
	S-4	12	14	21-31-28-19		Gray fine to medium sand, trace silt (SP)
	S-5	14	16	2-1-3-2	55.0	Dark gray silty clay, trace organic fibers (CL)
	S-6A	16	18	2-2-2-3	68.8	Dark gray silty clay, trace fine sand seams, organic fibers (CL)
	S-6B	16	18	2-2-2-3		Dark gray fine to coarse sand, some silt, trace roots (SM)
	S-7	18	20	2-4-6-7		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-8	20	22	6-3-9-10		Brown coarse to fine sand, some silt, trace gravel (SM)
	S-9	25	27	10-13-14-15		Brown fine to coarse sand, trace silt (SP)
	S-10	30	32	8-8-10-11		Brown coarse to fine sand, trace gravel, silt (SP)

B-226

SHEET NO.____ OF__

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY CJM DATE 2/7/

CHECK BY____ DATE____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-226	S-11	35	37	12-15-15-15		Brown coarse to fine sand, trace gravel, silt (SP)
	S-12	40	42	10-14-15-18		Brown fine to coarse sand, trace gravel, silt (SP)
	S-13	45	47	14-14-11-13		Gray fine to coarse sand, trace gravel, silt (SP)
	S-14	50	52	6-8-10-13		Dark gray silty clay, trace silty fine sand seams (CL)
	U-1	55	57	Rec=6"		Dark gray silty clay, trace silty fine sand seams (CL)
	S-15	60	62	10-11-15-15		Dark gray silty clay, trace silty fine sand seams (CL)
	S-16	70	72	31-28-27		Brown fine to coarse sand, trace gravel, silt, shells (SP)
	S-17	80	82	24-28-34		Gray fine to medium sand, trace silt, gray clay layers (SP)
	S-18	90	92	32-36-34		Gray fine to coarse sand, trace silt, black silt layers (SP)
	S-19	100	101	5.9-90		Tan coarse to fine sand, trace silt, gray clay pockets (SP)
	S-20	110	111.5	18-29-36		Gray silty clay, trace silty fine sand seams

B-226

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 610

CONSULTING ENGINEERS

MADE BY SM DATE 2/71

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-226	S-21	120	121.5	42-53-54		Gray medium to fine sand, trace silt, black silt pockets (SP)

B-226

SHEET NO.____ OF __

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 6102

MADE BY CM DATE 2/6/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-227	S-1	0	2	4-12-13-15		Brown fine to coarse sand, trace silt (SP)
	S-2	2	4	8-11-11-19		Brown fine to coarse sand, trace silt, shells (SP)
	S-3	4	6	4-4-4-5		Tan fine to coarse sand, trace silt, shells (SP)
	S-4	6	8	9-9-9-12		Tan fine to coarse sand, trace silt, shells (SP)
	S-5	8	10	3-5-5-6		Tan fine to coarse sand, trace silt, shells (SP)
	S-6	10	12	5-5-7-6		Tan fine to coarse sand, trace silt, shells (SP)
	S-7	12	14	1-1-1-2		Tan fine to coarse sand, trace silt, gravel (SP)
	S-8	14	16	1-1-4-4		Brown fine to coarse sand, trace silt, shells (SP)
	S-9	16	18	3-1-2-3		Brown fine to coarse sand, trace silt (SP)
	S-10	18	20	4-7-8-10		Brown coarse to fine sand, some silt, trace gravel, black silt layers (SM)

B-227

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 5610

CONSULTING ENGINEERS

MADE BY CJM DATE 2/6/8

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-227	S-11	20	22	8-10-12-24		Brown coarse to fine sand, trace silt, gravel (SP)
	S-12	25	27	11-14-18-18		Brown coarse to fine sand, trace silt, gravel (SP)
	S-13	30	32	7-10-10-9		Tan coarse to fine sand, trace silt, gravel (SP)
	S-14	35	37	9-13-11-11		Tan coarse to fine sand, some gravel, trace silt (WASH) (SP)
	S-15	40	42	7-9-8-13		Brown coarse to fine sand, little silt, black silt pockets (SP)
	S-16	45	47	6-12-20-20		Tan fine to coarse sand, trace silt (SP)
	S-17	50	52	8-11-13-18		Dark gray silty clay, trace silty fine sand seams (CL)
	S-18	55	57	10-12-16-20		Dark gray silty clay, trace silty fine sand seams (CL)
	S-19	60	62	8-13-16-20		Dark gray silty clay, trace silty fine sand seams (CL)
	S-20A	65	67	4-33-25-25		Dark gray silty clay, trace silty fine sand seams (CL)
	S-20B	65	67	4-33-25-25		Gray medium to fine sand, trace silt (SP)

B-227

SHEET NO.____ OF ____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

FILE 610

MADE BY CTM DATE 2/6/

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek WPCP

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-228	S-1	0	2	10-14-17-30		Brown fine to coarse sand, trace silt, shells (SP)
	S-2	5	7	14-30-31-50		Tan medium to fine sand, trace silt, brown silt pockets (SP)
	S-3	10	12	4-2-2-2	18.8	Brown organic silty coarse to fine sand, trace roots (SM)
	S-4	12	14	3-5-8-23		Brown coarse to fine sand, some silt, trace roots (SM)
	S-5	15	17	26-32-50		Brown coarse to fine sand trace gravel, silt (SP)
	S-6	20	22	8-16-22-22		Brown coarse to fine sand, trace silt (SP)
	S-7	25	27	6-12-13-12		Brown coarse to fine sand, trace silt (SP)
	S-8	30	32	18-22-25-27		Brown coarse to fine sand, some gravel, trace silt (SP)
	S-9	35	37	10-17-10-9		Brown coarse to fine sand, trace gravel, silt (SP)
	S-10	40	42	12-12-19-23		Brown coarse to fine sand, trace gravel, silt, gray silty clay pockets (SP)

B-228

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

FILE 6102

CONSULTING ENGINEERS

MADE BY CM DATE 2/6/8

CHECK BY____ DATE ____

CLASSIFICATION OF DRY SAMPLES

PROJECT Cedar Creek

BORING NUMBER	SAMPLE NUMBER	DEPTH FROM	DEPTH TO	BLOWS/6"	W.C. %	DESCRIPTION AND REMARKS
B-228	S-11	45	47	15-16-18-22		Dark gray silty clay, trace silt seams (CL)
	S-12	50	52	10-14-19-27		Dark gray silty clay, trace silty fine to medium sand seams (CL)
	S-13	55	57	8-14-18-23		Dark gray silty clay, trace silty fine sand seams (CL)
	S-14	60	62	10-13-15-25		Gray silty clay, trace silty fine sand seams (CL)
	S-15	65	67	22-42-55		Brown fine to medium sand, trace silt (SP)

B-228

SUMMARY OF WATER CONTENTS

Boring No.	Sample No.	water content, %	Stratum
B-301	11D	31	C
B-302P	10D	22	C
	11D	35	C
B-303	4D (TOP)	33	O
	10D	34	C
	11D	32	C
B-304	4D	102	O
	11D	36	C
B-305	4D	144	O
	5D	137	O
	12D	32	C
B-306	4D	143	O
	5D (TOP)	29	O
	11D	24	C
B-307	4D (BOT)	170	O
	11D	31	C
B-308	4D	89	O
	11D	34	C
B-309	4D	29	O
	12D	28	C
	13D	36	C
	14D	33	C
	15D	41	C
B-310	11D (BOT)	27	C
	12D	36	C
B-311	6D	33	O
	12D	34	C
	13D	42	C
	14D	39	C
B-312U	4D (BOT)	137	O
	14D	35	C

SUMMARY OF WATER CONTENTS

Boring No.	Sample No.	water content, %	Stratum
B-3134	6D	70	O
	14D	41	C
	15D	39	C
	16D	41	C
	17D	35	C
B-3144	13D	35	C
B-315P	4D	41	O
	11D	34	C
B-316P(A)	2D	129	O
B-319P	4D	29	O
B-320P	4D	48	O
B-321	3D	23	O
	10D	34	C
B-322	4D	113	O
	11D	32	C
B-323	4D (BOT)	123	O
B-324	5D	54	O
	6D	79	O
B-325	4D	23	O
B-326	5D	253	O
	11D	34	C
	12D	34	C
	13D	33	C
	14D	36	C
B-327	4D	93	O
	5D	32	O
	6D	72	O
	11D	25	C
	12D	31	C
	13D	29	C
	14D	41	C

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-301

SURFACE ELEV. +13.8

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1100	1D	0.0 2.0	3-6 3-7	Top: Topsoil Bot: Gray medium to fine sand (SP)		5		0'-5', drille ahead of cas
	2D	5.0 7.0	3-3 2-3	Gray medium to fine sand, trace shells (SP)		10		5'-52', used mud.
	3D	10.0 12.0	1-1 2-2	Gray medium to fine sand, trace coarse sand (SP)	F	15		
	4D	15.0 17.0	6-8 12-14	Gray medium to fine sand, trace gravel, organic silt layers (SP)		20		
	5D	20.0 22.0	9-9 13-12	Yellow brown medium to fine sand, trace silt, gravel (SP)		23		
	6D	25.0 27.0	4-5 6-6	Gray brown medium to coarse sand, trace silt (SP)		25		
	7D	30.0 32.0	3-4 4-5	Yellow brown medium to fine sand, trace coarse sand, silt (SP)	S_1	30		
	8D	35.0 37.0	4-4 5-6	Gray medium to fine sand, trace silt, coarse sand (SP)		35		
	9D	40.0 42.0	5-6 5-5	Do 8D (SP)		40		
	10D	45.0 47.0	8-12 8-12	Gray fine sand, trace gravel (SP)		45		
						48		
	11D	50.0 52.0	4-4 6-7	Stiff dark gray silty clay (CL)	C	50 52		End of boring @ 52.0'.
1500								

WEDNESDAY, 2-13-85 - SUNNY, 35°F

BORING NO. B-301

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-301
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 15/16"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-14-85	0800	-	5.0'	12.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-14-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-301

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6102
BORING NO. B-302P
SURFACE ELEV. +13.(

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1100	1D	0.0 2.0	17-11 11-12	Top: Topsoil Bot: Gray medium to fine sand(SP)			5 5 10 14 14	
	2D	5.0 7.0	3-30 4-8	Gray medium to fine sand and gravel (SP&GP)	F	5	14 5 5 17 10	
	3D	10.0 12.0	15-20 8-12	Gray medium to fine sand (SP)		10	13 4 5 11 14	
	4D	15.0 17.0	3-4 8-12	Brown medium to fine sand, trace roots, silt (SP)		15	13 14 14 24 24	
	5D	20.0 22.0	12-17 21-24	Yellow brown medium to fine sand trace silt (SP)		20	20 22 27 39 44	
1000 0800	6D	25.0 27.0	9-10 14-17	Brown medium to fine sand (SP)		25	56 24 27 39 46	
	7D	30.0 32.0	3-5 6-13	Gray brown medium to fine sand, trace coarse sand, gravel (SP)		30	61 27 34 43 62	
	8D	35.0 37.0	3-5 5-6	Gray brown medium to fine sand (SP)	S1	35	67 23 25 30 34	
	9D	40.0 42.0	4-6 10-11	Gray brown medium to fine sand, trace coarse sand, gravel (SP)		40	41 25 37 46 62	
	10D	45.0 47.0	6-6 8-13	Top: Do 9D (SP) Bot: Stiff gray silty clay,tr fine sand (CL)		45	71 34 41	
					C	46.5	59 73	
	11D	50.0 52.0	9-10 14-17	Gray silty clay, trace fine sand (CL)		50 52	84	End of boring @ 52.0'.

THURSDAY, 2-14-85 - SUNNY, 30°F
WEDNESDAY, 2-13-85 - SUNNY, 35°F

BORING NO. B-302P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-302P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.0 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0, DEPTH FROM 0.0' TO 50.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2-15/16
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300, AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-14-85	0800	25.0'	25.0'	10.0'	
2-14-85	1200	35.0'	35.0'	10.7'	AFTER COMPLETION OF HOLE
2-14-85	1330			10.5'	PIEZOMETER READING
2-15-85	0830			10.5'	PIEZOMETER READING
2-19-85	1300			10.9'	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC, ID 1.25, LENGTH 30.5', TOP ELEV. +13.5
INTAKE POINT: TYPE PVC-SLOTTED, OD 1.5", LENGTH 5.0', TIP ELEV. -22.0
FILTER: MATERIAL SAND, OD 3.0", LENGTH , BOT. ELEV. -39.0

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-14-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-30

SHEET 3 OF 3
FILE NO. 6102
SUBCODE

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

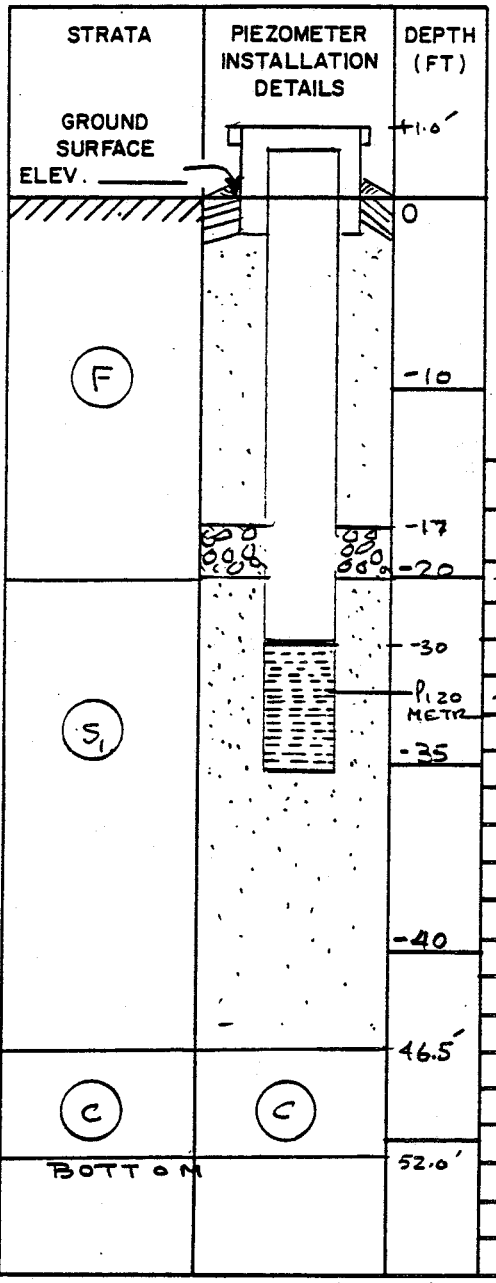
PROJECT CEDAR CREEK WPCP. EXPANSION PIEZOMETER NO. 302 P

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION SOUTH SIDE OF THE PUMPING WELL DATE OF INSTALLATION 2-14

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJE

PIEZOMETER TYPE PVC (SCH 40)



INTAKE POINT

depth to bottom, ft = -35.0'

depth to top, ft = -30.0'

length, ft = 5.0' = L

diameter, in = 1 1/4 (I.D), ft = _____ = 2R

STANDPIPE/RISER (PVC)

elevation of rim, ft = +13.5'

diameter, in = 1 1/4 (I.D), ft = _____ = 2r

READING TIME		DEPTH - RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
2-15	0830	10.5 (6.5)	+2.5'	
COULD NOT FILL UP THE PIEZOMETER PUMPED WATER FOR 5 MIN.				
2-19	1300	10.9	+2.1'	

Sand Bentonite

Gravel Grout

GROUND SURFACE ELEV. 13.00

PIEZOMETER NO. 302 P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

BORING NO. B-303

SURFACE ELEV. +12.4

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0800	1D	0.0 2.0	4-4 4-7	Top: Topsoil Bot: Gray fine sand (SP)				
	2D	5.0 7.0	10-18 18-24	Gray fine sand (SP)	F	5		5'-52', used mud.
	3D	10.0 12.0	9-16 19-22	Do 2D (SP)		10		
						14		
	4D	15.0 17.0	WOH/12" 4-4	Top: Medium dark gray organic silty clay (OH) Bot: Brown medium to fine sand, trace silt, gravel (SP)	O	15		
	5D	20.0 22.0	10-12 12-14	Gray brown medium to fine sand, trace gravel, silt (SP)		20		
	6D	25.0 27.0	8-14 14-16	Gray brown medium to fine sand, some gravel, trace silt (SP)	S_1	25		
	7D	30.0 32.0	12-18 25-27	Gray fine to medium sand, trace silt (SP)		30		
	8D	35.0 37.0	10-12 12-9	Gray fine to medium sand, trace coarse sand, silt (SP)		35		
	9D	40.0 42.0	12-18 25-27	Gray fine to medium sand (SP)		40		
	10D	45.0 47.0	15-12 12-13	Hard gray silty clay (CL)	C	45		
						50		
1200	11D	50.0 52.0	10-12 12-13	Do 10D (CL)		52		End of boring @ 52.0'.

TUESDAY, 2-19-85 35° - 40°

BORING NO. B-303

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-303

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +12.4 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'

DIAMETER, INCHES , DEPTH FROM TO

☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4

TYPE OF DRILLING MUD REVERT

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24

SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-19-85	1200	-	-	12.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON

STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.

INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.

FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES

___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER SAL DAMICO HELPERS BOB WOJCIK

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-19-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF ____
FILE NO. 6102
BORING NO. B-304
SURFACE ELEV. +13.3

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK RES. ENGR. GERALD C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1300	1D	0.0 2.0	PUSH	Brown fine to coarse sand, trace silt, organic silt seams (SP)				
	2D	5.0 7.0	2-2 2-3	Do 1D (SP)	F	5		
	3D	10.0 12.0	1-1 1-2	Gray fine to coarse sand, trace silt, organic silt and peat seams, gravel (SM)		10		
	4D	15.0 17.0	1-1 1-2	Medium gray organic silty clay, trace peat (OH-Pt)	O	15		
2-18-85 - SUNNY, 35°F	5D	20.0 22.0	1-1 6-9	Top: Medium gray organic clayey silt, tr coarse to fine sand (OH) Bot: Gray coarse to fine sand, some silt (SM)		20 21		
	6D	25.0 27.0	6-7 9-10	Tan coarse to fine sand, trace gravel (SP)		25		
	7D	30.0 32.0	4-4 5-4	Do 6D, trace gray clayey silt seams (SP)	S_1	30		
	8D	35.0 37.0	4-4 5-5	Tan fine to coarse sand, trace gravel (SP)		35		
	9D	40.0 42.0	4-4 5-6	Tan medium to fine sand, trace coarse sand, gravel (SP)		40		
	10D	45.0 47.0	6-9 11-16	Tan coarse to fine sand, some gravel, tr gray clayey silt seams (SP)		45 48		
1600	11D	50.0 52.0	5-9 11-12	Stiff gray silty clay, trace fine sand (CL)	C	50 52		End of borin @52.0'.

BORING NO. B-304

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-304
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.3 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 2-18-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-304

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

BORING NO. B-305

SURFACE ELEV. +14.5

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0800	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand(SP)				
	2D	5.0 7.0	5-4 4-10	Do 1D, bottom (SP)	F	5		5'-52', use mud.
	3D	10.0 12.0	15-23 30-35	Gray medium to fine sand (SP)		10		
	4D	15.0 17.0	4-1 1-2	Soft gray organic clay, some peat (OH-Pt)	O	15		
	5D	17.0 19.0	1-2 2-2	Do 4D (OH-Pt)		19		
	6D	20.0 22.0	1-8 14-18	Gray brown medium to fine sand, trace organic silt (SP-SM)	S & O	20 22		
TUESDAY, 2-19-85 35°-40°	7D	25.0 27.0	3-3 6-7	Brown fine to medium sand, trace coarse sand, silt (SP)		25		
	8D	30.0 32.0	5-5 6-6	Do 7D (SP)		30		
	9D	35.0 37.0	5-5 6-9	Do 7D (SP)	S_1	35		
	10D	40.0 42.0	3-4 5-7	Do 7D (SP)		40		
	11D	45.0 47.0	5-6 8-7	Gray fine to medium sand, trace coarse sand (SP)		45 47		
1200	12D	50.0 52.0	3-4 5-5	Stiff gray silty clay (CL)	C	50 52		End of boring @ 52.0'.

BORING NO. B-305

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-305

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +14.5' DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 3", DEPTH FROM 0.0' TO 5.0'

DIAMETER, INCHES , DEPTH FROM TO

☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES

TYPE OF DRILLING MUD REVERT

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS -, AVERAGE FALL, INCHES -

SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-19-85	1130	52.0'	5.0'	12.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON

STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.

INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.

FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES

DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-19-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-305

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

PROJECT CEDAR CREEK WPCP EXPANSION — FILE NO. 6102

BORING NO. B-306

PROJECT LOCATION WANTAGH, NEW YORK — RES. ENGR. BEN MUKHERJEE — SURFACE ELEV. +13.6

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1300	1D	0.0 2.0	6-7 9-11	Top: Topsoil Bot: Gray brown fine to medium sand, trace silt (SP-SM)				
	2D	5.0 7.0	12-17 23-31	Gray medium to fine sand, trace shells (SP)	F	5		5'-52' used mud.
	3D	10.0 12.0	15-21 27-33	Do 2D, trace gravel (SP)		10		
TUESDAY, 2-19-85	4D	15.0 17.0	1-1 2-3	Medium gray organic silty clay, some peat (OH-Pt)	O	14 15		
	5D	20.0 22.0	3-4 4-3	Top: Do 4D, sm fine sand (OH-Pt) Bot: Brown medium to fine sand, some organic silt (SM)	S&O	20 21 25		
1500 1800	6D	25.0 27.0	12-15 17-22	Gray medium to fine sand, trace coarse sand, silt (SP-SM)				
30°F	7D	30.0 32.0	11-14 15-17	Gray fine to medium sand (SP)	S_1	30 35		
	8D	35.0 37.0	12-14 15-19	Do 7D (SP)				
WEDNESDAY, 2-20-85	9D	40.0 42.0	10-12 10-14	Gray fine to medium sand, trace coarse sand (SP)		40		
	10D	45.0 47.0	12-25 31-27	Do 9D (SP)		45		
						49		
1030	11D	50.0 52.0	3-4 6-7	Stiff gray silty clay, some fine sand (CL)	C	50 52		End of boring @ 52.0'.

BORING NO. B-306

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-306
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.6 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 15/16"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-20-85	1100	52.0'	5.0'	8.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-20-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102
BORING NO. B-307
SURFACE ELEV. +14.7

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1300	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand(SP)				
	2D	5.0 7.0	14-23 22-22	Light gray coarse to fine sand, trace gravel (SP)	F	5		5'-52', used mud.
	3D	10.0 12.0	7-7 14-23	Gray fine to medium sand (SP)		10		
TUESDAY, 2-19-85	4D	15.0 17.0	4-1 1-2	Top: Do 3D (SP) Bot: Medium gray organic silty clay, trace peat (OH & Pt)	O	15 15.5 18		
	5D	20.0 22.0	8-7 6-7	Gray fine to coarse sand, some organic silt (SM)	S&O	20 22		
	6D	25.0 27.0	6-7 5-7	Brown medium to fine sand, trace silt (SP)		25		
1500 0800	7D	30.0 32.0	3-5 5-6	Gray medium to fine sand, trace coarse sand (SP)		30		
	8D	35.0 37.0	2-4 5-5	Do 7D (SP)	S_1	35		
WEDNESDAY, 2-20-85 30°	9D	40.0 42.0	4-4 4-7	Do 7D (SP)		40		
	10D	45.0 47.0	5-5 5-6	Do 7D (SP)		45 48		
1100	11D	50.0 52.0	3-4 4-5	Stiff gray silty clay (CL)	C	50 52		End of boring @ 52.0'

BORING NO. B-307

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-307
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 15/16"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-20-85	1030	52.0'	5.0'	12.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-23-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

PROJECT CEDAR CREEK WPCP EXPANSION — FILE NO. 6102

PROJECT LOCATION WANTAGH, NEW YORK — RES. ENGR. BEN MUKHERJEE — BORING NO. B-308 — SURFACE ELEV. +13.4

WEDNESDAY, 2-20-85 - 29°F

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1030	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand (SP)				
	2D	5.0 7.0	7-6 6-5	Gray fine to medium sand, trace roots (SP)	F	5		5'-52', use mud.
	3D	10.0 12.0	9-18 18-18	Do 2D (SP)		10		
	4D	15.0 17.0	1-1 2-3	Medium gray organic silty clay, some peat (OH & Pt)	O	15		
	5D	20.0 22.0	9-12 12-18	Brown coarse to fine sand, trace organic silt (SP)	S&O	18 20 22		
	6D	25.0 27.0	5-6 6-7	Gray fine to medium sand, trace coarse sand, silt (SP)		25		
	7D	30.0 32.0	3-4 6-4	Do 6D (SP)	S_1	30		
	8D	35.0 37.0	5-5 7-7	Do 6D (SP)		35		
	9D	40.0 42.0	3-5 5-8	Gray medium to fine sand, trace coarse sand, gravel, silt (SP)		40		
	10D	45.0 47.0	3-6 8-9	Do 9D (SP)		45 49		
1400	11D	50.0 52.0	1-2 4-4	Stiff gray silty clay, trace fine sand (CL)	C	50 52		End of boring @ 52.0'.

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-308
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.4 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 1/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-20-85	1400	52.0'	5.0'	11.8'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-23-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

BORING No. B-308

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-309

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +16.7

RES. ENGR. BEN MUKHERJEE

THURSDAY, 2-21-85 - SUNNY 33°

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0800	1D	0.0 2.0	PUSH	Topsoil				
	2D	5.0 7.0	1-1 1-1	Gray fine to medium sand, trace silt (SP-SM)	F	5 10		5'-80', used mud.
	3D	10.0 12.0	1-1 2-4	Gray fine to medium sand, trace coarse sand (SP)		15		
	4D	15.0 17.0	4-3 2-2	Medium gray organic silty clay, some peat (OH-Pt)	O	18		
	5D	17.0 19.0	5-4 5-6	Top: Do 4D (OH-Pt) Bot: Brown fine to medium sand, some organic silt (SM)	S&O	20		
	6D	20.0 22.0	2-2 1-2	Gray brown fine to medium sand, some silt (SM)		25		
	7D	25.0 27.0	8-8 8-13	Brown medium to fine sand, trace coarse sand, silt (SP)		30		
	8D	30.0 32.0	4-5 6-9	Gray fine to medium sand (SP)	S_1	35		
	9D	35.0 37.0	4-5 6-8	Do 8D, trace coarse sand (SP)		40		
	10D	40.0 42.0	4-5 5-6	Gray fine to coarse sand (SP)		45		
	11D	45.0 47.0	5-5 5-6	Gray fine to medium sand, trace silt (SP)		49 50		
	12D	50.0 52.0	7-7 7-7	Stiff gray silty clay, trace fine sand (CL)	C			

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-309

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +16.7

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
						55		
	13D	55.0 57.0	5-5 5-7	Do 12D (CL)				
					C	60		
	14D	60.0 62.0	3-5 5-6	Do 12D (CL)				
						65		
FEBRUARY 21, 1985	15D	65.0 67.0	3-5 6-8	Do 12D (CL)				
						69		
						70		
	16D	70.0 72.0	10-9 7-7	Gray fine to medium sand (SP)	S 2			
						75		
	17D	75.0 77.0	8-11 14-21	Gray fine to medium sand, trace silt (SP-SM)				
						80		
1400	18D	78.0 80.0	7-9 11-16	Do 17D (SP-SM)				End of bori @ 80.0'.
						85		
						90		
						95		
						100		

BORING NO. B-309

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-309
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +16.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3-3/4, 2-15/16
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-85	1400	80.0	5.0'	11.5'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 80.0 . NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-21-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-30

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-310

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +16.5

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1100	1D	0.0 2.0	7-9 11-4	Top: Topsoil Bot: Gray fine to medium sand (SP)				
	2D	5.0 7.0	9-14 13-17	Gray brown fine to medium sand, trace coarse sand, silt, gravel (SP-SM)		5		5'-55', use mud.
	3D	10.0 12.0	5-7 9-9	Gray brown fine to medium sand (SP)	F	10		
	4D	15.0 17.0	5-7 9-9	Do 3D, trace coarse sand (SP)		15		
	5D	20.0 22.0	17-19 11-12	Do 4D (SP)		20		
	6D	25.0 27.0	4-5 6-6	Brown medium to fine sand, trace silt pockets, gravel (SP-SM)		25		
	7D	30.0 32.0	4-5 9-12	Brown fine to medium sand, trace coarse sand, gravel (SP)	S_1	30		
	8D	35.0 37.0	4-6 6-7	Brown fine to medium sand, trace coarse sand, silt (SP)		35		
	9D	40.0 42.0	4-6 9-11	Do 8D (SP)		40		
	10D	45.0 47.0	5-7 10-12	Do 8D (SP)		45		
	11D	50.0 52.0	7-9 15-17	Top: Gray fine to medium sand(SP) Bot: Hard gray silty clay (CL)	C.	50 51		

WEDNESDAY, 2-20-85 - SUNNY, 29°-42°F

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-310

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +16.5

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
WED. 2-20-85					C			
1430	12D	53.0	7-7	Stiff gray silty clay, trace				
		55.0	7-9	fine sand (CL)		55		End of borir @ 55.0'.
						60		
						65		
						70		
						75		
						80		
						85		
						90		
						95		
						100		

BORING NO. B-310

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-310
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +16.5 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 55.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-20-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-310

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION — FILE NO. 6102

PROJECT LOCATION WANTAGH, NEW YORK — BORING NO. B-311

RES. ENGR. BEN MUKHERJEE — SURFACE ELEV. +15.3

THURSDAY, 2-21-85 - SUNNY, 33° - 42°

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0800	1D	0.0 2.0	2-9 11-15	Top: Topsoil Bot: Gray fine to medium sand(SP)				
	2D	5.0 7.0	4-2 2-3	Gray fine to medium sand, trace coarse sand, silt (SP)		5		5'-80', used mud.
	3D	10.0 12.0	4-5 5-7	Do 2D (SP)	F	10		
	4D	15.0 17.0	5-5 7-7	Gray fine to medium sand (SP)		15		
	5D	20.0 22.0	5-6 6-7	Do 4D (SP)		20		
						24		
	6D	25.0 27.0	4-6 9-11	Top: Medium gray organic silt(OH) Bot: Brown coarse to fine sand, some organic silt (SM)	O	25 26		
	7D	30.0 32.0	10-12 12-17	Do 6D (SM)	S&O	30 32		
	8D	35.0 37.0	9-12 12-16	Gray fine to coarse sand, trace silt (SP)		35		
	9D	40.0 42.0	10-12 12-14	Do 8D (SP)	S_1	40		
	10D	45.0 47.0	12-12 15-21	Gray fine sand, trace silt (SP)		45		
	11D	50.0 52.0	11-14 17-19	Gray fine sand, trace silt (SP-SM)		50		

BORING NO. B-311

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-311

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +15.

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
					S_1	53		
	12D	55.0 57.0	9-10 10-12	Stiff gray silty clay, trace fine sand (CL)		55		
THURSDAY, 2-21-85 - SUNNY, 33°-42°	13D	60.0 62.0	8-11 12-14	Do 12D (CL)	C	60		
	14D	65.0 67.0	12-12 13-17	Do 12D (CL)		65		
						68		
	15D	70.0 72.0	11-15 18-22	Gray fine to medium sand, trace silt (SP)		70		
					S_2	75		
	16D	75.0 77.0	13-20 22-27	Do 15D (SP)				
	17D	78.0 80.0	12-17 21-23	Gray fine to medium sand (SP)		80		End of boring @ 80.0'.
1500						85		
						90		
						95		
						100		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-311
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +15.3 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0 TO 5.0
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 15/16"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-85	1430	80.0	5.0	10.0	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 80.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-21-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-312U

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +14.4

RES. ENGR. BEN MUKHERJEE

DAILY ROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1100	1D	0.0 2.0	2-2 4-7	Top: Topsoil Bot: Gray brown fine to medium sand, trace roots, silt (SP-SM)				
	2D	5.0 7.0	9-12 17-19	Brown fine to medium sand, trace coarse sand, silt (SP-SM)	F	5		5'-55', use mud.
	3D	10.0 12.0	8-13 15-17	Gray fine to medium sand (SP)		10		
	4D	15.0 17.0	9-13 15-8	Top: Do 3D (SP) Bot: Medium dark gray organic silt, some veg (OH)		15 15.5		
	5U	18.0 20.0	P=24" R=19"	Med dk gray organic silty clay, tr fibers, shells (OH)	O	20		
	6U	20.0 22.0	P=24" R=23"	Stiff dk gry organic silty clay, tr fine sand, fibers (OH)				
	7U	22.0 24.0	P=24" R=23"	Top: Soft dk gry org silty clay (OH) Bot: Brn f-c sand, sm silt, trace fibers (SM)		23.5		
1400	8D	25.0 27.0	15-17 22-25	Brown fine to coarse sand, some organic silt (SP-SM)	S&O	25 27		
0800	9D	30.0 32.0	8-7 13-10	Gray fine to coarse sand, trace gravel (SP)		30		
	10D	35.0 37.0	16-12 7-11	Do 9D (SP)		35		
	11D	40.0 42.0	9-12 12-14	Gray fine to medium sand (SP)	S_1	40		
	12D	45.0 47.0	8-13 15-17	Gray fine to coarse sand (SP)		45		
	13D	50.0 52.0	8-10 12-14	Gray fine to medium sand, trace coarse sand (SP)		50		

MONDAY, 2-25-85 - CLOUDY, 45°F - 50°F

TUESDAY, 2-26-85 - SHOWERS, 44°F

BORING NO. B-312U

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-312U

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +14.4

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
TUESDAY 2-26-85 SHOWERS 44°F					S_1			
						53		
					C			
	14D	53.0	10-11	Hard gray silty clay (CL)		55		End of bor
1000		55.0	13-13					@ 55.0'.
						60		
						65		
						70		
						75		
						80		
						85		
						90		
						95		
						100		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-312U
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.4 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-26-85	1000	55.0'	5.0'	7.5'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 30.0. NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 25.0. NO. OF 3" UNDISTURBED SAMPLES 3
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS JOHN IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-26-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF ____
FILE NO. 6102
BORING NO. B-313
SURFACE ELEV. +16.1

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY ROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1100	1D	0.0 2.0	PUSH	Topsoil				
	2D	5.0 7.0	7-18 21-19	Gray fine to medium sand (SP)		5		5'-80', use mud.
	3D	10.0 12.0	12-17 20-24	Do 2D (SP)	F	10		
	4D	15.0 17.0	8-5 3-4	Do 2D (SP)		15		
	5U	18.0 20.0	P=24" R=22"	Stiff brn peat and dk gry organic silty clay (Pt & OH)		18		
	6D	20.0 22.0	4-4 3-4	Medium dark gray organic silt (OH)	O	20		
	7U	22.0 24.0	P=24" R=22"	Stiff dark brown organic silty clay, some peat (OH & Pt)		23		
	8D	24.0 26.0	2-2 5-7	Dark gray medium to fine sand, some organic silt (SM)	S&O	25		
	9D	30.0 32.0	5-6 8-13	Gray brown fine to coarse sand, trace silt, gravel (SP)		30		
1430 0800	10D	35.0 37.0	6-6 7-8	Brown fine to coarse sand, trace gravel (SP)		35		
	11D	40.0 42.0	6-9 10-11	Do 10D (SP)	S_1	40		
	12D	45.0 47.0	7-8 8-10	Gray fine to medium sand, trace coarse sand (SP)		45		
	13D	50.0 52.0	5-5 7-7	Do 12D (SP)		50		

FRIDAY, 2-22-85 - CLOUDY, 42°F-48°F

MONDAY, 2-25-85 - 45°

BORING NO. B-313U

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-313U

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +16.1

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
					S_1	53		
	14D	55.0 57.0	2-2 3-3	Stiff gray silty clay, trace fine sand (CL)		55		
	15D	60.0 62.0	4-4 9-8	Do 14D (CL)	C	60		
MONDAY, 2-25-85 - 45°	16D	65.0 67.0	3-3 3-5	Stiff gray silty clay, some silty fine sand layers (CL)		65		
	17D	70.0 72.0	8-10 18-38	Gray silty fine to medium sand, trace gravel, clay (SM)		70		
	18D	75.0 77.0	5-4 9-11	Gray silty fine to medium sand, trace gravel (SM)	S_2	75		
1200	19D	78.0 80.0	11-12 16-15	Gray silty fine to medium sand (SM)		80		End of boring @ 80.0'.
						85		
						90		
						95		
						100		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-313U
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +16.1 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4", 2 15/16", 2 1/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-25-85	1200	80.0'	5.0'	14.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 50.0. NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 30.0. NO. OF 3" UNDISTURBED SAMPLES 2
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JOE IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-25-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

BORING NO. B-314U

SURFACE ELEV. +18.

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY ROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0730	1D	0.0 2.0	7-9 9-12	Top: Topsoil Bot: Brown fine to medium sand, trace silt (SP-SM)				
	2D	5.0 7.0	10-17 25-25	Brown fine to medium sand, trace silt (SP-SM)	F	5 10		5'-57', use mud.
	3D	10.0 12.0	9-17 25-25	Gray fine to medium sand (SP)		15		
	4UD	15.0 17.0	P=24" R=6"	Do 3D, trace shells (SP)		18		
	5U	18.0 20.0	P=24" R=24"	Stiff dark gray organic silty clay and peat (OH & Pt)	O	20		
	6D	20.0 22.0	9-10 11-13	Gray fine to medium sand, some organic silt (SM)	S&O	25		
	7D	25.0 27.0	10-10 11-13	Do 6D, trace roots (SM)		27		
	8D	30.0 32.0	12-19 24-27	Gray brown medium to fine sand, trace gravel (SP)		30 35		
	9D	35.0 37.0	15-18 27-28	Gray brown coarse to fine sand (SP)	S_1	40		
	10D	40.0 42.0	8-9 9-10	Brown medium to fine sand, trace coarse sand, silt (SP)		45		
	11D	45.0 47.0	8-10 10-9	Gray fine to medium sand (SP)		50		
	12D	50.0 52.0	8-9 9-11	Do 11D (SP)				

FRIDAY, 2-22-85 - CLOUDY, 40°F

BORING NO. B-314U

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF ____

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-314U

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +18.3

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMAR
FRIDAY 2-22-85					S_1	54		
	13D	55.0 57.0	8-10 10-12	Hard gray silty clay, trace fine sand (CL)	C	55 57		End of bor @ 57.0'
1430						60		
						65		
						70		
						75		
						80		
						85		
						90		
						95		
						100		

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

Sheet 3 of
File No. 61

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-314U
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +18.3 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-22-85	1330	57.0'	-	8.5'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 32.0 . NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 25.0 . NO. OF 3" UNDISTURBED SAMPLES 1
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS BOB WOJCIK
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-22-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION — FILE NO. 6102

PROJECT LOCATION WANTAGH, NEW YORK — BORING NO. B-315P

RES. ENGR. GERALD C. BRAUN — SURFACE ELEV. +15.5

MONDAY, 2-18-85 - SUNNY, 35°F

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0830	1D	0.0 2.0	12-11 11-13	Brown medium to fine sand, some silt, trace clay pockets, gravel (SM)			PUSHED PUSHED 15 29	
						5	63	
	2D	5.0 7.0	12-25 25-28	White fine to medium sand, trace coarse sand, shells (SP)	F		15 25 37 44	
						10	61	
	3D	10.0 12.0	15-23 27-44	Gray fine to medium sand, trace coarse sand, shells (SP)			27 39 61 69	
						14		
						15	83	
	4D	15.0 17.0	2-2 3-3	Black organic silty clay, some medium to fine sand, trace roots (OH)	O		24 33 40 43	
						19		
						20	59	
	5D	20.0 22.0	12-24 30-35	Tan coarse to fine sand, trace gravel (SP)			31 47 63 79	
						25	96	
	6D	25.0 27.0	11-15 19-17	Do 5D (SP)			40 57 69 81	
						30	115	
	7D	30.0 32.0	12-15 19-27	Do 5D (SP)	S1		43 64 79 89	
						35	102	
	8D	35.0 37.0	11-14 16-21	Do 5D (SP)			47 63 75 89	
						40	96	
	9D	40.0 42.0	7-7 8-7	Tan fine to coarse sand (SP)			54 71 78 83	
						45	81	
	10D	45.0 47.0	4-7 7-13	Do 9D, trace gravel (SP)			55 74 86 97	
						48.5		
						50	117	
1350	11D	50.0 52.0	12-12 13-17	Stiff gray silty clay, trace silty fine sand layers (CL)	C	52		End of boring @ 52.0'.

BORING NO. B-315P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-315P

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +15.5 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 4, DEPTH FROM 0.0' TO 50.0'

DIAMETER, INCHES , DEPTH FROM TO

☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES

TYPE OF DRILLING MUD

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS 300, AVERAGE FALL, INCHES 24

SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3

STANDPIPE: TYPE PVC, ID 1.25", LENGTH 25.0', TOP ELEV.

INTAKE POINT: TYPE PVC-SLOTTED, OD 1.5", LENGTH 5.0', TIP ELEV. -14.5'

FILTER: MATERIAL SAND, OD 4.0", LENGTH , BOT. ELEV. -36.5'

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52. NO. OF 2" SHELBY TUBE SAMPLES

DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER SAL DAMICO HELPERS BOB WOJCIK

REMARKS

RESIDENT ENGINEER GERALD C. BRAUN DATE 2-18-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-31

SHEET 3 OF 3
FILE NO. 6102
SUBCODE _____

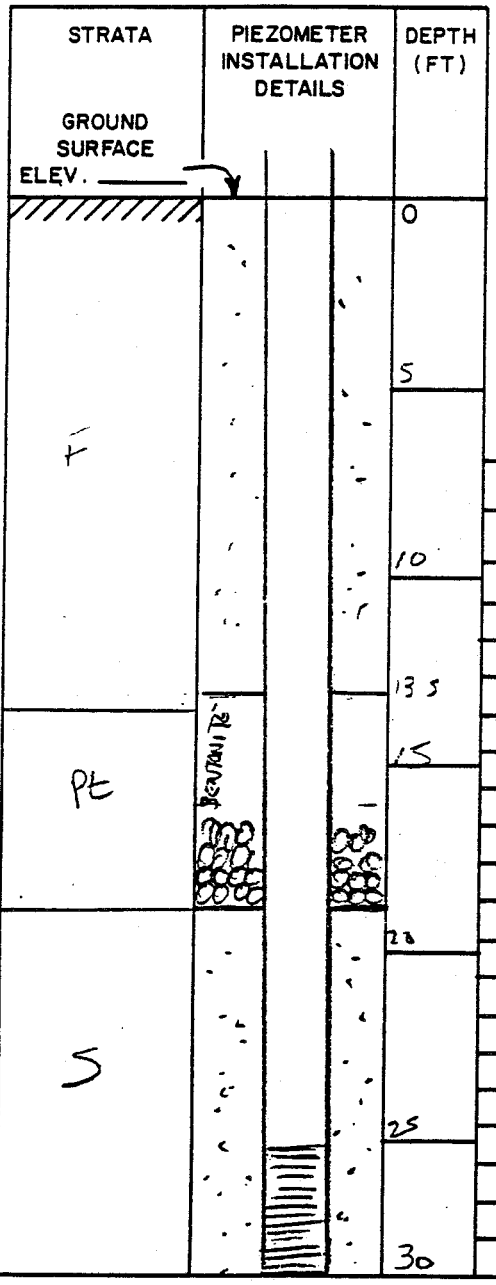
MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

PROJECT CEDAR CREEK WRP
PIEZOMETER NO. B 315P
LOCATION Wantagh NY
PIEZOMETER LOCATION _____
DATE OF INSTALLATION 2-18-8
☐ SEE SKETCH ON BACK
RES. ENG. G.C. BRAUN

PIEZOMETER TYPE _____



INTAKE POINT

depth to bottom, ft = 30
depth to top, ft = 25
length, ft = 5 = L
diameter, in = 1 1/4, ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = _____
diameter, in = ____, ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. +15.5

PIEZOMETER NO. B-315P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

PROJECT CEDAR CREEK WPCP EXPANSION — FILE NO. 6102

PROJECT LOCATION WANTAGH, NEW YORK — RES. ENGR. BEN MUKHERJEE — BORING NO. B-316P — SURFACE ELEV. +13.7

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0830	1D	0.0	5-4	Top: Topsoil			10	
		2.0	3-4	Bot: Gray medium to fine sand, trace silt (SP)	F		18	
							13	
2-14-85							15	
						5	18	
	2D	5.0	2-1	Top: Do 1D, Bottom (SP)				
		7.0	25-75	Bot: Gray-white fine to coarse sand, some gravel and concrete fragments (SP)		7		End of bori @ 7.0'
1030								
						10		Hole abando Hit obstruc @ 7.0'.
						15		
						20		
						25		
						30		
						35		
						40		
						45		
						50		

BORING NO. B-316P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-316P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 7.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS HOLE WAS ABANDONED DUE TO UNDERGROUND UTILITIES
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-14-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
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5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-316

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6102
BORING NO. B-316P(A)
SURFACE ELEV. +13.

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1030				0'-10' NO SAMPLES TAKEN. SEE LOG FOR BORING NO. B-316P.				0-5', casi blows not recorded.
						5		
							17	
							21	
					F		24	
							30	
	1D	10.0	13-20			10	32	
		12.0	18-20				20	
							26	
							29	
						14	48	
	2D	15.0	2-2	Top:Gry org silty clay,sm Pt(OH-Pt)	O	15	36	
		17.0	4-4	Bot: Gray m-f sand, sm org silt(SM)			22	
	3D	17.0	4-5	Gray medium to fine sand, trace			20	
		19.0	8-9	gravel, silt (SP)	S&O		24	
							23	
	4D	20.0	3-5	Light gray silty fine to medium		20	30	
		22.0	7-11	sand, trace organic silt (SM)		21	24	
							29	
							41	
							52	
	5D	25.0	13-10	Gray medium to fine sand (SP)		25	80	
		27.0	18-10				31	
							37	
							43	
					S_1		54	
	6D	30.0	4-6	Do 5D (SP)		30	61	
		32.0	8-8				37	
							49	
							60	
							69	
	7D	35.0	3-3	Do 5D (SP)		35	71	
		37.0	9-7				45	
							39	
							49	
							51	
	8D	40.0	4-8	Do 5D, trace coarse sand		40	60	
1400		42.0	9-11	(SP)		42		End of boring @ 42.0'.
						45		
						50		

THURSDAY, 2-14-85 - 29°F

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-316P(A)
LOCATION WANTAGH, NEW YORK
BORING LOCATION OFFSET 20' SOUTHWEST OF B-316P
SURFACE ELEVATION +13.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 40.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-14-85	1400	42.0	40.0	12.0	AT COMPLETION
2-15-85	0800			11.0'	PIEZOMETER READING
2-19-85	1305			11.2'	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 34.5' , TOP ELEV. +14.2
INTAKE POINT: TYPE PVC-SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. -25.3
FILTER: MATERIAL SAND , OD 3.0 " , LENGTH , BOT. ELEV. -28.3

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 35.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-14-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-316

SHEET 3 OF 3
FILE NO. 6102
SUBCODE

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

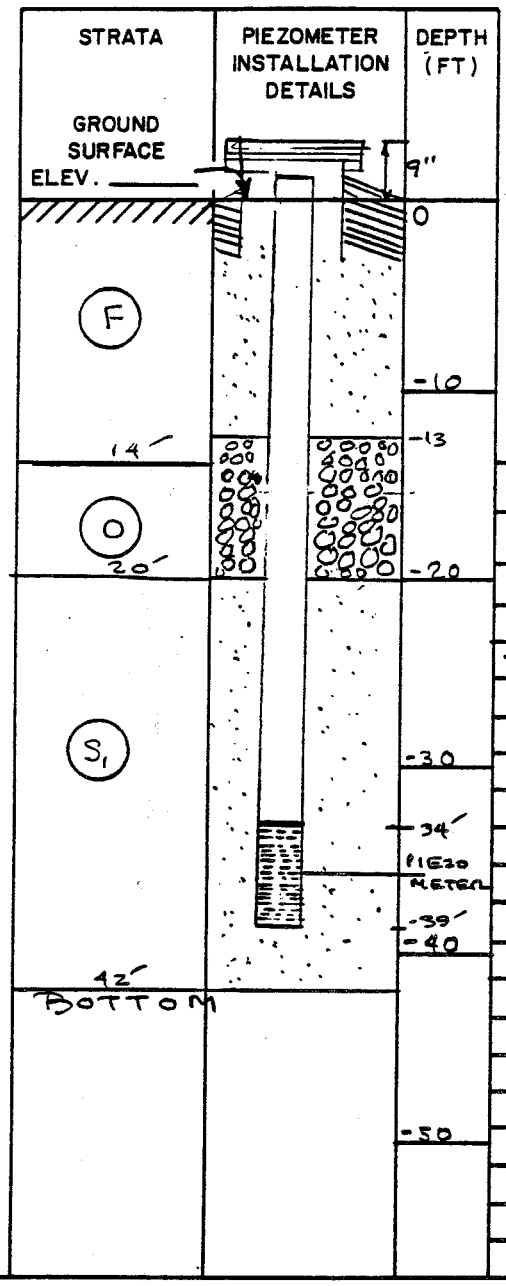
PIEZOMETER RECORD

PROJECT CEDARCREEK WPCP EXPANSION PIEZOMETER NO. 316 P (A)

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION NORTH SIDE OF THE PUMPING WELL DATE OF INSTALLATION 2-14-

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE



PIEZOMETER TYPE PVC.

INTAKE POINT

depth to bottom, ft = 39.0'
depth to top, ft = 34.0
length, ft = 5.0 = L
diameter, in = 1 1/4, ft = ____ = 2R

STANDPIPE/RISER

elevation of rim, ft = +14.20
diameter, in = 1 1/4, ft = ____ = 2r

READING TIME		DEPTH - RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
2-15	0800	11.0' (6.5)	+2.70'	
PUMPED IN WATER FOR 2 MIN.				COULD NOT FILL.
2-19	1305	11.2'	+2.5	

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. +13.70

PIEZOMETER NO. 316P(

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-317UP

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +16.1

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1415 2-14-85	1D	0.0	6-8	Top: Topsoil			15	
		2.0	8-12	Bot: Gray medium to fine sand, trace silt (SP-SM)			27	
							39	
							40	
	2D	5.0	18-27	Gray medium to fine sand, some		5	55	
1500		7.0	30-41	organic silt (SM)			27	
0800							46	
					F		97	
							119	
						10	205	
	3D	10.0	8-15	Gray medium to fine sand (SP)			58	
		12.0	27-39				76	
							102	
						14.5	155	
						15	145	
	4U	15.0	P=24"	Stiff gray organic silty clay,			49	
		17.0	R=21"	trace fine sand (OH)	O		54	
	5U	17.0	P=24	Top: Do 4U (OH)		18	66	
		19.0	R=21"	Bot: Gray brown coarse to fine	S&O	19	73	
				sand, trace organic silt (SP)		20	85	
	6D	20.0	9-14	Gray brown medium to fine sand			59	
		22.0	18-23	(SP)			89	
							97	
					S1		127	
						25	175	
	7D	25.0	10-17	Gray brown fine to medium sand,			68	
		27.0	21-25	trace coarse sand (SP)			93	
							124	
							143	
						30	151	
	8D	30.0	13-15	Gray brown fine to medium sand			68	
		32.0	19-17	(SP)			79	
							94	
							134	
						35	155	
	9D	35.0	11-15	Do 8D (SP)				End of boring
1500		37.0	17-21			37		@ 37.0'
						40		
						45		
						50		

FRIDAY, 2-15-85 - CLOUDY, 29°F

BORING NO. B-317UP

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-317 UP
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +16.1 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 35.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 3/4
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-15-85	1445	37.0	35.0	8.0	
2-19-85	1310			14.0	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 29.5' , TOP ELEV. +16.6
INTAKE POINT: TYPE PVC SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. -18.0
FILTER: MATERIAL SAND , OD 4.0" , LENGTH , BOT. ELEV. -20.9

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 17.0'. NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 20.0'. NO. OF 3" UNDISTURBED SAMPLES 2
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-17-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-317UP

SHEET 3 OF 3
FILE NO. 6102
SUBCODE

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

PIEZOMETER RECORD

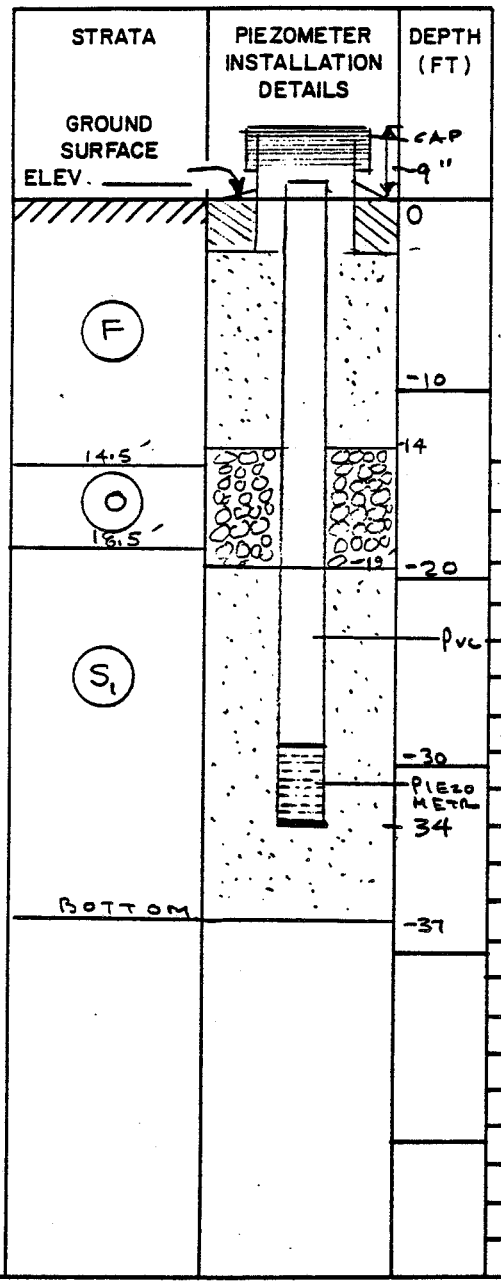
PROJECT CEDARCREEK WPCP EXPANSION PIEZOMETER NO. 317 U P

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION _____ DATE OF INSTALLATION 2-15-9

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE

PIEZOMETER TYPE Pvc



INTAKE POINT

depth to bottom, ft = -34.0

depth to top, ft = -29.0

length, ft = 5.0 = L

diameter, in = 1 1/4", ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = +16.60

diameter, in = 1 1/4", ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
2-15	1400	8' (6.5)	+8.10'	
COULD NOT		FILL TIME	PIEZOMETER.	
2-19	1310	14.0'	+2.0'	

Sand Bentonite

Gravel Grout

GROUND SURFACE ELEV. +16.10

PIEZOMETER NO. 317 U1

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-318P

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +18.0

RES. ENGR. GERALD C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0835	1D	0.0 2.0	PUSH	Brown fine to medium sand, some silt, trace clay layers, gravel (SM)	(F)			
MONDAY 2-18-85 SUNNY, 35°F						5		
	2D	5.0 7.0	1-2 2-2	White fine to medium sand, trace coarse sand, gravel (SP)				End of bori @ 8.0'.
0900						8		Hole abando
						10		Hit obstruc @ 8.0'.
						15		
						20		
						25		
						30		
						35		
						40		
						45		
						50		

BORING NO. B-318P

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-318P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +18.0 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4 , DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 8 . NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS HIT OBSTRUCTION - ELECTRIC UTILITY
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-18-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-318P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6182
BORING NO. B-318P(A)
SURFACE ELEV. +18.(

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. GERALD C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0910							5	
							11	
							18	
				0'-10' NO SAMPLES TAKEN. SEE LOG FOR BORING NO. B-318P.			23	
						5	17	
							10	
							14	
							31	
							30	
						10	33	
	1D	10.0 12.0	3-3 3-3	White fine to medium sand, trace shells (SP)	F		10	
							14	
							14	
							20	
	2D	15.0 17.0	2-2 3-4	Brown fine to medium sand, trace coarse sand, silt (SP)		15	23	
							12	
							13	
							14	
							14	
						20	20	
	3D	20.0 22.0	1-1 3-2	Do 2D, trace shells (SP)			13	
							14	
							10	
							18	
						25	21	
	4D	25.0 27.0	1-1 2-2	Gray white fine to medium sand, trace coarse sand, shells (SP)			21	
						27	23	
							30	
					S1		44	
						30	51	
	5D	30.0 32.0	4-8 7-10	Tan coarse to fine sand (SP)				End of borin @ 32.0'.
1045						32		
						35		
						40		
						45		
						50		

MONDAY, 2-18-85 - SUNNY, 35°F

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-318P(A)
LOCATION WANTAGH, NEW YORK
BORING LOCATION OFFSET 20' ± EAST OF B-318P
SURFACE ELEVATION +18.0 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC, ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4 , DEPTH FROM 0.0' TO 30.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 26.5' , TOP ELEV.
INTAKE POINT: TYPE PVC SLOTTED , OD 1.5" , LENGTH 2.5' , TIP ELEV. -11.0
FILTER: MATERIAL SAND , OD 4" , LENGTH , BOT. ELEV. -14.0

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 24' . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS JR.
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 2-18-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-318

SHEET 3 OF 3
FILE NO. 6102
SUBCODE ______

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
CONSULTING ENGINEERS

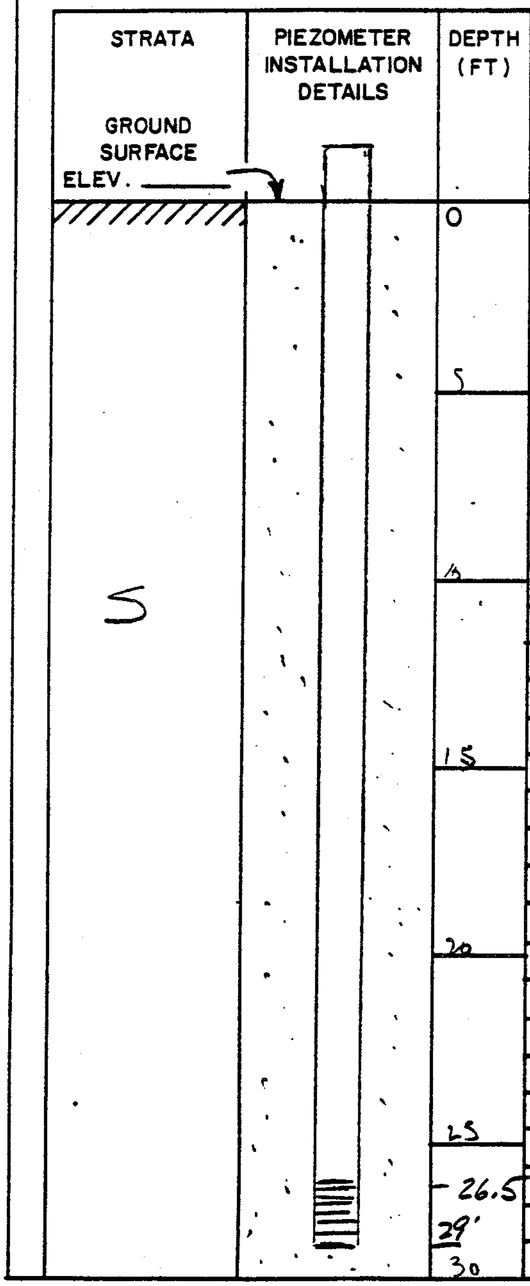
PIEZOMETER RECORD

PROJECT: CEDAR CREEK WPCP — PIEZOMETER NO. B-318P(A

LOCATION: ______

PIEZOMETER LOCATION: ______ — DATE OF INSTALLATION: 2-18-8

☐ SEE SKETCH ON BACK — RES. ENG. G.C. BRAUN



PIEZOMETER TYPE: PVC

INTAKE POINT
depth to bottom, ft = 29
depth to top, ft = 26 1/2
length, ft = 2 1/2 = L
diameter, in = 2, ft = ______ = 2R

STANDPIPE/RISER
elevation of rim, ft = ______
diameter, in = ______, ft = ______ = 2r

READING TIME		DEPTH - RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			

Legend: Sand; Bentonite; Gravel; Grout

GROUND SURFACE ELEV. + 18.0

PIEZOMETER NO. B-318P(A

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION — FILE NO. 6102

PROJECT LOCATION WANTAGH, NEW YORK — BORING NO. B-319P

RES. ENGR. BEN MUKHERJEE — SURFACE ELEV. +13.8

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1300	1D	0.0 2.0	4-4 8-9	Top: Topsoil Bot: Brown medium to fine sand, some silt (SM)			41 40 38 54	
						5	53	
	2D	5.0 7.0	11-10 9-6	Light gray medium to fine sand (SP)	F		20 26 29 30	
2-15-85						10	33	
	3D	10.0 12.0	7-9 16-17	Do 2D (SP)			14 11 26	
						14	20	
						15	13	
	4D	15.0 17.0	3-3 2-3	Medium gray organic silt, some fine sand (OH)	O		21 24	
	5D	17.0 19.0	2-3 5-6	Gray medium to fine sand, some silt, trace organic silt (SM)	S&O		29 43	
						20	48	
1300	6D	20.0 22.0	10-18 21-24	Brown medium to fine sand, trace coarse sand, silt (SP)	S1	22		End of borir @ 22.0'.
						25		
						30		
						35		
						40		
						45		
						50		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-319P
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 20.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 1/4
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-19-85	1330	-	13.0'	11.4'	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED, SKETCH SHOWN ON SHEET 3 OF 3
STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 8.5' , TOP ELEV. +14.3
INTAKE POINT: TYPE PVC-SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. + 0.8
FILTER: MATERIAL SAND , OD 3.0" , LENGTH 12.0' , BOT. ELEV. - 0.2

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 22.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-15-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

SHEET 3 OF 3
FILE NO. C102
SUBCODE

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

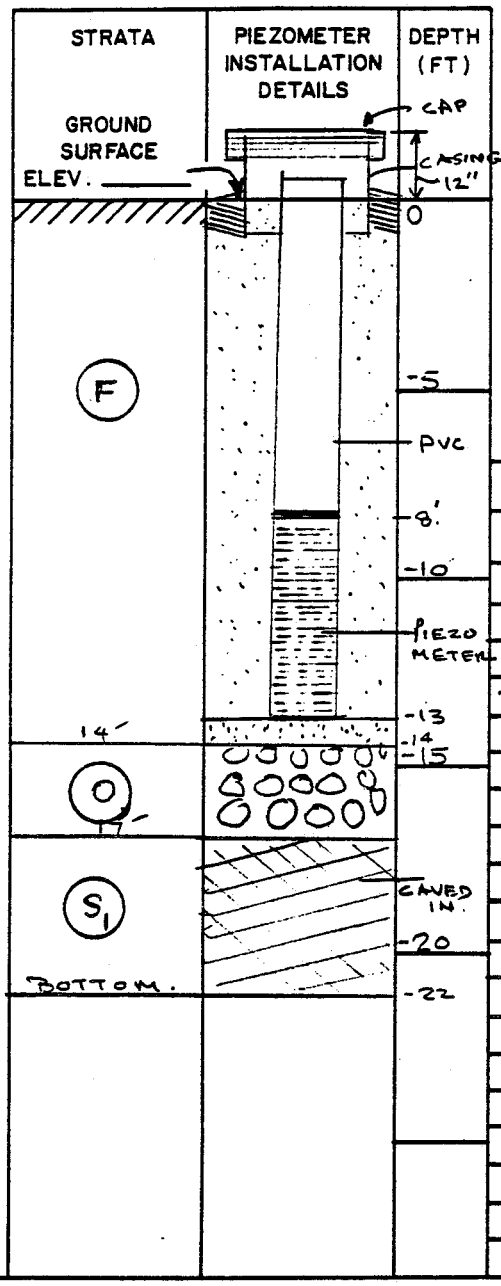
PIEZOMETER RECORD

PROJECT CEDAR CREEK WPCP EXPANSION — PIEZOMETER NO. 319 P

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION _____ — DATE OF INSTALLATION 2-15-

☐ SEE SKETCH ON BACK — RES. ENG. B. MUKHERJEE.



PIEZOMETER TYPE PVC.

INTAKE POINT

depth to bottom, ft = -13.0
depth to top, ft = -8.0
length, ft = 5.0 = L
diameter, in = 1 1/4", ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = +14.25
diameter, in = 1 1/4", ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
FILL LINE PIEZOMETER TO THE TOP.				
W.T. DROPS TO 11.0' IN 1 MIN.				
2-19	1315	11.4'	+2.35'	

Sand ▭ Bentonite ▭
Gravel ▭ Grout ▭

GROUND SURFACE ELEV. +13.75

PIEZOMETER NO. 319 P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

BORING NO. B-320P

SURFACE ELEV. +13.6

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0830	1D	0.0 2.0	7-8 9-9	Light brown-gray fine to medium sand, trace coarse sand (SP)			18 40 45 53	
						5	60	
	2D	5.0 7.0	8-9 10-13	Do 1D (SP)	F		18 21 24 27	
						10	33	
	3D	10.0 12.0	10-13 14-14	Gray fine sand (SP)			21 33 43	
						14	48	
					O	15	57	
FRIDAY, 2-15-85 - 29°F	4D	15.0 17.0	1-1 3-3	Top: Soft gray organic silty clay, trace peat (OH & Pt) Bot: Gray-brown coarse to fine sand, some silt, trace organic silt (SM)	S&O		14 21 30 41	
						20	44	
	5D	20.0 22.0	5-9 10-11	Gray brown coarse to fine sand, some silt, trace organic silt (SM)		22	29 43 49 76	
						25	80	
	6D	25.0 27.0	8-9 9-11	Gray brown fine to medium sand, trace coarse sand (SP)	S1		45 53 51 66	
						30	70	
	7D	30.0 32.0	5-7 7-9	Do 6D (SP)				End of boring @ 32.0'
1200						32		
						35		
						40		
						45		
						50		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-320P

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +13.6 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 30.0'

DIAMETER, INCHES , DEPTH FROM TO

☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 15/16"

TYPE OF DRILLING MUD

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24

SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-15-85	1200	32.0'	30.0'	12.5'	
2-19-85	1320			11.5'	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3

STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 24.5' , TOP ELEV. +14.1

INTAKE POINT: TYPE PVC-SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. -15.4

FILTER: MATERIAL SAND , OD 3.0" , LENGTH 16.0' , BOT. ELEV. -18.4

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 32.0. NO. OF 2" SHELBY TUBE SAMPLES

DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-15-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-320P

SHEET 3 OF 3
FILE NO. 6102
SUBCODE _____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

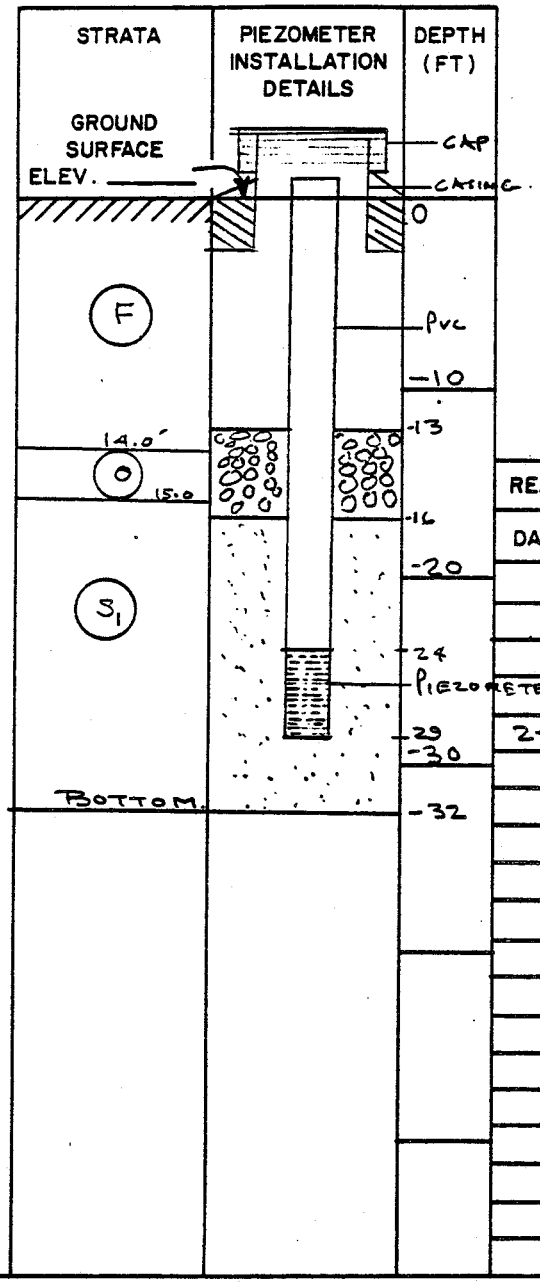
PIEZOMETER RECORD

PROJECT CEDARCREEK WPCP. EXPANSION PIEZOMETER NO. 320P

LOCATION WANTAGH, NY.

PIEZOMETER LOCATION _____ DATE OF INSTALLATION 2-15-

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE



PIEZOMETER TYPE PVC

INTAKE POINT

depth to bottom, ft = 29.0'
depth to top, ft = 24.0
length, ft = 5.0' = L
diameter, in = 1 1/4", ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = 14.10
diameter, in = 1 1/4", ft = _____ = 2r

READING TIME		DEPTH - RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
COULD NOT FILL UP THE PIEZOMETER				
2-19	1320	11.5'	+2.1'	

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. 13.60

PIEZOMETER NO. 320P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

BORING NO. B-321

SURFACE ELEV. +13.8

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0800	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand(SP) No sample taken at 5.0'. Roller bitted to 10.0' to check for utilities.	F	5		5'-52', used mud.
	2D	10.0 12.0	10-26 23-20	Gray fine to medium sand (SP)		10 14		
THURSDAY, 2-28-85 - SUNNY, 24°F	3D	15.0 17.0	1-1 2-2	Medium dark gray organic silt and peat (OH & Pt)	O	15 17		Note: Boring was relocated twice because of obstruct (Underground utility)
	4D	20.0 22.0	6-4 20-21	Brown fine to medium sand, trace coarse sand (SP)		20		
	5D	25.0 27.0	5-9 12-8	Gray brown fine to medum sand, trace coarse sand (SP)		25		
	6D	30.0 32.0	4-5 8-9	Gray brown fine to coarse sand (SP)	S_1	30		
	7D	35.0 37.0	4-7 10-9	Gray brown fine to coarse sand (SP)		35		
	8D	40.0 42.0	5-6 9-9	Gray brown fine to medium sand (SP)		40		
	9D	45.0 47.0	5-9 10-14	Gray fine to coarse sand (SP)		45 49		
1130	10D	50.0 52.0	3-4 7-8	Stiff gray silty clay, trace fine sand (CL)	C	50 52		End of boring @ 52.0'.

BORING NO. B-321

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-321

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +13.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'

DIAMETER, INCHES , DEPTH FROM TO

☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8

TYPE OF DRILLING MUD REVERT

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES

SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-28-85	1130	52.0'	5.0'	10.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON

STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.

INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.

FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES

___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER MIKE IMPARATO HELPERS JOE IMPARATO

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-28-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

BORING No. B-321

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

BORING NO. B-322

SURFACE ELEV. +15.

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1045	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Brown silty fine to coarse sand, trace gravel (SM)		5		
	2D	5.0 7.0	7-7 10-13	Gray fine to medium sand, trace silt (SP)	F	10		5'-52', use mud.
	3D	10.0 12.0	5-7 9-4	Gray fine to medium sand (SP)		15		
	4D	15.0 17.0	1-1 1-1	Medium dark gray organic silt and peat (OH & Pt)	O	18		
WEDNESDAY, 2-27-85	5D	20.0 22.0	5-4 5-3	Gray brown fine to medium sand, some silt, trace coarse sand (SM)	S&O	20 23		
	6D	25.0 27.0	6-6 8-10	Gray fine to coarse sand, trace gravel, silt (SP)		25 30		
	7D	30.0 32.0	7-13 12-8	Gray fine to coarse sand, trace silt (SP)				
	8D	35.0 37.0	5-6 7-11	Gray fine to coarse sand, trace silt (SP)	S_1	35 40		
	9D	40.0 42.0	5-6 8-6	Gray fine to medium sand, trace coarse sand (SP)		45		
	10D	45.0 47.0	7-10 15-9	Do 9D (SP)		49.5		
1230	11D	50.0 52.0	6-9 11-9	Stiff gray silty clay (CL)	C	50 52		End of boring @ 52.0'.

BORING NO. B-322

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-322
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +15.4 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4 - 2 7/8
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-27-85	1230	52.0	5.0	7.5'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JOE IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-27-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-322

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-323

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +14.5

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1030	1D	0.0 2.0	4-7 7-9	Top: Topsoil Bot: Gray fine to medium sand(SP)				
	2D	5.0 7.0	4-3 5-7	Gray fine to medium sand, trace gravel (SP)	F	5		5'-52', use mud.
	3D	10.0 12.0	2-5 15-21	Gray fine to medium sand, trace shells (SP)		10		
	4D	15.0 17.0	10-6 3-5	Top: Do 3D (SP) Bot: Medium gray organic silt and peat (OH & Pt)	0	15 16 18		
	5D	20.0 22.0	7-7 8-7	Gray fine to coarse sand; trace silt (SP-SM)		20		
	6D	25.0 27.0	7-12 20-25	Gray fine to medium sand (SP)		25		
	7D	30.0 32.0	9-14 17-21	Gray fine to medium sand, trace coarse sand (SP)		30		
	8D	35.0 37.0	6-7 9-14	Brown fine to medium sand (SP)	S_1	35		
	9D	40.0 42.0	6-7 9-9	Brown fine to medium sand, trace coarse sand (SP)		40		
	10D	45.0 47.0	3-4 15-17	Gray fine to medium sand, trace gravel (SP)		45		
1330	11D	50.0 52.0	14-20 21-30	Gray fine to medium sand (SP)		50 52		End of boring @ 52.0'.

TUESDAY, 2-26-85 - CLOUDY 44°F-48°F

BORING NO. B-323

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-323

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +14.5 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0' TO 5.0'

DIAMETER, INCHES , DEPTH FROM TO

☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4

TYPE OF DRILLING MUD REVERT

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES

SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-26-85	1330	52.0'	5.0'	7.0	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON

STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.

INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.

FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES

DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER SAL DAMICO HELPERS JOHN IMPARATO

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-26-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-32

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 2

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-324

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +14.

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1330	1D	0.0 2.0	PUSH	Topsoil				
	2D	5.0 7.0	9-9 11-12	Brown fine to medium sand, trace silt, gravel (SP-SM)		5		5'-52', use mud.
	3D	10.0 12.0	5-7 8-8	Gray fine to medium sand, trace silt (SP)	F	10		
TUESDAY, 2-26-85 - OCC.DRIZZLE, 45°F	4D	15.0 17.0	11-10 7-3	Do 3D (SP)		15		
						17.5		
1515	5D	20.0 22.0	1-1 1-1	Medium dark gray organic silt, some peat (OH & Pt)	O	20		
0730	6D	25.0 27.0	1-1 2-2	Do 5D (OH & Pt)		25		
						27		
	7D	30.0 32.0	15-14 16-16	Gray brown fine to medium sand, some organic silt (SM)	S&O	30		
WEDNESDAY, 2-27-85 CLOUDY, 45°F	8D	35.0 37.0	5-6 10-9	Do 7D (SM)		35		
	9D	40.0 42.0	7-8 11-14	Do 7D (SM)		40		
						42		
	10D	45.0 47.0	14-14 14-16	Gray fine to coarse sand, some silt (SM)	S_1	45		
	11D	50.0 52.0	15-13 19-21	Gray fine to medium sand, trace silt (SP-SM)		50		End of borin @ 52.0'
1000						52		

BORING NO. B-324

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-324
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +14.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0 TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-27-85	1000	52.0'	5.0'	4.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0 . NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER MIKE IMPARATO HELPERS JOE IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-27-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-324

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION — BORING NO. B-325P

PROJECT LOCATION WANTAGH, NEW YORK — RES. ENGR. BEN MUKHERJEE — SURFACE ELEV. +14.5

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
0730	1D	0.0 2.0	PUSH	Top: Topsoil Bot: Gray fine to medium sand (SP)			10 11 12 12	
	2D	5.0 7.0	4-4 5-5	Do 1D Bottom (SP)	F	5	13 9 10 11 12	
	3D	10.0 12.0	3-2 4-4	Do 1D Bottom (SP)		10	12 8 10 18 24	
	4D	15.0 17.0	1-1 1-1	Medium gray peat (Pt)	O	15 17	26 7 8	
	5D	20.0 22.0	3-6 11-13	Top: Gray silty medium to fine sand, trace clay (SM) Bot: Brown fine to medium sand, trace silt (SP-SM)	S&O	20 21	10 23 24 23 27	
	6D	25.0 27.0	6-8 10-13	Gray brown medium to fine sand, trace silt (SP)	S1	25 30	30 70 78 24 30 41 54 63	
	7D	30.0 32.0	5-7 7-6	Do 6D, trace gravel (SP)		35	42 41 59 48 56	
1030	8D	35.0 37.0	4-6 6-7	Gray fine to medium sand, trace coarse sand (SP)		37 40 45 50		End of borin @ 37.0'.

FRIDAY, 2-22-85 - CLOUDY, 40°F

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-325P

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +14.5 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 3.0 , DEPTH FROM 0.0' TO 35.0'

DIAMETER, INCHES , DEPTH FROM TO

☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 2 1/4"

TYPE OF DRILLING MUD

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24

SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-22-85	1400			12.5'	PIEZOMETER READING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 3 OF 3

STANDPIPE: TYPE PVC , ID 1.25" , LENGTH 28.8' , TOP ELEV. +15.0

INTAKE POINT: TYPE PVC SLOTTED , OD 1.5" , LENGTH 5.0' , TIP ELEV. -18.8

FILTER: MATERIAL SAND , OD 3.0" , LENGTH 16.0' , BOT. ELEV. -22.5

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 37.0 . NO. OF 2" SHELBY TUBE SAMPLES

___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER MIKE IMPARATO HELPERS JAKE HARRIS, JR.

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-22-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-325

SHEET 3 OF 3
FILE NO. 6102
SUBCODE

MUESER, RUTLEDGE, JOHNSTON & DESIMONE

CONSULTING ENGINEERS

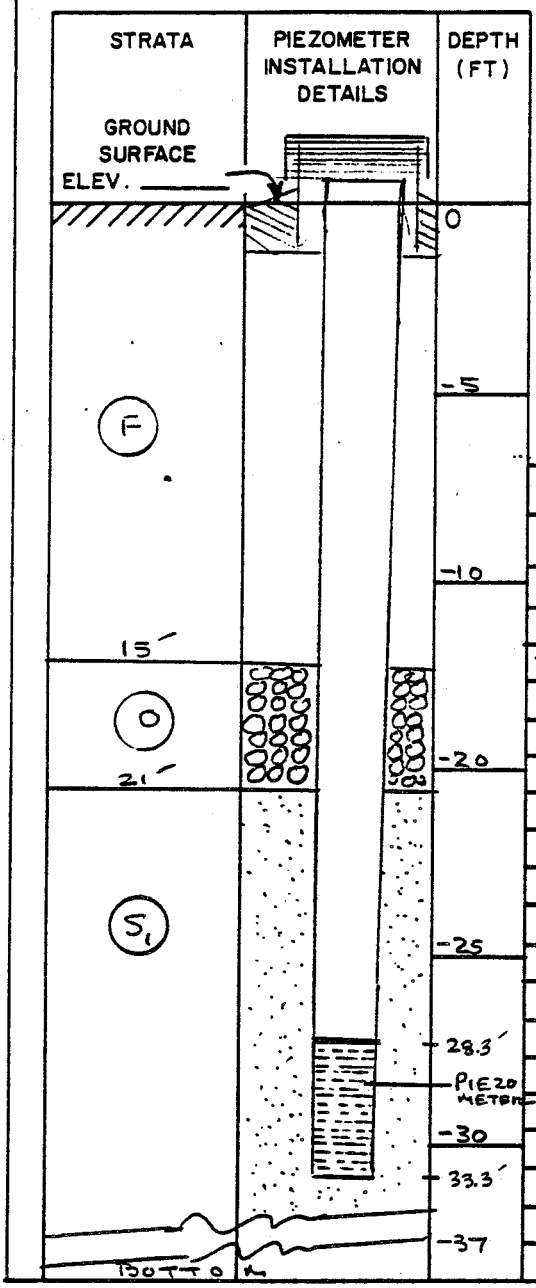
PIEZOMETER RECORD

PROJECT CEDARCREEK WPCP EXPANSION. PIEZOMETER NO. 325 P

LOCATION WANTAGH, N.Y.

PIEZOMETER LOCATION _____ DATE OF INSTALLATION 2-22-

☐ SEE SKETCH ON BACK RES. ENG. B. MUKHERJEE



PIEZOMETER TYPE PVC (SLOTTED)

INTAKE POINT

depth to bottom, ft = 33.3

depth to top, ft = 28.3

length, ft = 5.0 = L

diameter, in = 1¼, ft = _____ = 2R

STANDPIPE/RISER

elevation of rim, ft = +15.0

diameter, in = 1¼, ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
2-22	1400	12½" (G.S.)	+2.0	
	MIN			
2-22	0	0'-0"		
	1	-11½"		
	2	–		
	3	–		
	4	–		
	5	12½"		

Sand Bentonite

Gravel Grout

GROUND SURFACE ELEV. +14.50

PIEZOMETER NO. 325 P

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3

FILE NO. 6102

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-326

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +14.7

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1300	1D	0.0 2.0	PUSHED	Top: Topsoil Bot: Gray fine to medium sand(SP)				
	2D	5.0 7.0	12-17 24-16	Gray fine to medium sand (SP)		5		5'-79.5', u mud.
	3D	10.0 12.0	7-8 13-10	Do 2D (SP)	F	10		
	4D	15.0 17.0	10-12 17-18	Do 2D (SP)		15		
						18		
	5D	20.0 22.0	1-1 1-2	Medium gray organic silt, trace peat (OH)	O	20		
						23		
	6D	25.0 27.0	2-4 5-9	Gray fine to medium sand, trace silt (SP-SM)		25		
	7D	30.0 32.0	7-6 10-13	Gray fine to medium sand, trace silt (SP)	S_1	30		
1530	8D	35.0 37.0	6-7 8-8	Do 7D, trace gravel (SP)		35		
0800								
	9D	40.0 42.0	6-7 7-8	Gray fine to coarse sand, trace gravel, silt (SP)		40		
	10D	45.0 47.0	6-8 7-9	Gray fine to medium sand (SP)		45		
						49.5		
	11D	50.0 52.0	11-7 6-5	Stiff gray silty clay, trace fine sand (CL)	C	50		

MONDAY, 2-25-85 - PARTLY SUNNY, 48°F

TUESDAY, 2-26-85 - SHOWERS

BORING NO. B-326

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-326

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +14

RES. ENGR. BEN MUKHERJEE

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
	12D	55.0 57.0	3-4 4-5	Do 11D (CL)		55		
	13D	60.0 62.0	4-4 6-9	Do 11D (CL)	C	60		
2-26-85	14D	65.0 67.0	4-4 10-10	Do 11D (CL)		65		
	15D	70.0 72.0	5-7 7-10	Gray silty fine to medium sand (SM)		70		
	16D	75.0 77.0	8-15 27-65	Gray fine to medium sand, some silt (SM)	S_2	75		
	17D	78.0 79.5	34-55 100	Gray medium to fine sand, trace silt (SP-SM)		79.5 80		End of bor @ 79.5'.
1200						85		
						90		
						95		
						100		

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-326

LOCATION WANTAGH, NEW YORK

BORING LOCATION

SURFACE ELEVATION +14.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER

TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER

☒ CASING UTILIZED: DIAMETER, INCHES 4.0, DEPTH FROM 0.0' TO 5.0'

DIAMETER, INCHES , DEPTH FROM TO

☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8

TYPE OF DRILLING MUD REVERT

☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES

TYPE AND SIZE OF:

DRILL RODS BW . D-SAMPLER 2" O.D. SPLIT SPOON

S-SAMPLER . U-SAMPLER

CORE BARREL . CORE BIT

CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES

SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-26-85	1145	79.5	5.0'	13.5'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON

STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.

INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.

FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 79.5. NO. OF 2" SHELBY TUBE SAMPLES

DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES

CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.

DRILLER MIKE IMPARATO HELPERS JOE IMPARATO

REMARKS

RESIDENT ENGINEER BEN MUKHERJEE DATE 2-26-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6102
BORING NO. B-327
SURFACE ELEV. +13.9

PROJECT CEDAR CREEK WPCP EXPANSION

PROJECT LOCATION WANTAGH, NEW YORK RES. ENGR.

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARK
1400 TUESDAY, 2-26-85 OCC DRIZZLE, 45°	1D	0.0 2.0	5-7 6-7	Top: Topsoil Bot: Brown fine to medium sand, trace silt, gravel (SP-SM)		5		
	2D	5.0 7.0	5-10 12-18	Gray fine to medum sand (SP)	F	10		5'-80', used mud.
	3D	10.0 12.0	4-15 21-27	Do 2D (SP)		14 15		
	4D	15.0 17.0	4-8 6-5	Top: Medium gray organic silt (OH) Bot: Gray shells				
	5D	20.0 22.0	2-4 4-5	Gray-white shells, some fine sand	O	20		
1515 1700								
	6D	25.0 27.0	2-3 3-4	Medium dark gray organic silt and peat (OH & Pt)		25 29		
WEDNESDAY, 2-27-85 PARTLY SUNNY 45°	7D	30.0 32.0	10-12 12-15	Brown fine to medium sand, trace silt, gravel (SP-SM)		30		
	8D	35.0 37.0	12-18 13-13	Gray fine to coarse sand, trace silt, shells (SP-SM)		35		
	9D	40.0 42.0	14-11 10-12	Gray brown fine to medium sand, trace silt (SP-SM)	S_1	40		
	10D	45.0 47.0	10-10 12-19	Gray fine to medium sand (SP)		45		
	11D	50.0 52.0	10-6 8-9	Stiff gray silty clay, some fine sand layers (CL)	C	49.5 50		

BORING NO. B-327

MUESER, RUTLEDGE, JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF 3

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102

BORING NO. B-327

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. BEN. MUKHERJEE

SURFACE ELEV. +13.9

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
WEDNESDAY, 2-27-85 PARTLY SUNNY, 45°	12D	55.0 57.0	10-12 9-8	Do 11D (CL)		55		
	13D	60.0 62.0	4-14 19-21	Hard gray silty clay, trace fine sand (CL)	C	60		
	14D	65.0 67.0	6-8 9-10	Stiff gray silty clay, trace fine sand (CL)		65		
	15D	70.0 72.0	11-15 17-25	Gray fine sand, some silt (SM)		68 70		
	16D	75.0 77.0	20-26 34-44	Gray fine sand, some silty clay (SM & CL)	S_2	75		
	17D	78.0 80.0	11-22 29-33	Do 16D (SM & CL)		80		End of bor @ 80.0'.
1200						85		
						90		
						95		
						100		

BORING NO. B-327

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-327
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +13.9 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 4.0 , DEPTH FROM 0.0 TO 5.0'
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 3 1/4, 2 7/8
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-27-85	1200	80.0'	5.0'	8.0'	MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 80.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER SAL DAMICO HELPERS JOHN IMPARATO
REMARKS
RESIDENT ENGINEER BEN MUKHERJEE DATE 2-27-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-327

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET NO. ____ OF ____
FILE 6102 A
MADE BY FA DATE 7-18-85
CHECKED BY ____ DATE ____

FOR CEDAR CREEK WPCP

SUBJECT INFLUENT SCREENING CHAMBER

SUMMARY OF WATER CONTENTS

BORING NO.	SAMPLE NO.	WATER CONTENT %	STRATUM
B-328 UP	13D	34	C
	16D	31	C
	19D	27	SZ
B-329 U	10D	29	C
	12D	33	C
	14D	35	C

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 5
FILE NO. 6102 A
BORING NO. B-328UP
SURFACE ELEV. +17.7

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. FRANK ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0630	1D	0.0 2.0	6-10 12-16	Gray fine to medium sand, trace silt, coarse sand, gravel (SP)				2' to 117' used mud.
	2D	3.0 5.0	10-27 24-100	Do 1D (SP)		5		
	3D	7.0 8.5	21-53 100	Do 1D, trace shells (SP)		10		
	4D	10.0 12.0	11-11 15-25	Gray fine to medium sand, trace silt, shells (SP)		15		
	5D	15.0 17.0	10-23 18-30	Gray fine to medium sand, trace silt (SP)	F	20		
	6D	20.0 21.5	15-55 100	Gray fine to medium sand, trace silt pockets, shells (SP-SM)		25		
	7D	25.0 27.0	13-22 34-22	Do 6D (SP-SM)		27.0		
	8D	30.0 32.0	12-22 21-33	Do 6D, trace coarse sand (SP-SM)		30		
	9D	35.0 37.0	2-2 3-4	Gray fine to medium sand, trace silt, coarse sand, shells (SP-SM)		35		
	10D	40.0 42.0	6-8 14-32	Gray brown fine to coarse sand, trace silt, wood (SP-SM)	S1	40		Piece of wood & gravel in spoon.
	11D	45.0 46.5	15-56 100	Do 10D (SP-SM)		45		
	12D	50.0 52.0	12-22 25-23	Gray brown fine to medium sand, trace silt, coarse sand (SP)		50		

THURSDAY, 6-13 - - PARTLY SUNNY

BORING NO. B-328UP

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 2 OF 5

PROJECT CEDAR CREEK WPCP EXPANSION

FILE NO. 6102 A

BORING NO. B-328UP

PROJECT LOCATION WANTAGH, NEW YORK

SURFACE ELEV. +17.7

RES. ENGR. FRANK ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
					S1			
0530						54.0		
0700						55		
	13D	55.0 57.0	5-6 8-10	Stiff gray silty clay, trace fine sand (CL)				
	14U	58.0 60.0	P= 16 R=13.5	Stiff gray silty clay, trace fine sand layers (CL)		60		Osterberg sampler
					C			
	15U	62.0 64.0	P=16 R=14.5	Do 14U (CL)				Osterberg sampler
						65		
	16D	64.0 66.0	12-20 30-46	Do 14U (CL)				
	17U	68.0 70.3	P=27 R=27	Do 14U varved with fine sand lyrs & seams (CL)				Pitcher sampler
						70		
FRIDAY 6-14-85 - CLEAR, SUNNY	18D	70.3 72.3	9-9 24-30	Gray medium to fine sand, trace silt (SP-SM)		70.3		
						75		
	19D	75.0 77.0	6-11 22-33	Stiff gray silty clay, trace fine sand seams (CL)				
						80		
	20U	80.0 82.0	P=24 R=24	Top:Gr silty f-m sand layered w/ stiff gray clay (SM&CL)	S2			Pitcher sampler
	21D	82.0 84.0	23-22 51-53	Bot:Gray fine sand, tr silt(SP) Gray f-m sand, trace silty clay pockets (SP-SM)				
						85		
	22U	90.0 92.0	P-24 R-20	Gray medium to fine sand, trace silt & gravel layers (SP-SM)		90		Pitcher sampler
	23D	92.0 94.0	16-33 44-56	Gray silty fine sand (SM)				
						95		
	24D	95.0 97.0	12-38 37-43	Gray medium to fine sand, trace silt (SP-SM)				
						100		
	25D	100.0 100.9	25-105/5	Gray fine to medium sand, trace silt (SP-SM)				

BORING NO. B-328UP

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 3 OF 5
FILE NO. 6102A
BORING NO. B-328UP
SURFACE ELEV. +17.7

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. FRANK ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
FRIDAY, 6-14-85 - SUNNY, CLEAR	26D	105.0 107.0	30-76 100/5	Gray fine to medium sand, trace silt pockets (SP-SM)		105		
	27D	110.0 112.0	12-22 21-27	Gray fine to medium sand, trace silt (SP)	S2	110		
	28D	115.0 117.0	4-6 7-7	Gray fine sand, some silt (SM)		115 117.0		End of boring at 117.0'.
'30								

BORING NO. B-328UP

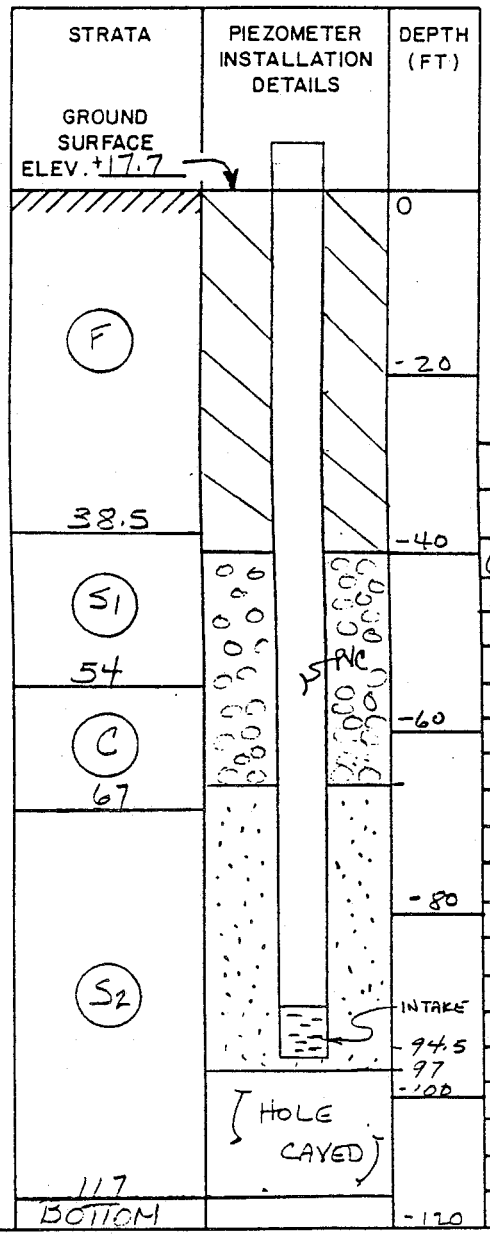
SHEET 4 OF 5
FILE NO. 6102 A
SUBCODE _____

MUESER, RUTLEDGE, JOHNSTON & DESIMONE
CONSULTING ENGINEERS

PIEZOMETER RECORD

PROJECT CEDAR CREEK WPCP EXPANSION — PIEZOMETER NO. B-328 UP
LOCATION WANTAGH, NEW YORK
PIEZOMETER LOCATION AS PER LOCATION PLAN — DATE OF INSTALLATION 6-17-85
☐ SEE SKETCH ON BACK — RES. ENG. FRANK ARLAND

PIEZOMETER TYPE PVC



INTAKE POINT
depth to bottom, ft = 94.5
depth to top, ft = 89.5
length, ft = 5.0 = L
diameter, in = 1 1/4, ft = _____ = 2R

STANDPIPE/RISER
elevation of rim, ft = +20.2
diameter, in = 1 1/4, ft = _____ = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
6-17	1037	12.9	+7.3	
6-17	1230	13.0	+7.2	
6-18	0710	12.9	+7.3	
6-19	1009	12.8	+7.4	

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. +17.7

PIEZOMETER NO. B-328UP

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT CEDAR CREEK WPCP EXPANSION BORING NO. B-328UP
LOCATION WANTAGH, NEW YORK
BORING LOCATION AS PER LOCATION PLAN
SURFACE ELEVATION +17.7 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4 3/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS MAYHEW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER OSTERBERG/PITCHER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE *MEASURED FROM TOP OF PIEZOMETER STANDPIPE.

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
6-13-85	1530	52.0'	-	10.0'	MUD LEVEL
6-14-85	0700	52.0'	-	14.5'	MUD LEVEL
6-17-85	0730	caved at 80.0'	-	12.2' *	RAIN OVERNIGHT
6-17-85	1037	94.5'	-	12.9' *	PIEZOMETER
6-17-85	1700	94.5'	-	13.0' *	PIEZOMETER
6-18-85	0710	94.5'	-	12.9' *	PIEZOMETER

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SHEET 5 OF 5
STANDPIPE: TYPE PVC , ID 1¼" , LENGTH 92.0' , TOP ELEV. 20.2
INTAKE POINT: TYPE PVC-SLOTTED , OD 1 5/8" , LENGTH 5.0' , TIP ELEV. -76.8
FILTER: MATERIAL SAND , OD 5" , LENGTH 30.5' , BOT. ELEV. -79.3

PAY QUANTITIES
2½" DIA. DRY SAMPLE BORING, LIN. FT. 25.0 . NO. OF 2" SHELBY TUBE SAMPLES
3½" DIA. U-SAMPLE BORING, LIN. FT. 92.0 . NO. OF 3" UNDISTURBED SAMPLES 5
CORE DRILLING IN ROCK, LIN. FT. . OTHER PIEZOMETER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER TONY TIRRO HELPERS JIM BARGA
REMARKS
RESIDENT ENGINEER FRANK ARLAND DATE 6-13-85

NOTES:
1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-328UP

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 5
FILE NO. 6102A
BORING NO. B-329U
SURFACE ELEV. +14.6

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. FRANK ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1115	1D	0.0 2.0	3-5 10-14	Top: Medium brown silt, some fine to coarse sand, trace roots (ML)		6"		Boring moved 6' north.
	2D	3.0 5.0	7-12 7-10	Bot: Tan f-m sand, tr c sand, silt pockets, shells (SP)		5		2' to 65', used mud (revert).
				Gray fine to medium sand, trace coarse sand, silt, shells (SP)				
	3D	7.0 9.0	3-4 7-10	Do 2D (SP)		10		
	4D	10.0 12.0	2-4 4-4	Do 2D (SP)		15		
	5D	15.0 17.0	1-1 1-1	Do 2D (SP)	F	20		
	6D	20.0 22.0	1-0 1-1	Do 2D (SP)		23.0		
	NR	25.0 27.0	1-1 1-1	Do 2D (SP)		25		Fine sand in wash.
	7D	30.0 32.0	8-18 21-21	Do 2D (SP)		30		
	8D	35.0 37.0	1-1 2-1	Gray fine to coarse sand, trace silt, shells (SP)	S1	35		
	9D	40.0 42.0	6-7 9-15	Brown black fine to coarse sand, trace silt (SP-SM)		40		
	NR	45.0 45.9	36-100/5	NO RECOVERY		45		Sand & gravel in wash.
	10D	50.0 52.0	10-10 22-23	Stiff gray silty clay, trace fine sand (CL)	C	49.0 50		

MONDAY, 6-17-85 - PARTLY SUNNY

BORING NO. B-329U

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 2 OF 5

FILE NO. 6102A

PROJECT CEDAR CREEK WPCP EXPANSION

BORING NO. B-329U

SURFACE ELEV. +14.6

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. FRANK ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
MONDAY, 6-17-85 PARTLY SUNNY	11U	53.0 55.0	P=24 R=23	Stiff gray silty clay, trace fine sand (CL)		55		
	12D	55.0 57.0	7-12 26-36	Do 11U (CL)				
	13U	58.0 60.0	P-24 R=23	Do 11U (CL)	C	60		
	14D	60.0 62.0	13-19 21-22	Do 11U (CL)				
	15U	63.0 65.0	P=24 R=22	Top: Stiff gray silty clay, some m-f sand (CL)		64.0		
530 300				Bot: Gray fine sand, some silt (SM)		65		
	16D	65.0 67.0	9-11 13-16	Gray silty fine sand, tr clay (SM)				65' to 151.3' use mud (quick gel).
	17D	70.0 72.0	23-34 33-36	Gray fine to medium sand, trace silt (SP-SM)	S2	70		
	18D	75.0 77.0	10-13 19-23	Gray silty fine sand (SM)		75		
TUESDAY, 6-18-85 - OVERCAST, RAIN	19D	80.0 82.0	11-14 20-24	Gray silty fine sand, trace gravel (SM)		80		
	20D	85.0 86.0	35-100	Gray fine to medium sand, trace silt pockets (SP-SM)		85		
	21D	90.0 92.0	21-48 53-43	Gray fine to medium sand, some silt (SM)		90		
	22D	95.0 95.8	78-100/3	Gray medium to fine sand, trace silt (SP)		95		
	23D	100.0 101.3	30-60 100/4	Gray fine to medium sand, trace silt (SP)		100		

BORING NO. B-329U

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 3 OF 5
FILE NO. 6102A
BORING NO. B-329U
SURFACE ELEV. +14.6

PROJECT CEDAR CREEK WPCP EXPANSION
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. FRANK ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
						105		
	24D	105.0 105.8	63-100/3	Gray fine to medium sand, some silt pockets (SM)				
	25U	110.0 112.0	P=24 R=12	Gray fine sand, some silt (SM)		110		Pitcher sampler
					S_2	115		
	26D	115.0 117.0	15-24 38-60	Gray fine sand, trace silt (SP-SM)				
						120		
	27D	120.0 121.5	22-67 100	Gray fine to medium sand, trace silt (SP)				
						125		
	28D	125.0 126.8	7-22 55-100/4	Gray fine to medium sand, trace silt (SP)				Pieces of wood in spoon.
						130		
	29D	130.0 130.8	30-100/4	Gray fine to medium sand, some silt (SM)				
						135		
	30D	135.0 135.3	100/3	Gray fine to medium sand, trace silt pockets, shells (SP)				
						140		
	31D	145.0 145.7	90-100/2	Gray fine to medium sand, trace silt, shells (SP)				
						145		
1730	32D	150.0 151.3	42-75 100/3	Gray fine to medium sand, some silt layers (SM)				End of boring at 151.3'.
						150		
						151.3		

TUESDAY, 6-18-85 - OVERCAST, RAIN

BORING NO. B-329U

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 4 of 4
File No. 6102A

PROJECT CEDAR CREEK WPCP EXPANSION — BORING NO. B-329U
LOCATION WANTAGH, NEW YORK
BORING LOCATION AS PER LOCATION PLAN
SURFACE ELEVATION +14.6 — DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4 3/4"
TYPE OF DRILLING MUD REVERT/QUICK-GEL
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES ____
TYPE AND SIZE OF:
DRILL RODS MAYHEW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER ____ . U-SAMPLER OSTERBERG/PITCHER
CORE BARREL ____ . CORE BIT ____
CASING HAMMER: WEIGHT, POUNDS ____, AVERAGE FALL, INCHES ____
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
6-18-85	0700	65.0'	-	12.0'	RAIN OVERNIGHT (MUD LEVEL)
6-19-85	0730	94.0'	-	9.0'	HOLE CAVED OVERNIGHT (MUD LEVEL)

*ote reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON ____
STANDPIPE: TYPE ____, ID ____, LENGTH ____, TOP ELEV. ____
INTAKE POINT: TYPE ____, OD ____, LENGTH ____, TIP ELEV. ____
FILTER: MATERIAL ____, OD ____, LENGTH ____, BOT. ELEV. ____

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 39.3. NO. OF 2" SHELBY TUBE SAMPLES ____
5" DIA. U-SAMPLE BORING, LIN. FT. 112.0. NO. OF 3" UNDISTURBED SAMPLES 4
CORE DRILLING IN ROCK, LIN. FT. ____. OTHER ____

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER TONY TIRRO HELPERS JIM BARGA
REMARKS ____
RESIDENT ENGINEER FRANK ARLAND DATE 6-17-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-329U

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6243
BORING NO. 1

PROJECT CEDAR CREEK WPCP
LOCATION WANTAGH, NEW YORK
RES. ENGR. FRANIC ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0800	1D	0.0	1-1	Gray m-f sand, tr gvl,				
		2.0	1-3	silt pkts (SP)				
							A	
	2D	5.0	1-2	Gray m-f sand, tr coarse		5	W	
		7.0	2-3	sand, silt, shells (SP)				
							G	
					F			
							E	
10-29-85	3D	10.0	10-19	DO 2D (SP)		10		
		12.0	29-50				R	
	4D	15.0	22-48	DO 2D (SP)		15		
		16.5	92					
	5D	20.0	40-120	Gray brown m-f sand, tr coarse		20		
		21.0		sand, silt (SP-SM)				
	6D	25.0	16-53	Gray c-f sand, tr gvl, silt		25		
		27.0	48-50	shells (SP)	S1			
	7D	30.0	4-15	DO 6D (SP)		30		
		32.0	24-25					
	8D	35.0	11-17	DO 6D (SP)		35		
		37.0	23-26					
1000								End of boring @ 37'
						40		
						45		

FORM No. B-1

BORING NO. 1
SURFACE ELEV. +12

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 6243.

PROJECT CEDAR CREEK WPCP BORING NO. 1
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION + 12 ± DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☒ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☒ AUGER UTILIZED: TYPE AND DIAMETER, INCHES CONTINUOUS FLIGHT - 3" O.D.
TYPE AND SIZE OF:
DRILL RODS A . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
10-29	1000	37'		14.5'	AUGERS IN BORE HOLE
	1030	37'		14.0'	OPEN HOLE

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 37. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR SOIL MECHANICS
DRILLER CHARLES GAMBEL HELPERS SHAWN KENNEDY GLEN COLEMAN
REMARKS GROUND SURFACE ELEVATIONS ARE ESTIMATED VALUES
RESIDENT ENGINEER FRANK ARLAND DATE 10-29-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. 1

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6243
BORING NO. 2

PROJECT CEDAR CREEK WPCP
LOCATION WANTAGH, NEW YORK RES. ENGR. FRANK ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1100	1D	0.0	1-1	Gray M-F sand, tr wood,				
		2.0	3-4	shells, silt pkts (SP)				
	2D	5.0	10-5	Gray M-F sand, tr shells,		5	A	
		7.0	6-8	silt (SP)				
							U	
					(F)			
							G	
	3D	10.0	6-12	Do 2D (SP)		10		
		12.0	18-22				E	
							R	
	4D	15.0	15-22	Do 2D, tr silt pkts (SP)		15		
		17.0	27-38					
	5D	20.0	13-29	Do 2D (SP)		20		
		21.5	76					
	6D	25.0	39-79	Gray brown M-F sand, tr		25		
		26.5	100	coarse sand, silt (SP-SM)				
					(S1)			
	7D	30.0	19-23	Do 6D, tr grvl (SP-SM)		30		
		32.0	23-25					
	8D	35.0	11-18	Gray M-F sand, tr coarse		35		
		37.0	17-21	sand, silt (SP)				
	9D	40.0	10-15	Gray C-F sand, tr grvl, silt		40		
		42.0	20-30	Shells (SP)				
1400								End of boring @ 42'

BORING NO. 2
SURFACE ELEV. +18 ±

FORM No. B-1

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 6243

PROJECT CEDAR CREEK WPCP BORING NO. 2
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION +18 ± DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☒ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☒ AUGER UTILIZED: TYPE AND DIAMETER, INCHES CONTINUOUS FLIGHT 3" O.D.
TYPE AND SIZE OF:
DRILL RODS A . D-SAMPLER 1" OD. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
10-29	1350	42'		18'	AUGERS IN BORE HOLE

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 42'. NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR SOIL MECHANICS
DRILLER CHARLES GANABEL HELPERS SHAWN KENNEDY, GLEN COLEMAN
REMARKS GROUND SURFACE ELEVATIONS ARE ESTIMATED VALUES.
RESIDENT ENGINEER FRANK ARLAND DATE 10-29-85

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. 2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6243
BORING NO. 3

PROJECT CEDAR CREEK WPCP
LOCATION MANTAGH, NEW YORK
RES. ENGR. FRANK ARLAND

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0730	1D	0.0	2-4	Gray m-f sand, tr org. silt,				
		2.0	7-9	gvl (SP-SM)				
							A	
	2D	5.0	7-15	Gray m-f sand, tr coarse		5		
		7.0	18-27	sand, silt, shells (SP)	F		V	
							G	
	3D	10.0	7-14	DO 2D (SP)		10	E	
		12.0	20-29					
							R	
	4D	15.0	18-23	DO 2D (SP)		15		
		17.0	28-30					
	5D	20.0	20-35	DO 2D (SP)		20		
		21.5	76					
	6D	25.0	35-120	Gray brown m-f sand, tr		25		
		26.0		gvl, coarse sand, silt (SP-SM)				
					S1			
	7D	30.0	6-25	Gray brown c-f sand, tr gvl,		30		
		32.0	45-46	silt (SP-SM)				
	8D	35.0	16-24	Gray c-f sand, tr gvl, silt		35		
		37.0	24-27	(SP)				
1000								End of boring @ 37'
						40		

BORING NO. 3
SURFACE ELEV. +18 ±

FORM No. B-1

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 6243

PROJECT CEDAR CREEK WPCP BORING NO. 3
LOCATION WANTAGH, NEW YORK
BORING LOCATION
SURFACE ELEVATION ± 18 ± DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☒ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES ____
TYPE OF DRILLING MUD ____
☒ AUGER UTILIZED: TYPE AND DIAMETER, INCHES CONTINUOUS FLIGHT - 3" O.D.
TYPE AND SIZE OF:
DRILL RODS A . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER ____ . U-SAMPLER ____
CORE BARREL ____ . CORE BIT ____
CASING HAMMER: WEIGHT, POUNDS ____, AVERAGE FALL, INCHES ____
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
10-30	1000	37'		19.5'	AUGERS IN BARE HOLE

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON ____
STANDPIPE: TYPE ____, ID ____, LENGTH ____, TOP ELEV. ____
INTAKE POINT: TYPE ____, OD ____, LENGTH ____, TIP ELEV. ____
FILTER: MATERIAL ____, OD ____, LENGTH ____, BOT. ELEV. ____

PAY QUANTITIES
2½" DIA. DRY SAMPLE BORING, LIN. FT. 37'. NO. OF 2" SHELBY TUBE SAMPLES ____
____ DIA. U-SAMPLE BORING, LIN. FT. ____. NO. OF 3" UNDISTURBED SAMPLES ____
CORE DRILLING IN ROCK, LIN. FT. ____. OTHER ____

BORING CONTRACTOR SOIL MECHANICS
DRILLER CHARLES GAMBEL HELPERS GLEN COLEMAN
REMARKS GROUND SURFACE ELEVATIONS ARE ESTIMATED VALUES
RESIDENT ENGINEER FRANK ARLAND DATE 10-30-85

NOTES:
1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

BORING No. 3

FORM NO. B-2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 6
FILE NO. 6400
BORING NO. B-401P
SURFACE ELEV. +14.95

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1400	1D	0.0	6-15	Brown silty fine sand, some gravel				
		2.0	16-19	vegetation (SM)				
	2D	2.0	15-25	Brown tan f-m sand, trace silt,				
		4.0	32-46	shell, gravel (SP-SM)		5		
	3D	5.0	14-19	Brown tan m-f sand, trace silt,				
		7.0	33-44	gravel (SP)				
	4D	8.0	24-23	Tan medium to fine sand, trace	F			
		10.0	23-22	silt (SP)		10		
	5D	10.0	11-28	Tan medium to fine sand, trace				
		12.0	38-46	coarse sand, shells, gravel (SP)				
						15		
	6D	15.0	11-12	Gray medium to fine sand, trace				Strong organic odors in sample 6D, 7D, 8D, 9D 10D, 11D& 12D.
		17.0	15-12	shells (SP)		18		
	7D	19.0	1-1	Soft gray organic clayey silt,	O	20		
		21.0	2-2	trace peat (OH)				
						23.5		
	8D	25.0	9-13	Gray coarse to fine sand, trace		25		
		27.0	12-13	silt (SP)				
						30		
	9D	30.0	9-9	Gray coarse to fine sand, trace				
		32.0	9-12	silt (SP)	S1			
						35		
	10D	35.0	8-11	Gray coarse to fine sand, trace				
		37.0	10-10	silt, gravel (SP)				
						40		
	11D	40.0	6-12	Do 10D				
1530		42.0	12-13	(SP)				
0800								
						45		
	12D	45.0	18-28	Do 10D				
		47.0	25-23	(SP)				
						48.5		
	13D	50.0	6-7	Stiff gray silty clay, trace fine	C	50		
		52.0	8-10	sand partings (CL)				

MONDAY, JUNE 2, 1986 - WINDY, PARTLY CLOUDY, 70°F

TUESDAY, JUNE 3, 1986 - SUNNY, 70°F

BORING NO. B-401P

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 2 OF 6

FILE NO. 6400

PROJECT POWER GENERATING BUILDING, CEDAR CREEK, WPCP

BORING NO. B-401P

SURFACE ELEV. +14.95

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
TUESDAY, JUNE 3, 1986 (CONT'D)								
	14D	55.0 57.0	6-7 16-18	DO 13D (CL)	C	55		
	15D	60.0 62.0	7-9 14-18	Do 13D (CL)		60		
0900						62		End of boring at 62.0'.
						65		
						70		
						75		
						80		
						85		
						90		
						95		
						100		

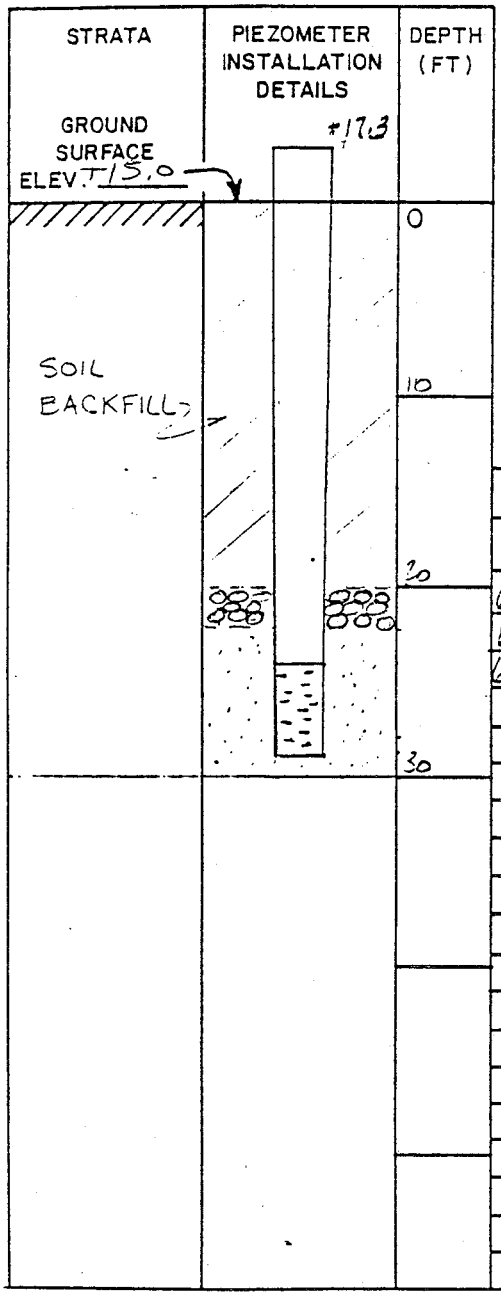
BORING NO. B-401P

MUESER RUTLEDGE CONSULTING ENGINEERS

PIEZOMETER RECORD

PROJECT CEDAR CREEK WPCP — PIEZOMETER NO. B-401P
LOCATION WANTAGH NY
PIEZOMETER LOCATION 5' EAST OF 401 — DATE OF INSTALLATION 6-3-86
☐ SEE SKETCH ON BACK — RES. ENG. G.C. BRAUN

PIEZOMETER TYPE 1½" OD PVC



INTAKE POINT

depth to bottom, ft = 30
depth to top, ft = 22
length, ft = 8 = L
diameter, in = 4¾, ft = 0.4 = 2R

STANDPIPE/RISER

elevation of rim, ft = +17.3
diameter, in = 1½, ft = 0.125 = 2r

READING TIME		DEPTH - RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
6-3-86	1600	17.3'	0	
6-4-86	0800	18.1'	-0.8	
6-14-86	1200	19.6'	-2.3	

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. +15.0

PIEZOMETER NO. B-401P

SHEET 4 OF 6

MUESER RUTLEDGE CONSULTING ENGINEERS

FILE NO. 6400

SUBCODE

VARIABLE HEAD PERMEABILITY TEST

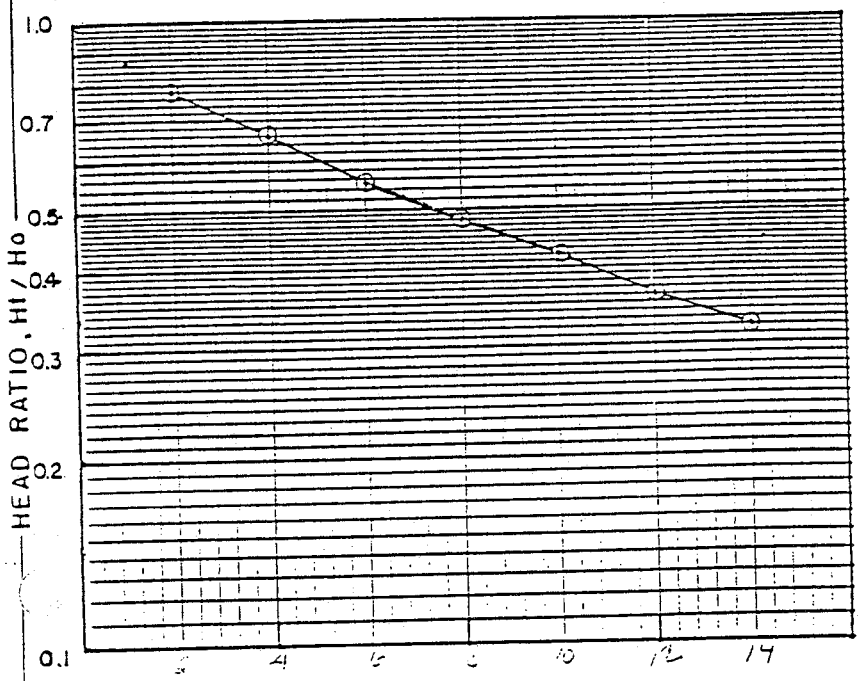
☐ BOREHOLE OR ☑ PIEZOMETER NO. 401P

TEST NO. 1

PROJECT CEDAR CREEK — RES. ENG. G.C BRAUN

LOCATION WANTAGH NEW YORK — CALC. BY GCB DATE

PIEZOMETER LOCATION 5' EAST OF 401 — CH'KD BY ___ DATE



INTAKE POINT

depth to bottom, ft = 30

depth to top, ft = 22

length, ft = 8 = L

diameter, in = 4 3/4, ft = 0.4 = 2R

STANDPIPE / RISER

diameter, in = 1 1/2, ft = 0.125 = 2r

depth of casing, ft = –

depth to which standpipe was bailed, ft = – = Z

READING TIME			TEST DEPTH-RIM TO WATER ft.	DEPTH-RIM TO TIDE OR GWL +17.3 ft.	UNBALANCED HEAD H ft.	HEAD RATIO Ht/Ho	REMARKS
DATE	CLOCK	Δt MIN.					
6-3-82			17'4"	17.3	0		STATIC WATER LEVEL
		1	2'3" 2.3		15.0	.87	FILLED TO RIM
		2	3'9" 3.8		13.5	.78	
		4	5'11" 5.9		11.4	.66	
		6	7'9" 7.8		9.5	.55	
		8	9'0" 9.0		8.3	.48	
		10	10'1" 10.		7.3	.42	
		12	11'0" 11		6.3	.36	
		14	11'8" 11.7		5.6	.32	

PIEZOMETER NO. 401P

SHEET 5 OF 6

MUESER RUTLEDGE CONSULTING ENGINEERS

FILE NO. 6400

SUBCODE

VARIABLE HEAD PERMEABILITY TEST

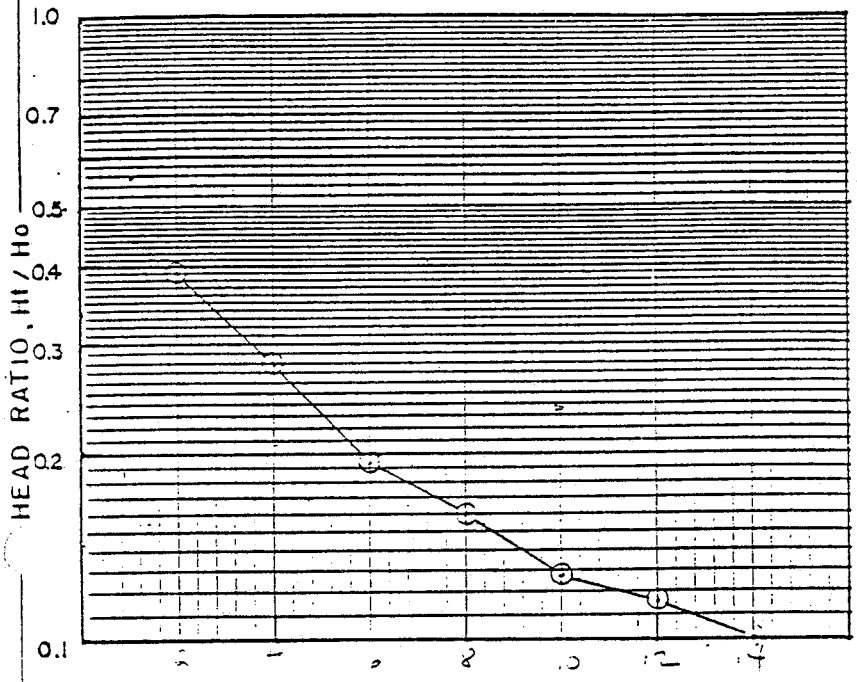
☐ BOREHOLE OR ☑ PIEZOMETER NO. 401P

TEST NO. 2

PROJECT CEDAR CREEK WPCP — RES.ENG. G C BRAUN

LOCATION WANTAGH NEW YORK — CALC.BY GCB DATE

PIEZOMETER LOCATION 5' EAST OF 401 — CH'KD BY ___ DATE



INTAKE POINT

depth to bottom, ft = 30

depth to top, ft = 22

length, ft = 8 = L

diameter, in = 4 3/4, ft = 0.4 = 2R

STANDPIPE/RISER

diameter, in = 1 1/2, ft = .125 = 2r

depth of casing, ft = —

depth to which standpipe was bailed, ft = — = Z

READING TIME			TEST DEPTH-RIM TO WATER ft.	DEPTH-RIM TO TIDE OR GWL ft.	UNBALANCED HEAD H ft.	HEAD RATIO Ht/Ho	REMARKS
DATE	CLOCK	Δt MIN.					
6-4-86			18' 2"	18.1	0		STATIC WATER LEVEL
		1	8' 1" 8		10.1	0.56	
		2	11' 0" 11		7.1	.39	
		4	13' 0" 13		5.1	.28	
		6	14' 7" 14 6		3.5	.19	
		8	15' 3" 15 7		2.9	.16	
		10	15' 9" 15 9		2.3	.127	
		12	16' 1" 16 1		2.1	.116	
		14	16' 4" 16 4		1.8	.10	

PIEZOMETER NO. 401P

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 6 of 6
File No. 6400

PROJECT POWER GENERATING BLDG. CEDAR CREEK WPCP BORING NO. B-401P
LOCATION WANTAGH, NEW YORK
BORING LOCATION AS PER PLAN
SURFACE ELEVATION +14.95 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N, D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER ____, U-SAMPLER ____
CORE BARREL ____, CORE BIT ____
CASING HAMMER: WEIGHT, POUNDS ____, AVERAGE FALL, INCHES ____
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
6-3-86	0800	42.0'	-	12.0'	OVERNIGHT MUD LEVEL

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SEE SHEET NO. 3
STANDPIPE: TYPE PVC, ID 1-1/2", LENGTH 27.3', TOP ELEV. +17.3'
INTAKE POINT: TYPE SLOTTED PVC, OD 1-7/8", LENGTH 5', TIP ELEV. -10.7'
FILTER: MATERIAL SAND, OD 4-3/4", LENGTH 8', BOT. ELEV. -12.7'

PAY QUANTITIES
2½" DIA. DRY SAMPLE BORING, LIN. FT. 62.0'. NO. OF 2" SHELBY TUBE SAMPLES ____
____ DIA. U-SAMPLE BORING, LIN. FT. ____. NO. OF 3" UNDISTURBED SAMPLES ____
CORE DRILLING IN ROCK, LIN. FT. ____. OTHER ____

BORING CONTRACTOR TESTWELL CRAIG TEST BORING CO., INC.
DRILLER R. BARTHOLOMEW HELPERS J. WARREN
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-2-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

BORING NO. B-401P

FORM NO. B-2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6400
BORING NO. B-402
SURFACE ELEV. +13.25

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1030	1D	0.5 2.0	6-7 9	Brown silty m-f sand, sm clayey silt pkts, c sa, tr gravel (SM)				
	2D	2.0 4.0	13-14 24-26	Brown tan f-m sand, trace silt, shells (SP)		5		
	3D	5.0 7.0	8-26 27-31	Do 2D (SP)	F			
	4D	8.0 10.0	14-15 25-29	Tan f-m sand, trace silt, shells (SP)		10		
	5D	10.0 12.0	18-18 30-38	Tan m-f sand, trace silt, shells, gravel (SP)		13.5		
	6W	15.0 17.0	5-3 2-2	Soft gray organic silty clay, tr pt, shells, f sand partings (OH)	O	15 20		2 attempts no recovery sample from wash.
	7D	20.0 22.0	1-1 1-2	Soft gray organic clayey silt, trace pt, fine sand partings (OL)		23.5		
	8D	25.0 27.0	13-17 21-24	Light gray c-f sand, trace silt, gravel (SP)		25		Strong organic odors in samples 8D, 9D, 10D, 11D, and 12D.
	9D	30.0 32.0	14-22 28-34	Light gray m-f sand, trace c sand, silt, shells (SP)	S1	30		
	10D	35.0 37.0	8-10 11-12	Light gray brown c-f sand, trace silt, gravel (SP)		35		
	11D	40.0 42.0	16-14 15-19	Light brown m-f sand, trace gvl, silt, coarse sand (SP)		40		
	12D	45.0 47.0	11-11 12-15	Do 11D, light gray (SP)		45 48		
1330	13D	50.0 52.0	3-8 15-15	Gray clayey silt, trace gravel (ML)	C	50		End of boring at 52.0'.

TUESDAY, JUNE 3, 1986 - SUNNY, 70°

BORING NO.

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 6410

PROJECT POWER GENERATING BLDG. CEDAR CREEK WPCP BORING NO. B-402
LOCATION WANTAGH, NEW YORK
BORING LOCATION AS PER PLAN
SURFACE ELEVATION +13.23 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
					NO OBSERVATION DUE TO
					GROUTING OF HOLE

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0' NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR TESTWELL CRAIG TEST BORING CO., INC.
DRILLER R. BARTHOLOMEW HELPERS J. WARREN
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-3-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

BORING No. B-402

FORM NO. B-2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6400

BORING NO. B-403

SURFACE ELEV.

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP

PROJECT LOCATION WANTAGH, NEW YORK RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1000	1D	0.0	2-8	Gray-brown f-m sand, some vegetation, trace silt, gravel (SP)				.5' Top soil casing blows did not record from 0.0'-5.0'.
		2.0	12-15					
	2D	2.0	17-21	Tan f-m sand, trace silt, shells (SP)				
		4.0	36-12			5		
	3D	4.0	25-36	DO 2D, tr silt pockets, gravel (SP)			7	
		6.0	48-57		F		7	
	4D	6.0	15-38	Tan fine to medium sand, trace gravel, shells (SP)			24	
		8.0	66-75				70	
						10	77	
	5D	10.0	25-26	Gray brown f-m sand, trace gravel vegetation (SP)			80	
		12.0	24-27				27	
							46	
							44	
						15	54	
	6D	15.0	12-22	Light brown f-m sand, pieces of plastic (SP)			48	
		17.0	25-24				37	
							51	
						18.5	55	
						20	43	
	7D	20.0	1-2	Soft gray organic silty clay, trace fine sand, peat (OH)	O		56	
		22.0	2-1				38	
							53	
						23.5	67	
						25	53	
	8D	25.0	19-22	Light gray gravelly c-f sand, trace silt (GP)			43	
		27.0	19-20				45	
							49	
							49	
						30	52	
	9D	30.0	5-10	Gray c-f sand, trace gravel, silt (SP)			41	
		32.0	15-17				50	
							60	
							73	
						35	68	
	10D	35.0	7-10	Brown-gray c-f sand, trace silt, vegetation (SP)	S1		34	
		37.0	10-9				37	
							52	
							63	
						40	67	
	11D	40.0	22-25	Brown c-f sand, some gravel, tr silt (SP)			49	
		42.0	28-30				55	
							61	
							70	
						45	91	2 attempts.
	NR	45.0	15-20	NO RECOVERY			87	
		47.0	14-20				77	
							88	
						48.5	72	
						50	66	
	12D	50.0	9-11	Stiff gray silty clay, trace fine sand (CH)	C			End of boring at 52.0'.
1600		52.0	15-17					

SATURDAY, JUNE 14, 1986 - SUNNY, 8

BORING NO. B-403

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 6400

PROJECT POWER GENERATING BLDG. CEDAR CREEK WPCP BORING NO. B-403
LOCATION WANTAGH, NEW YORK
BORING LOCATION 15' NORTH OF PLAN LOCATION
SURFACE ELEVATION +13.23 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☐ TRUCK, ☒ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☒ CASING UTILIZED: DIAMETER, INCHES 3", DEPTH FROM 0.0' TO 50.0'
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS A . O-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS 300 , AVERAGE FALL, INCHES 24
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
6-14-86	1600	52.0'	50.0'	0	AT COMPLETION (WATER AT TOP OF CASING)

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE INC.
DRILLER G. KUTSCHERA HELPERS A. KIDES
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-14-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-403

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2

FILE NO. 6400

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP

BORING NO. B-404U

SURFACE ELEV. +14.6

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1030	1D	0.0	5-5	Brown tan f-m sand, some silt,				
		2.0	7-10	trace gravel, vegetation (SP-SM)				
	2D	2.0	7-7	Do 1D, trace silt, shells				
		4.0	8-10	(SP)		5		
	3D	5.0	7-10	Light tan m-f sand, trace silt,				
		7.0	13-10	shells (SP)	F			
	4D	7.0	6-5	Do 3D				
		9.0	5-6	(SP)		10		
	5D	10.0	5-7	Light tan f-m sand, trace silt				
		12.0	10-11	(SP)				
						15		
	6D	15.0	7-12	Gray fine to medium sand, trace				Strong organic odor in sample 6D.
1100		16.5	17	silt, gravel (SP)		16.5		End of boring at 16.5'.
						20		
						25		
						30		
						35		
						40		
						45		
						50		

TUESDAY, JUNE 3, 1986 - SUNNY, 60°F

BORING NO. B-404U

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 6400

PROJECT POWER GENERATING BLDG, CEDAR CREEK WPCP BORING NO. B-404U
LOCATION WANTAGH, NEW YORK
RING LOCATION AS PER PLAN
SURFACE ELEVATION +14.6 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
					NO READING TAKEN

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 16.5'. NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR TESTWELL CRAIG TEST BORING CO., INC.
DRILLER J. FRECK HELPERS J. JESTER
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-3-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-404U

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6400
BORING NO. B-404UA
SURFACE ELEV.

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
						5		Moved due to close proximity of underground drain. For soil description 0.0'-20.0 see B-404U.
					F	10		
						15		
						20		
	7D	20.0 22.0	6-6 7-8	Light gray m-f sand, trace silt, shells (SP)	S/F	25		Strong organic odors in samples 7D, 8D, 10D, 11D, 12D, & 13D.
	8D	25.0 27.0	2-3 2-1	Do 7D, trace coarse sand, shells (SP)		27		
	9D	30.0 32.0	16-35 48-56	Do 7D, trace coarse sand, gravel (SP)		30		
	10D	35.0 37.0	5-5 9-12	Brown coarse to fine sand, trace gravel, silt (SP)	S1	35		
	11D	40.0 42.0	14-11 9-12	Do 10D (SP)		40		
	12D	45.0 47.0	8-7 8-10	Tan coarse to fine sand, trace gravel, silt (SP)		45		
	13D	50.0 52.0	8-10 11-7	Do 12D (SP)		50		

TUESDAY, JUNE 3, 1986 - SUNNY, 70°F

BORING NO. B-404UA

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 2 OF 3

FILE NO. 6400

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP

BORING NO. B-404UA

SURFACE ELEV.

PROJECT LOCATION WANTAGH, NEW YORK

RES. ENGR. G.C. BRAUN

DAILY OGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
TUESDAY, JUNE 6, 1986 CONT'D)					S1	53.5		
	14U	55.0 57.0	P = 24" Rec=23"	Top: Stiff gray silty clay, tr sa pockets (CL) Bot: Stiff gray silty clay (CL)	C	55 60		
	15U 16D	60.0 62.0 62.0 64.0	P = 24" Rec=22" 7-7 12-13	Stiff gray silty clay, trace fine sand seams (CL) Do 15U (CL)		64 65		End of boring at 64.0'.
1445						70 75 80 85 90 95 100		

BORING NO. B-404UA

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 3 of 3
File No. 6400

PROJECT POWER GENERATING BLDG. CEDAR CREEK WPCP BORING NO. B-404UA
LOCATION WANTAGH, NEW YORK
BORING LOCATION 25' EAST OF PLAN
SURFACE ELEVATION +14.6 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N, D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER ____, U-SAMPLER 3" O.D. OSTERBERG
CORE BARREL ____, CORE BIT ____
CASING HAMMER: WEIGHT, POUNDS ____, AVERAGE FALL, INCHES ____
SAMPLER HAMMER: WEIGHT, POUNDS 140, AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
6-3-86	1445	64.0'	-	3.0'	MUD LEVEL AT COMPLETION

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON ____
STANDPIPE: TYPE ____, ID ____, LENGTH ____, TOP ELEV. ____
INTAKE POINT: TYPE ____, OD ____, LENGTH ____, TIP ELEV. ____
FILTER: MATERIAL ____, OD ____, LENGTH ____, BOT. ELEV. ____

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 64.0' NO. OF 2" SHELBY TUBE SAMPLES ____
____ DIA. U-SAMPLE BORING, LIN. FT. ____. NO. OF 3" UNDISTURBED SAMPLES ____
CORE DRILLING IN ROCK, LIN. FT. ____. OTHER ____

BORING CONTRACTOR TESTWELL CRAIG TEST BORING CO., INC.
DRILLER J. FRECK HELPERS J. JESTER
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-6-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING NO. B-404UA

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 5
FILE NO. 6400
BORING NO. B-405P
SURFACE ELEV.

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, N.Y. RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1455	1D	0.0 2.0	8-12 18-20	Brown silty fine sand, trace brick, veg, coarse sand, gvl (SM)				
	2D	2.0 4.0	7-8 13-17	Tan f-m sand, trace silt, gravel (SP)		5		
	3D	5.0 7.0	8-8 8-10	Do 2D, trace shells (SP)				
	4D	8.0	2-3 2-2	Light gray f-m sand, trace silt, shells, coarse sand (SP)	F	10		
	5D	10.0 12.0	5-3 2-2	Do 4D (SP)				
	6D	15.0 17.0	4-8 16-18	Do 4D (SP)		15		
	7D	20.0 22.0	1-0 1-1	Gray c-f sand, trace silt, gravel (SP)	S/F	20		
	8D	25.0 27.0	1-0 0-2	Gray f-m sand, trace silt, coarse sand, shells (SP)		25 28		Strong organic odors in samples 8D,9D,10D,12D
	9D	30.0 32.0	5-6 8-8	Brown medium to fine sand, trace silt, coarse sand (SP)		30		Loss of drilling fluid at 30.0'.
	10D	35.0 37.0	5-10 12-12	Brown m-f sand, trace silt, shells (SP)	S1	35		
	11D	40.0 42.0	6-8 11-15	Light brown m-f sand, trace coarse sand, silt (SP)		40		
	12D	45.0 47.0	7-12 19-28	Light gray m-f sand, trace coarse sand, silt (SP)		45 48.5		
1630	13D	50.0 52.0	11-10 12-12	Stiff gray silty clay, trace fine sand (CL)	C	50		End of boring at 52.0'.

TUESDAY, JUNE 3, 1986 - SUNNY, 70°F

BORING NO. B-405P

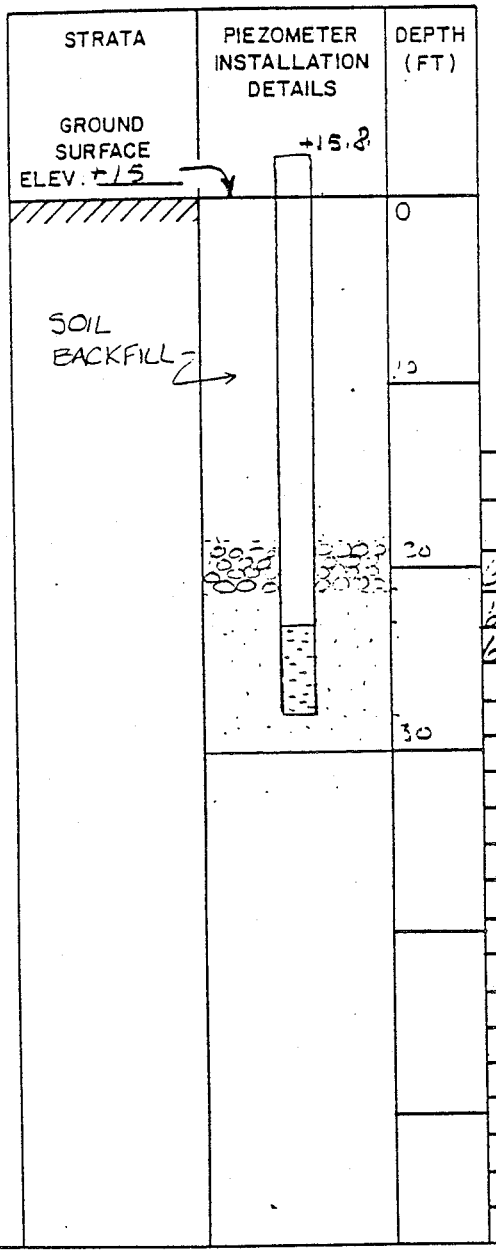
MUESER RUTLEDGE CONSULTING ENGINEERS

PIEZOMETER RECORD

PROJECT CEDAR CREEK WRP
LOCATION WANTAGH NEW YORK
PIEZOMETER LOCATION 5' NORTH OF 405
☐ SEE SKETCH ON BACK

PIEZOMETER NO. 405P
DATE OF INSTALLATION 6-3-86
RES. ENG. G.C. BRAUN

PIEZOMETER TYPE 1½" ID PVC



INTAKE POINT

depth to bottom, ft = 30.8'
depth to top, ft = 21.8
length, ft = 9 = L
diameter, in = 4 3/4, ft = 0.4 = 2R

STANDPIPE/RISER

elevation of rim, ft = +15.8
diameter, in = 1 1/2, ft = 0.125 = 2r

READING TIME		DEPTH – RIM TO WATER	ELEVATION OF WATER	REMARKS
DATE	CLOCK			
6-4-86	0845	17.8	-2	
6-4-86	0900	12.8	+3	AFTER FILLING H.D. TEST
6-14-86	1230	18.8	-3	

Sand Bentonite
Gravel Grout

GROUND SURFACE ELEV. +15

PIEZOMETER NO. 405P

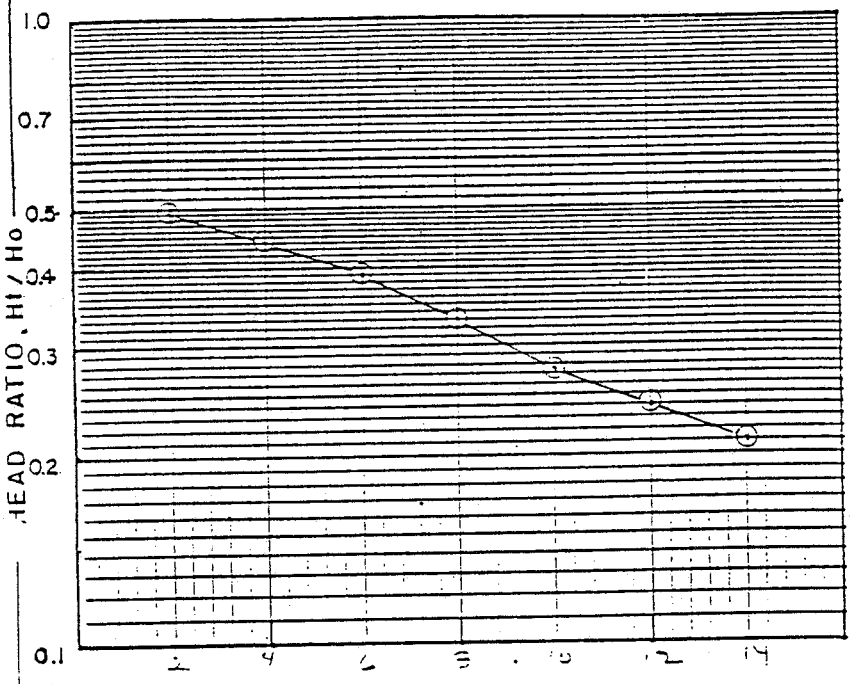
SHEET 3 OF 5
FILE NO. 6400
SUBCODE

MUESER RUTLEDGE CONSULTING ENGINEERS

VARIABLE HEAD PERMEABILITY TEST

☐ BOREHOLE OR ☐ PIEZOMETER NO. 405P
TEST NO. 2

PROJECT CEDAR CREEK WPCP — RES.ENG. G.C. BRAUN
LOCATION NAUTAGH NEW YORK — CALC.BY ___ DATE ___
PIEZOMETER LOCATION ___ — CH'KD BY ___ DATE ___



INTAKE POINT

depth to bottom, ft = 30.8
depth to top, ft = 21.8
length, ft = 9.0 = L
diameter, in = 4 3/4, ft = 0.4 = 2R

STANDPIPE/RISER

diameter, in = 1 1/2, ft = 0.125 = 2r

depth of casing, ft = —

depth to which standpipe was bailed, ft = — = Z

READING TIME			TEST DEPTH-RIM TO WATER ft.	DEPTH-RIM TO TIDE OR GWL ft.	UNBALANCED HEAD H ft.	HEAD RATIO Ht/Ho	REMARKS (17.8 USED THESE NOS. FOR GRAPH)	
DATE	CLOCK	Δt MIN.						
1-4-86			12'9"	12.8	0		STATIC WATER LEVEL	
		1	12'8.2"		4.6	.36	9.6	54
		2	9'2" 9.1		3.7	.29	8.7	.49
		4	10'0" 10		2.2	.22	7.8	.44
		6	10'11" 10.9		1.9	.15	6.9	.39
		8	11'10" 11.9		0.9	.07	5.9	.33
		10	12'10" 12.8		0.1	.008	4.9	.275
		12	13'6" 13.5		-0.7		4.3	.24
		14	14'0" 14		-1.2		3.8	.21

PIEZOMETER NO. 405P

MUESER RUTLEDGE CONSULTING ENGINEERS

FILE NO. 6400

SUBCODE

VARIABLE HEAD PERMEABILITY TEST

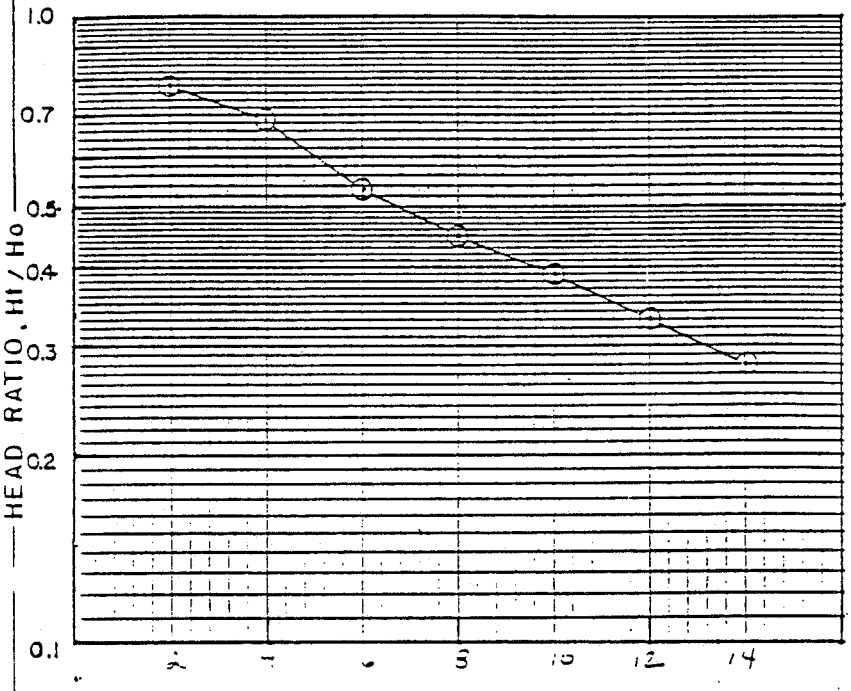
☐ BOREHOLE OR ☐ PIEZOMETER NO. 405P

TEST NO. 1

PROJECT CEDAR CREEK WPCP — RES.ENG. G.C BRAUN

LOCATION — CALC.BY ____ DATE ____

PIEZOMETER LOCATION — CH'KD BY ____ DATE ____



INTAKE POINT

depth to bottom, ft = 30.8

depth to top, ft = 21.8

length, ft = 9 = L

diameter, in = 4 3/4, ft = 0.4 = 2R

STANDPIPE/RISER

diameter, in = 1 1/2, ft = 0.125 = 2r

depth of casing, ft = —

depth to which standpipe was bailed, ft = — = T

READING TIME			TEST DEPTH-RIM TO WATER ft.	DEPTH-RIM TO TIDE OR GWL ft.	UNBALANCED HEAD H ft.	HEAD RATIO Ht/Ho	REMARKS
DATE	CLOCK	Δt MIN.					
6-486			17' 9"	17.8	0		STATIC WATER LEVEL
		1	2' 2"		15.7	.88	
		2	3' 10"		13.9	.78	
		4	5' 6"		12.3	.69	
		6	8' 5"		9.4	.53	
		8	9' 9"		8.0	.45	
		10	10' 10"		6.9	.39	
		12	11' 10"		5.9	.33	
		14	12' 9"		5.0	.28	

PIEZOMETER NO. 405P

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 5 of 5
File No. 6400

PROJECT POWER GENERATING BLDG. CEDAR CREEK WPCP BORING NO. B-405P
LOCATION WANTAGH, NEW YORK
BORING LOCATION 50' NORTH OF PLANNED LOCATION
SURFACE ELEVATION +14.2 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
					NO OBSERVATION TAKEN
					DUE TO GROUTING

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☒ PIEZOMETER INSTALLED. SKETCH SHOWN ON SEE SHEET NO. 2
STANDPIPE: TYPE PVC , ID 1-1/2" , LENGTH 23.8' , TOP ELEV. +15.8'
INTAKE POINT: TYPE SLOTTED PVC , OD 1-7/8" , LENGTH 5' , TIP ELEV. -15.0'
FILTER: MATERIAL SAND , OD 4-3/4" , LENGTH 8' , BOT. ELEV. -10.0'

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR TESTWELL CRAIG TEST BORING CO., INC.
DRILLER R. BARTHOLOMEW HELPERS J. WARREN
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-3-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
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6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-405P

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6400
BORING NO. B-406U
SURFACE ELEV. +14.35

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0800	1D	0.0 2.0	10-10 11-10	Brown silty fine to medium sand, some gravel, tr vegetation (SM)				
	2D	2.0 4.0	4-18 13-15	Tan silty fine to medium sand, trace gravel (SM)		5		
	3D	5.0 7.0	5-5 6-6	Tan fine to medium sand, trace silt, shells (SP)				
	4D	7.0 9.0	7-7 8-9	Do 3D (SP)	F	10		
	5D	10.0 12.0	2-2 2-4	Do 3D, trace gravel (SP)				
	6D	15.0 17.0	9-11 23-28	Tan brown m-f sand, trace silt, wood shells (SP)		15		
						19		
	7D	20.0 22.0	1-1 1-1	Light gray gravel & m-f sand, trace silt, shells (GP&SP)	S/F	20		
						24		
	8D	25.0 27.0	10-12 12-13	Light gray c-f sand, trace gravel, silt (SP)		25		Strong organic odors in samples 8D,9D, 10D,11D,& 12D.
	9D	30.0 32.0	11-11 12-12	Do 8D (SP)		30		
	10D	35.0 37.0	11-14 12-14	Light brown c-f sand, trace gravel silt (SP)	S1	35		
	11D	40.0 42.0	10-12 13-17	Do 10D (SP)		40		
	12D	45.0 47.0	12-10 8-12	Light gray m-f sand, trace silt (SP)		45		
						49		
	13D	50.0 52.0	6-7 10-10	Stiff gray silty clay, trace fine sand (CL)	C	50		

WEDNESDAY, 6-4-86 - SUNNY, 70°F

BORING NO. B-406U

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 2 OF 3
FILE NO. 6400
BORING NO. B-406U
SURFACE ELEV. +14.95

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
WEDNESDAY, 6-5-86 (CONT'D)						55		
	14D	55.0 57.0	P =24" Rec=10"	Do 13D (CL)	C	60		Tube crimped too much for acceptance.
	15U	60.0 62.0	P = 24" Rec=24"	Do 13D (CL)		65		
	16U	65.0 67.0	P = 14" Rec=12"	Top: Do 13D (CL) Bot: Do 13D, tr f-m sand (CL)		67		
	17D	70.0 72.0	16-17 25-35	Gray m-f sand, trace silt (SP)	S2	70		
1200	18D	75.0 76.3	33-71 100/3"	Do 17D (SP)		75 76.2		End of boring at 76.2'.
						80		
						85		
						90		
						95		
						100		

BORING NO B-406U

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 3 of 3
File No. 6400

PROJECT POWER GENERATING BLDG, CEDAR CREEK WPCP BORING NO. B-406U
LOCATION WANTAGH, NEW YORK
BORING LOCATION AS PER PLAN
SURFACE ELEVATION +14.35 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER 3" O.D. OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
					NO OBSERVATION TAKEN

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. . NO. OF 2" SHELBY TUBE SAMPLES
3 DIA. U-SAMPLE BORING, LIN. FT. 76.2' NO. OF 3" UNDISTURBED SAMPLES 2
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR TESTWELL CRAIG TEST BORING INC., CO.
DRILLER J. FRECK HELPERS J. JESTER
REMARKS
RESIDENT ENGINEER GERALD C BRAUN DATE 6-5-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

BORING No. B-406U

FORM NO. B-2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6400
BORING NO. B-407
SURFACE ELEV. +15.25

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1400	1D	0.0	8-8	Brown silty m-f sand, trace gravel				
		2.0	17-23	vegetation (SM)				
	2D	2.0	15-28	Brown tan f-m sand, trace silt,				
		4.0	42-59	silt pockets, gravel (SP)		5		
	3D	5.0	7-8	Do 2D, trace shells				
		7.0	7-12	(SP)				
	4D	7.0	10-14	Tan medium to fine sand, trace				
		9.0	20-20	silt (SP)	F	10		
	5D	10.0	5-6	Light gray medium to fine sand,				
		12.0	4-8	trace silt (SP)				Strong organic odors in samples 5D, &6D.
						15		
	6D	15.0	9-10	Do 5D				
		17.0	8-8	(SP)		19		
						20		
	7D	20.0	1-1	Soft gray organic silty clay,				
		22.0	2-2	trace fine sand (OH)	O	24		
						25		
	8D	25.0	10-11	Dark brown coarse to fine sand,				
		27.0	11-12	trace silt, gravel (SP)				
						30		
	9D	30.0	6-7	Tan coarse to fine sand, trace				
		32.0	7-9	silt, gravel (SP)	S1			Strong organic odors in samples 9D, 10D, 11D, 12D & 13D.
						35		
	10D	35.0	6-6	Do 9D				
		37.0	7-11	(SP)				
						40		
	11D	40.0	14-11	Do 9D				
1530		42.0	15-15	(SP)				
0800								
						45		
	12D	45.0	5-18	Light gray coarse to fine sand,				
		47.0	23-25	trace silt, gravel (SP)				
						50		
	13D	50.0	16-7	Top: Do 12D				
		52.0	10-14	Bot: Stiff gry si cl, tr si, f sa partings (CL)		51		

MONDAY, JUNE 2, 1986 - ...NDY, PARTLY CLOUDY, 70°F

TUES JUNE 3, 1986 SUNNY, 0°F

BORING NO. B-407

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 2 OF 3
FILE NO. 6400
BORING NO. B-407
SURFACE ELEV. +15.25

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
					S1	51		
	14D	55.0 57.0	10-10 11-14	Stiff gray silty clay, trace fine sand (CL)		55		
	15D	60.0 62.0	8-10 10-12	Do 14D (CL)	C	60		
	16D	65.0 67.0	5-7 11-17	Medium gray silty clay, some fine sand, trace vegetation (CL)		65		
TUESDAY, JUNE 3, 1986 - SUNNY 60°F 0900	17D	70.0 72.0	28-34 35-38	Light gray coarse to fine sand, trace silt (SP)	S2	68.5 70		Strong organic odor in sample 17D. End of boring at 72.0'.
						75		
						80		
						85		
						90		
						95		
						100		

BORING NO. B-407

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT POWER GENERATING BLDG. CEDAR CREEK WPCP BORING NO. B-407
LOCATION WANTAGH, NEW YORK
BORING LOCATION AS PER PLAN
SURFACE ELEVATION +15.25 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE
TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER FAILING
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS N . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
6-3-86	0800	42.0'	-	1.0'	MUD LEVEL OVERNIGHT - HOSE
					WAS LEAKING INTO TUBE WHICH
					THEN RAN INTO HOLE.

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES
2½" DIA. DRY SAMPLE BORING, LIN. FT. 72.0'. NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR TESTWELL CRAIG TEST BORING CO., INC.
DRILLER J. FRECK HELPERS J. JESTER
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-3-86

NOTES:
1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

BORING No. B-407

FORM NO. B-2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6400
BORING NO. B-408U
SURFACE ELEV. +24.1

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1330	1D	0.0 2.0	3-7 12-14	Gray-brown f-m sand, trace silt (SP)				
	2D	2.0 4.0	7-14 26-22	Do 1D, trace gravel, silt (SP)		5		
	3D	5.0 7.0	4-11 23-22	Brown f-m sand, trace silt, clayey silt pockets (SP-SM)				
	4D	7.0 9.0	15-40 18-74	Gray brown f-m sand, some black asphalt, trace silt (SP-SM)		10		
	5D	10.0 12.0	15-24 28-36	Brown gray m-f sand, trace silt, shells, clayey silt pockets (SP-SM)	F	15		
	6D	15.0 17.0	23-41 51-58	Light gray fine to medium sand, trace silt (SP)				
	7D	20.0 22.0	12-15 26-22	Do 6D (SP)		20		
	8D	25.0 27.0	13-13 7-9	Do 6D, trace shells (SP)		25		
	9U	29.0 31.0	P =24" Rec=21"	Top: Stiff gry org clay, some peat (OH)		28		Driller notes change.
				Bot: Stiff dark gray organic si clay, trace vegetation (OH)	O	30		
						34		Driller notes change.
	10D	35.0 37.0	13-20 25-29	Gray medium to fine sand, trace coarse sand, silt, gravel (SP)		35		
	11D	40.0 42.0	13-19 21-29	Brown coarse to fine sand, trace gravel, silt (SP)	S1	40		
	12D	45.0 47.0	11-15 20-19	Brown coarse to fine sand, trace silt (SP)		45		
	13D	50.0 52.0	11-17 24-25	Brown coarse to fine sand, trace silt (SP)		50		

SATURDAY, JUNE 14, 1986 - SUNNY, 80°F

BORING NO. B-408U

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 2 OF 3
FILE NO. 6400
BORING NO. B-408U
SURFACE ELEV. +24.1

PROJECT POWER GENERATING BUILDING, CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
						55		
	14D	55.0 57.0	10-20 23-24	Gray medium to fine sand, trace coarse sand, silt (SP)	S1	60		
	15D	60.0 62.0	17-21 18-15	Top: Do 14D (SP) Bot: Medium gray silty clay, tr fine sand (CH)	C	61 62		End of boring at 62.0'.
1600						65		
						70		
						75		
						80		
						85		
						90		
						95		
						100		

BORING NO. B-408U

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 3 of 3
File No. 6400

PROJECT POWER GENERATING BLDG, CEDAR CREEK WPCP BORING NO. B-408U
LOCATION WANTAGH, NEW YORK
BORING LOCATION AS PER PLAN
RFACE ELEVATION +24.1 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER MAYHEW
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS 3-1/4" OD MAYHEW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER 3" O.D. OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. . NO. OF 2" SHELBY TUBE SAMPLES
5 DIA. U-SAMPLE BORING, LIN. FT. 62.0'. NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE INC.
DRILLER V. AIMAR HELPERS G. BURKE
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-14-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING NO. B-408U

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102A
BORING NO. B-409U
SURFACE ELEV. +12.8

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, NEW YORK
RES. ENGR. G.C. BRAUN

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0830	1D	0.0 2.0	3-7 13-20	White fine to medium sand, trace silt (SP)				.5' Topsoil
	2D	2.0 4.0	20-22 28-31	Do 1D (SP)		5		
	3D	5.0 7.0	9-14 13-14	Do 1D (SP)				
	4D	7.0 9.0	10-15 18-21	Gray fine to medium sand, trace silt (SP)	F	10		
	5D	10.0 12.0	11-14 15-15	Do 4D (SP)		14.5		
	6U	15.0 17.0	P=24" Rec=17"	Medium gray organic silty clay (OH)	O	20		Sample 7D: Water content is 150%.
	7D	20.0 22.0	1-1 2-2	Soft gray organic silty clay, trace fine sand, peat, w/6" peat at bottom of sample (OH & Pt)		23.0		
	8D	25.0 27.0	8-19 22-26	Brown fine to coarse sand, trace gravel, silt (SP-SM)		25		
	9D	30.0 32.0	8-13 15-17	Brown-gray medium to fine sand, trace silt (SP)		30		
	10D	35.0 37.0	6-8 12-14	Gray fine to medium sand, trace coarse sand, silt (SP)	S1	35		
	11D	40.0 42.0	12-13 14-17	Do 10D (SP)		40		
	12D	45.0 47.0	15-22 25-24	Do 10D (SP)		45		
	13D	50.0 52.0	7-9 7-13	Medium gray silty clay, trace fine sand, fine sand partings (CL)	C	49.0 50 52.0		Sample 13D: Water content is 37%. End of boring @ 52.0'.
1130								

Saturday, June 14, 1986, Sunny, 80°F

BORING NO. B-409U

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT CEDAR CREEK WPCP BORING NO. B-409U
LOCATION WANTAGH, NEW YORK
BORING LOCATION 195' EAST AND 30' SOUTH OF SOUTHEAST CORNER OF ADMINISTRATION BL
SURFACE ELEVATION +12.8 DATUM NASSAU COUNTY DATUM

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS MAYHEW . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER 3" O.D. OSTERBERG
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. . NO. OF 2" SHELBY TUBE SAMPLES
4-3/4" DIA. U-SAMPLE BORING, LIN. FT. 52.0' NO. OF 3" UNDISTURBED SAMPLES 1
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER V. AIMAR HELPERS G. BURKE
REMARKS
RESIDENT ENGINEER GERALD C. BRAUN DATE 6-14-86

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water, including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102A
BORING NO. B-501
SURFACE ELEV. 17.5

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, N.Y. RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1120	1D	0.0	4-6	Top: Dk brn si f-m sa, tr veg (SM)				pp=Pocket Penetrome
		2.0	8-9	Bot: Lt gry f sa, tr silt (SP)				
	2D	2.0	6-8	Gry-brn f-m sand, tr silt				reading in t.
		4.0	11-15	(SP-SM)				
	3D	4.0	14-27	Gry c-f sand, sm gvl, tr shells		5		
		6.0	34-27	(SP)				
	4D	6.0	16-18	Gry f-c sand, tr gvl, shells				
		8.0	24-19	(SP)				
	5D	8.0	11-17	Gry f-m sand (SP)	F			Drilled with
		10.0	26-24			10		revert from
	6D	10.0	9-16	Gry f-m sand, tr silt (SP)				2' - 50'.
		12.0	16-19					
						15		
	7D	15.0	26-27	Gry m-f sand, tr c sand, gvl,				
		17.0	30-29	shells, silt (SP)				
						20		pp=1 TSF
	8D	20.0	3-3	Med-stiff dk gry org silty clay,				
		22.0	5-5	and peat (OH)&(PT)	0			
				Top: Med dk gry org silty cl, tr		25		pp=1.25 TSF
	9D	25.0	1-3	f-m sand (OH)	S & 0	25.3		
		27.0	7-16	Bot: Dk gry org silty f-c sand,				
				tr gvl, fibers (SM)		28.0		
						30		
	10D	30.0	18-13	Brn c-f sand, tr gvl (SP)				
		32.0	14-16					
						35		
	11D	35.0	9-9	Brn m-f sand, tr c sand, gvl,	S1			
		37.0	15-15	silt (SP)				
						40		
	12D	40.0	10-9	Do 11D (SP)				
		42.0	11-12					
						45		
	13D	45.0	8-5	Gry f-m sand, tr silt (SP-SM)				
		47.0	8-12					
						50		
	14D	50.0	10-10	Do 13D (SP-SM)				End of boring
1430		52.0	14-13					@ 52.0'.

January 13, 1987, Sunny-Windy 35°F

BORING NO. B-501

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT CEDAR CREEK WPCP BORING NO. B-501
LOCATION WANTAGH, N.Y.
BORING LOCATION NORTH 9749.00, EAST 11242.00
SURFACE ELEVATION 17.5 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER MAYHEW
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS MAYHEW JUNIORS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
1-13-87	1530	52.0'	38.5' PVC PIPE	2.1'	UNSTABLE AFTER FLUSHING HOLE
					MEASURED INSIDE OF 1" ID PVC PIPE
1-14-87	0655	52.0'	38.5'PVC PIPE	8.7'	
	1549	52.0'	38.5'PVC PIPE	11.7'	
1-15-87	0715	52.0'	38.5'PVC PIPE	13.3'	
1-15-87	0830	52.0'	38.5'PVC PIPE	14.8'	OPEN HOLE (AFTER PULLING PVC PIPE)

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 52.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER BILL LAZRO HELPERS GUS SURI
REMARKS
RESIDENT ENGINEER JOSEPH DUMINUCO DATE 1-13-87

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

BORING No. B-501

FORM NO. B-2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102A
BORING NO. B-502
SURFACE ELEV. 17.3

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, N.Y.
RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0800	1D	0.0	3-6	Lt brn f-m sand, tr silt, brick fgmts (SP)				pp=Pocket Penetrometer reading in t.s. Drilled with mud from 2'-35'.
		2.0	8-9					
	2D	2.0	8-9	Lt brn f-m sand, tr silt (SP-SM)				
		4.0	16-17					
	3D	4.0	17-20	Gry f-m sand, tr silt (SP)		5		
		6.0	30-31					
	4D	6.0	31-35	Gry f-m sand, tr silt, shells, c sand, gvl (SP)	F			
		8.0	39-46					
	5D	8.0	16-17	Gry f-m sand, tr silt (SP)				
		10.0	20-20			10		
	6D	10.0	11-12	Gry f-m sand, tr silt (SP)				
		12.0	14-15					
						15		19.5'-drilling easier, some clay in wash and on roller bit teeth
	7D	15.0	13-16	Do 6D, tr shells (SP)				
		17.0	16-20			19.5		
				Top: Dk gry f-m sand, sm silt & org silty clay layers (SM)&(OH)		20		Top: pp=1.0 TSF
	8D	20.0	3-2					Bot: pp=1.75 TSF
		22.0	4-5	Bot: Stiff dk gry org silty clay, sm peat (OH)	0			
				Top: Stiff dk gry org silty clay, tr veg (OH)		25		Top pp=1.75 TSF
	9D	25.0	2-2			26.0		
		27.0	3-3	Bot: Dk brn org silty f-c sand, tr fibers (SM)	S&O			
						27.5		27.5' bit chatter, wash turned gry
						30		
	10D	30.0	9-18	Gry m-f sand, tr c sand, gvl, silt (SP-SM)				
		32.0	19-19		S1			
						35		
	11D	35.0	10-11	Gry f-m sand, tr silt, c sand, gvl (SP-SM)				
0930		37.0	18-19					End of boring @ 37.0'.
						40		
						45		
						50		

January 14, 1987. Clear 35°F

BORING NO. B-502

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 610?

PROJECT CEDAR CREEK WPCP BORING NO. B-502
LOCATION WANTAGH, N.Y.
BORING LOCATION NORTH 9749.00, EAST 11140.00
SURFACE ELEVATION 17.3 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER MAYHEW
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4"
TYPE OF DRILLING MUD QUICK GEL
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS MAYHEW JUNIORS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
1-14-87		37.0'			HOLE FILLED

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 37.0'. NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER BILL LAZRO HELPERS GUS SURI
REMARKS
RESIDENT ENGINEER JOSEPH DUMINUCO DATE 1-14-87

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-502

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102A
BORING NO. B-503
SURFACE ELEV. 16.2

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, N.Y. RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1030	1D	0.0	3-5	Brn f-m sand, tr silt (SP-SM)				pp=Pocket Penetrometer reading in t.
		2.0	10-11					
	2D	2.0	16-16	Brn-gry f-m sand, tr silt, c sand (SP)				
		4.0	20-22					
	3D	4.0	22-42	Gry f-m sand, tr silt (SP)		5		Drilled with mud from 2' to
		6.0	46-50					
	4D	6.0	15-22	Gry f-m sand, tr dk brn clayey silt lenses (SP-SM)				
		8.0	37-41					
	5D	8.0	14-17	Gry f-m sand, tr silt (SP)	F			
		10.0	22-26			10		
	6D	10.0	14-16	Gry f-m sand, tr silt, shells (SP)				
		12.0	19-20					
						15		
	7D	15.0	11-12	Gry m-f sand, tr silt, gvl, shells (SP)				
		17.0	13-15					
						19.7		Soft drilling; dk gry clay
						20		in wash @ 19.7
	8D	20.0	1-1	Med to stiff dk gry org silty clay and peat (OH)&(PT)	0			pp=0.75-1.75 T
		22.0	2-2					
				Top: Stiff dk brn & gry org si cl, sm peat (OH)		25		Top pp=1.25 TS
	9D	25.0	1-2					
		27.0	3-5	Bot: Dk gry org silty f-m sand, tr gvl (SM)	S & 0	26.5		
						28.0		
						30		
	10D	30.0	9-12	Brn m-f sand, tr silt, c sand (SP-SM)	S1			
		32.0	14-15					
						35		
	11D	35.0	11-11	Gry brn m-f sand, tr silt, gvl (SP-SM)				End of boring @ 37.0'.
1230		37.0	13-17					
						40		
						45		
						50		

January 14, 1987 - Clear, 35°F

BORING NO. B-503

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT CEDAR CREEK WPCP BORING NO. B-503
LOCATION WANTAGH, N.Y.
BORING LOCATION NORTH 9749.00, EAST 11058.00
SURFACE ELEVATION 16.2 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER MAYHEW
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4"
TYPE OF DRILLING MUD QUICK GEL
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS MAYHEW JUNIORS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
1-14-87	1330	37.0'	NONE	6.1'	MUD LEVEL-1 HOUR AFTER COMPLETION

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 37.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER BILL LAZRO HELPERS GUS SURI
REMARKS
RESIDENT ENGINEER JOSEPH DUMINUCO DATE 1-14-87

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-503

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102A
BORING NO. B-504
SURFACE ELEV. 15.5

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, N.Y. RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0930	1D	0.0	4-5	Brn f-c sand, sm silt, tr roots				pp=Pocket Penetrometer reading in t.s.f
		2.0	9-12	(SM)				
	2D	2.0	18-24	Brn-gry f-m sand, tr silt, c				
		4.0	29-31	sand shells (SP)				Drilled with muc
	3D	4.0	24-37	Do 2D (SP)		5		from 2' to 35'.
		6.0	46-69					
	4D	6.0	18-21	Brn & gry f-c sand, tr silt, gvl				
		8.0	24-23	shells (SP-SM)				
	5D	8.0	19-21	Gry f-m sand, tr silt, shells	F			
		10.0	21-25	(SP)		10		
	6D	10.0	12-13	Do 5D (SP)				
		12.0	15-20					
						15		
	7D	15.0	3-3	Gry f-m sand, tr silt, org silty				
		17.0	4-4	clay pkts (SP-SM)&(OH)				
	8D	17.5	1-2	Med-stiff dk gry org silty clay,		17.5		pp=0.75-1.25 TSF
		19.5	3-3	and peat (OH)&(PT)				
						20		
	9D	20.0	1-1	Med dk gry org silty clay, tr	0			pp=0.75 TSF
		22.0	1-1	shells (OH)				
								20'-25' soft drilling & clay
				Top: Med dk gry org silty clay,		25		lumps in wash.
	10D	25.0	4-6	tr f-c sand, shells (OH)		26.0		Drill chatter
		27.0	6-7	Bot: Gry f-c sand, sm org silt				@ 27'.
				(SM)	S & 0	28.0		10D Top pp=0.75 T
						30		
	11D	30.0	8-7	Gry m-f sand, tr silt, c sand,				
		32.0	9-9	gravel (SP-SM)	S1			
						35		
	12D	35.0	5-6	Do 11D (SP-SM)				End of boring
1130		37.0	6-7					@ 37.0'.
						40		
						45		
						50		

January 15, 1987 - Cloudy, Showers, 40°F

BORING NO. B-504

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT CEDAR CREEK WPCP BORING NO. B-504
LOCATION WANTAGH, N.Y.
BORING LOCATION NORTH 9749.00, EAST 10975.00
SURFACE ELEVATION 15.5 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER MAYHEW
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4"
TYPE OF DRILLING MUD REVERT
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS MAYHEW JUNIORS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
1-15-87	1145	37.0'	NONE	2.0'	MUD LEVEL AT COMPLETION

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 37.0'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER BILL LAZRO HELPERS GUS SURI
REMARKS
RESIDENT ENGINEER JOSEPH DUMINUCO DATE 1-15-87

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-504

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 3
FILE NO. 6102A
BORING NO. B-505
SURFACE ELEV. 16.4

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, N.Y. RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1340	1D	0.0 2.0	4-4 7-10	Dk brn f-m sand, sm silt, tr gvl, veg (SM)				pp=Pocket Penetrometer reading in t.s. Drilled with mu from 2'-53.5'.
	2D	2.0 4.0	10-19 19-20	Dk brn f-c sand, sm silt (SM)				
	3D	4.0 6.0	44-51 67-71	Gry f-m sand, tr silt (SP)		5		
	4D	6.0 8.0	15-16 16-19	Do 3D (SP)				
	5D	8.0 10.0	13-17 19-22	Do 3D (SP)	F	10		
	6D	10.0 12.0	9-13 17-18	Do 3D (SP)				
						15		
	7D	15.0 17.0	12-16 22-18	Do 3D, tr shells (SP)				19'-20' chatter of bit.
				Top: Dk gry silty f-m sand (SM)		20		pp = 1-2 TSF
	8D	20.0 22.0	2-2 3-4	Bot: Stiff dk gry org silty clay and peat (OH)&(PT)	0	20.3		
						25		pp=1-1.5 TSF
	9D	25.0 27.0	1-2 3-6	Top: Do 8D Bot (OH)&(PT) Bot: Brn f-m sand, sm org silt, tr c sand (SM)	S&O	26.5 28.0		
						30		
	10D	30.0 32.0	12-13 13-15	Brn c-f sand, sm gvl, tr silt (SP-SM)				
January 14, 1987 - Clear, 35°F						35		
	11D	35.0 37.0	9-11 11-11	Gry f-m sand, tr c sand, gvl, silt (SP-SM)	S1			
						40		
	12D	40.0 42.0	10-14 17-22	Gry f-m sand, tr c sand, silt (SP)				
						45		
	13D	45.0 47.0	11-14 16-23	Do 12D (SP)				
						50		
	14D	50.0 52.0	20-25 26-29	Do 12D, tr gvl (SP)				

BORING NO. B-505

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 2 OF 3
FILE NO. 6102A
BORING NO. B-505
SURFACE ELEV. 16.4

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH, N.Y. RES. ENGR. JOSPEH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
(cont'd) 1-14-87 Clear 35°F 1620	15D	53.5 55.5	9-9 13-20	Stiff gry silty clay, tr f sand (CL)	S1 C	53.5 55 60 65 70 75 80 85 90 95 100		pp=3.5-4.0 TSF End of boring @ 55.5'.

BORING NO. B-505

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 3 of 3
File No. 6102

PROJECT CEDAR CREEK WPCP SORING NO. B-505
LOCATION WANTAGH, N.Y.
BORING LOCATION NORTH 9685.00, EAST 11051.00
SURFACE ELEVATION 16.4 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER MAYHEW
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☒ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES 4-3/4"
TYPE OF DRILLING MUD QUICK GEL
☐ AUGER UTILIZED: TYPE AND DIAMETER, INCHES
TYPE AND SIZE OF:
DRILL RODS MAYHEW JUNIORS . D-SAMPLER 2" O.D. SPLIT SPOON
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
1/14/87	1650	55.5'	NONE	6.7'	MUD LEVEL-1/2 HOUR AFTER
					COMPLETION

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 55.5'. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR WARREN GEORGE, INC.
DRILLER BILL LAZRO HELPERS GUS SURI
REMARKS
RESIDENT ENGINEER JOSPEH DUMINUCO DATE 1-14-87

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. B-505

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102-14
BORING NO. D-1
SURFACE ELEV. +13.9

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH NY
RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0730								Drilled hollow stem augers down to 10.0 before beginning sampling
						5	HOLLOW	
								gry-brn f-m sand caving upon flight
	1D	10.0	7-13	lt brn f-m sand, tr csa (SP)	F	10	STEM	1D: DRY
		12.0	15-17					
	2D	15.0	6-10	gry f-m sand, sm brn f-c sand lyrs, tr silt, wood (SP-SM)		15	AUGERS	2D: DRY
		17.0	15-30					Strata contacts are estimated with auger
	3D	20.0	30-47	gray f-m sand, tr c sand, gvl, silt (SP-SM)		20		3D: WET; ORGANIC ODOR (NO ODOR IN SAMPLE JAR)
		21.5	60					
								(See note-1)
	4D	25.0	9-60	brn f-m sand, tr silt, c sand, gvl (SP-SM)		25		4D: slight odor
		26.5	62					≈6" of running sand
								top 12" of sample looks disturbed
					S1			collected bottom 6" in jar only
	5D	30.0	6-9	gry f-m sand, tr coarse sand, gvl, silt, wood fibers, shells (pos. wash sample)		30		5D: added head of water to auger before pulling OU
0830		32.0	15-17			32.0		
						35		some sand blew into augers; collected bottom 6" only, top 18" of sample was disturbed
						40		
								End of boring @ 32
								Note 1: in order not slow down progress of this job by washing out the augers a small amount of running sand was allowable to sample through

FORM NO. B-1

BORING NO. D-1

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 6102

PROJECT CEDAR CREEK WPCP BORING NO. D-1
LOCATION WANTAGH NY
BORING LOCATION 85' NORTH OF CENTER OF DIGESTER #4
SURFACE ELEVATION +13.9 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER CME
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☒ AUGER UTILIZED: TYPE AND DIAMETER, INCHES Hollow Stem 2¼" ID ; 6½" OD
TYPE AND SIZE OF:
DRILL RODS A . D-SAMPLER 2" OD Split Spoon
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-87	1150	10.5	none	dry	Hole caved in

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 32.0. NO. OF 2" SHELBY TUBE SAMPLES
___ DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR Soil Mechanics Drilling Corp
DRILLER Al Tay HELPERS Angelo Armine, Fred Mede
REMARKS
RESIDENT ENGINEER Joseph Dominico DATE 2-21-87

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. D-1

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF
FILE NO. 6102-A
BORING NO. D-2
SURFACE ELEV. +13.2

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH NY
RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
0845								Drilled hollow
								augers to 10.0
							H	befor beginn
							O	sample
						5	L	
							L	gry-brn f-m sa
							O	coming up on fl
							W	
	1D	10.0	9-12	gry f-m sand (SP)	F			
		12.0	13-12			10	S	1D: DRY
							T	strata contacts
							E	estimated withou
							M	
	2D	15.0	2-3	gry f-m sand, tr silt, shells				
		17.0	11-12	(SP-SM)		15	A	2D: DAMP ; sli
							U	ORGANIC ODOR
							G	
							E	
							AUGER	
	3D	20.0	1-2	Top 12": stiff-med dk gry organic silty clay, sm				
		22.0	1-1	peat, tr f sand (OH)	O	20		3D: WET
				Bott 12": dk brn f-c sand, sm org silt,				TOP: PP = 0.75-1.25
				tr gvl (SM)	S&O			
								(See note -1
	4D	25.0	11-24	lt brn m-f sand, tr silt, gry clayey		25		4D: Added head
		27.0	52-33	silt pkts.				water to auger
				(SP-SM)	S1			before pulling a
								6" running sand
								top 18" looks dist
	5D	30.0	3-12	gry m-f sand, tr csa, gvl, silt		30		bott 6" taken for sa
		32.0	12-22	(SP-SM)				
0945						32.0		5D: Added head
								water to augers be
								pulling plug; 21' o
						35		running sand; en
								sample may be
								running sand.
								End of boring @ 32
								Note-1: running
								sand was allowe
								because washin
								would have cau
								too many delays
								this investigation
								5D: If entire sa
								is running sand it
								still representativ
								of the strata at
								that depth

2-21-87 Clear, windy 30° 0'-32.0'

FORM NO. B-1

BORING NO. D-2

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT CEDAR CREEK WPCP BORING NO. D-2
LOCATION WANTAGH NY
BORING LOCATION 80' East of D-1 AND 12' NORTH
SURFACE ELEVATION +13.7 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER CME
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☒ AUGER UTILIZED: TYPE AND DIAMETER, INCHES Hollow Stem 2¼" ID ; 6½" OD
TYPE AND SIZE OF:
DRILL RODS A . D-SAMPLER 2" OD Split spoon
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-87	1152	9.5'	none	dry	Hole caved in

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 32.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR Soilmechanics Drilling Corp
DRILLER Al Tay HELPERS Angelo Armine, Fred Mede
REMARKS
RESIDENT ENGINEER Joseph Duminuco DATE 2-21-87
NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. D-2

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102-A
BORING NO. D-3
SURFACE ELEV. +13.2

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH NY
RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1000								Drilled hollow st
								augers to 15' bea
								begining to sample
							H	
					F	5	O	gry-brn f-m
							L	sand, tr csa,
							L	observed caving
							O	up in flights
							W	
						10		
							S	Strata contacts
							T	are estimated wit
							E	hollow stem aug
							M	
	NR	15.0	3-4			15		
		17.0	5-9				A	
	1D	17.0	6-20	brn m-f sand, tr silt, c sand, gvl, gry		17.0	U	1D: WET - ~12"
		19.0	40-55	clayey silt pkts. (SP-SM)			G	running sand;
							E	bott 6" taken for
	2D	20.0	25-100/6"	brn m-F sand, tr csa, silt gvl, shells,		20	R	sample, top 18"
		21.0		wood fibers, plastic (pos. wash		21.0	S	looks disturbed
				sample) (SP)				
					S1			2D: WET
	3D	25.0	1-8	brn f-m sand, tr gvl, csa, silt		25		3D: ~6" running
		27.0	11-16	(SP)				sand (see not
1115						27.0		
								End of boring @ 27.0
						30		
								note: running
								sand was sand
								instead of washin
								out the augers
						35		to save time
								3D is represen
								ative of the
								strata @ 25'

2-21-87 Clear, windy 35° 0'-27.0'

FORM NO. B-1

BORING NO. D-3

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT CEDAR CREEK WPCP BORING NO. D-3
LOCATION WANTAGH NY
BORING LOCATION 80' EAST OF D-1
SURFACE ELEVATION +13.2 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER CME
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☒ AUGER UTILIZED: TYPE AND DIAMETER, INCHES Hollow stem 2¼" ID, 6½" OD
TYPE AND SIZE OF:
DRILL RODS A . D-SAMPLER 2" OD split spoon
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-87	1156	10.5	none	dry	Hole caved in

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 27.0 . NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR SOIL MECHANICS DRILLING CORP
DRILLER Al Tan HELPERS Angelo Armine
REMARKS
RESIDENT ENGINEER Joseph Dumnuco DATE 2-21-87

NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. D-3

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102-A
BORING NO. D-4
SURFACE ELEV. +14.7

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH NY RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1230								drilled hollow stem augers to 15' before sampling
0'-26.5'						5	HOLLOW STEM AUGERS	gry-brn f-m sand tr silt coming up on flights
35°						10		
2-21-87 clear, windy	1D	15.0 17.0	2-3 11-13	gry-brn m-f sand, tr gvl (SP)	F	15		1D: DRY
	2D	20.0 21.5	27-57 85	brn m-f sand, tr csa, silt, gvl (SP-SM)		20		2D: DAMP
	3D	25.0 26.5	20-50 50	Top 12" gry m-f sand, tr gvl, csa, silt (SP) Bott 6" dk brn F-c sand, sm gvl, org silt (SM)		25 26.0 26.5		3D: WET END OF BORING @ 26.5
1320						30		
						35		

BORING NO. D-4

MUESER RUTLEDGE CONSULTING ENGINEERS

Sheet 2 of 2
File No. 6102-A

PROJECT CEDAR CREEK WPCP BORING NO. D-4
LOCATION WANTAGH NY
BORING LOCATION 85' NORTH AND 65' WEST OF CENTER OF DIGESTER #4
SURFACE ELEVATION + 14.7 DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER CME
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES , DEPTH FROM TO
DIAMETER, INCHES , DEPTH FROM TO
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES
TYPE OF DRILLING MUD
☒ AUGER UTILIZED: TYPE AND DIAMETER, INCHES Hollow Stem 2¼" ID 6½" OD
TYPE AND SIZE OF:
DRILL RODS A . D-SAMPLER 2" OD split spoon
S-SAMPLER . U-SAMPLER
CORE BARREL . CORE BIT
CASING HAMMER: WEIGHT, POUNDS , AVERAGE FALL, INCHES
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-87	1320	10.2	none	dry	hole caved in

*Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON
STANDPIPE: TYPE , ID , LENGTH , TOP ELEV.
INTAKE POINT: TYPE , OD , LENGTH , TIP ELEV.
FILTER: MATERIAL , OD , LENGTH , BOT. ELEV.

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 26.5. NO. OF 2" SHELBY TUBE SAMPLES
DIA. U-SAMPLE BORING, LIN. FT. . NO. OF 3" UNDISTURBED SAMPLES
CORE DRILLING IN ROCK, LIN. FT. . OTHER

BORING CONTRACTOR SOIL MECHANICS DRILLING CORP
DRILLER Al Fay HELPERS Angelo Armine
REMARKS
RESIDENT ENGINEER JOSEPH DUMINUCO DATE 2-21-87
NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regardless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. D-4

MUESER RUTLEDGE CONSULTING ENGINEERS

SHEET 1 OF 2
FILE NO. 6102-A
BORING NO. D-5
SURFACE ELEV. +14.5

PROJECT CEDAR CREEK WPCP
PROJECT LOCATION WANTAGH NY
RES. ENGR. JOSEPH DUMINUCO

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
330								Drilled hollow stem augers to 15' before beginning sampling
2-21-87 Clear, windy 40° 0-26.5'						5	HOLLOW STEM AUGERS	gry-brn f-m sand tr silt coming up on flights
						10		strata contacts are estimated w auger
	1D	15.0	2-4	gry f-m sand, tr shells (SP)	F	15		1D: TOP 18" DAMP
		17.0	2-3					1D: BOTT 6" DAMP to WET
	2D	20.0	36-70	brn f-m sand, tr csa gvl, silt (SP)	S1	20		2D: WET
		21.5	70					
1430	3D	25.0	13-27	gry & brn f-m sand, tr csa gvl, silt (SP)		25		3D: color banded
		26.5	38			26.5		End of boring @ 26.5'
						30		

BORING NO. D-5

MUESER RUTLEDGE CONSULTING ENGINEERS

PROJECT CEDAR CREEK WPCP
LOCATION WANTAGH NY
BORING NO. D-5
BORING LOCATION 85' NORTH AND 65' EAST OF CENTER OF DEXTER 3
SURFACE ELEVATION +14.5' DATUM NASSAU COUNTY

BORING EQUIPMENT AND METHODS OF STABILIZING BOREHOLE:

TYPE OF BORING RIG: ☒ TRUCK, ☐ SKID, ☐ TRIPOD, ☐ OTHER CME
TYPE OF FEED DURING CORING: ☐ MECHANICAL, ☐ HYDRAULIC ☐ OTHER
☐ CASING UTILIZED: DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
DIAMETER, INCHES ____, DEPTH FROM ____ TO ____
☐ DRILLING MUD UTILIZED: DIAMETER OF ROTARY BIT, INCHES ____
TYPE OF DRILLING MUD ____
☒ AUGER UTILIZED: TYPE AND DIAMETER, INCHES Hollow Stem 2¼" ID 6½" OD
TYPE AND SIZE OF:
DRILL RODS A . D-SAMPLER 2" OD split spoon
S-SAMPLER ____ . U-SAMPLER ____
CORE BARREL ____ . CORE BIT ____
CASING HAMMER: WEIGHT, POUNDS ____ , AVERAGE FALL, INCHES ____
SAMPLER HAMMER: WEIGHT, POUNDS 140 , AVERAGE FALL, INCHES 30"

WATER LEVEL OBSERVATIONS IN BOREHOLE

DATE	TIME	DEPTH OF HOLE	DEPTH OF CASING	DEPTH TO WATER	CONDITIONS OF OBSERVATION*
2-21-87	1435	10.0'	none	dry	hole caved in

* Note reliability of observation, rainfall, elevation of nearby open water, tide gauge or other factors affecting water level recorded.

☐ PIEZOMETER INSTALLED. SKETCH SHOWN ON ____
STANDPIPE: TYPE ____ , ID ____ , LENGTH ____ , TOP ELEV. ____
INTAKE POINT: TYPE ____ , OD ____ , LENGTH ____ , TIP ELEV. ____
FILTER: MATERIAL ____ , OD ____ , LENGTH ____ , BOT. ELEV. ____

PAY QUANTITIES

2½" DIA. DRY SAMPLE BORING, LIN. FT. 26.5 . NO. OF 2" SHELBY TUBE SAMPLES ____
____ DIA. U-SAMPLE BORING, LIN. FT. ____ . NO. OF 3" UNDISTURBED SAMPLES ____
CORE DRILLING IN ROCK, LIN. FT. ____ . OTHER ____

BORING CONTRACTOR SOIL MECHANICS DRILLING CORP
DRILLER Al Tay HELPERS Angelo Armine
REMARKS ____
RESIDENT ENGINEER JOSEPH DUMINUCO DATE 2-21-87
NOTES:

1. Make a separate log of each boring and each unsuccessful attempt. Keep a copy of all logs in the field.
2. In daily progress column indicate depth at beginning and end of work day, calendar date, time at beginning and end of work day and weather conditions.
3. All samples shall be numbered in consecutive order regaruless of type; dry samples D, wash samples W, shelby tube samples S, fixed piston samples U. Do not assign numbers to lost samples but record blows and reasons for lack of recovery.
4. Mark each U-sample with boring number, sample number, depth, recovery and job number.
5. Record blows on sampler per six inches of penetration. Note all blows and penetrations when taken at less than six inch intervals. Indicate method by which penetration of tube sampler was obtained.
6. Indicate changes of material in strata column and list generalized strata description.
7. List under remarks the manner by which changes in material were detected, all obstructions, any loss or gain of wash water including amount, the recovery of rock core in feet and inches and per cent of run, Rock Quality Designation (RQD) in per cent and any unusual occurrences.
8. Include sample description by Unified Soil Classification System.
9. Obtain water level at the beginning of each day and at all other times when stable water conditions exist.

FORM NO. B-2

BORING No. D-5

TABLE 2
GROUNDWATER QUALITY TESTS*

Parameter	Sample No. 1	Sample No. 2
pH	7.5	7.5
Alkalinity, Total	317	365
BOD_5	47	25
Chlorides	660	440
COD, Dichromate	58	32
Color (APHA) Apparent	25	35
Nitrogen, Ammonia N	3.51	2.64
Nitrogen, Nitrate N	0.004	0.06
Odor (Threshold)	2	2
Phosphate, Total as P	1542	1105
Sulfates	86	10
Sulfides	22	8.0
	1.5	0.7
Arsenic	<0.005	<0.005
Barium	<0.2	<0.2
Cadmium	<0.01	<0.01
Chromium, Total	<0.05	<0.05
Copper	<0.05	<0.05
Iron	0.72	0.53
Lead	0.06	0.06
Mercury	<0.0005	0.0005
Selenium	<0.010	<0.005
Silver	<0.02	<0.02
Sodium	320	230
Zinc	0.02	0.01

* Analytical procedures in accordance with Standard Methods for the Examination of Water and Wastewater, 14th Edition and Methods for Chemical Analysis of Water and Wastes, EPA. (<) indicates lowest detectable concentration with procedure used.

NOTE: THE SOURCES OF SAMPLE No.1 AND No.2 ARE MONITORING WELLS MW-1 AND MW-2, RESPECTIVELY.

FIELD DATA

Date of Sampling:	9/13/83, 12:26 p.m.	9/13/83, 1:37 p.m.
pH:	7.1 @ 1:25 p.m.	7.26 @ 2:45 p.m.
Temperature:	14.3°C @ 1:25 p.m.	13.3°C @ 2:45 p.m.
Conductivity:	227 micro ohms/cm	1705 micro ohms/cm

Ref: REPORT of SOILS AND FOUNDATION INVESTIGATION
CEDAR CREEK EXPANSION WANTAGH, NEW YORK
BY CONVERSE CONSULTANTS DEC. 22, 1983

N 10,000 N 9,500 N 9,000 N 8,500 N 8,000

N

E 11,500

E 11,000

E 10,500

E 10,000

B-206A[2.9] (MEASURED 2-26-85)

B-206[1.7] (MEASURED 2-26-85)

MW-1 [1.3] (MEASURED 2-26-85.)

LEVEL FLUCTUATES WITH TIDE.

AERATION TANKS

B-315P[2.0]

B-318P(A)[2.1] & WELL [2.1]

317P[2.0]

B-320P[2.1]

B-319P[2.8]

325P[2.6]

B-316P(A)[2.1]

B-302P[2.0]

STATIC WATER LEVEL (MEASURED 2-25-85) BEFORE START OF PUMP TEST (TYP.)

MW-2 [1.1] (MEASURED 2-26-85)

LEGEND

BORING AND PIEZOMETER INSTALLATION MADE IN 1985 BY WARREN GEORGE, INC., UNDER CONTINUOUS INSPECTION OF MRCE.

PUMP WELL INSTALLED IN 1985 BY MORETRENCH AMERICAN CORP. UNDER CONTINUOUS INSPECTION OF MRCE.

BORING AND PIEZOMETER INSTALLATION MADE IN 1983 BY WARREN GEORGE, INC., FOR CONVERSE CONSULTANTS.

GROUNDWATER MONITORING WELL INSTALLED IN 1983 FOR CONVERSE CONSULTANTS.

BORING

MW Groundwater Monitoring Well

"P" indicates a piezometer was installed in the borehole.

"U" indicates undisturbed samples were obtained in the boring.

"(A)" indicates the boring was offset from its original drilled location because an obstruction was encountered.

NOTE:

BORINGS SHOWN ARE ONLY THOSE PIEZOMETER HOLES USED DURING THE PUMP TEST. OTHER BORINGS ARE NOT SHOWN.

CEDAR CREEK WPCP
WANTAGH N.Y.

MALCOLM PIRNIE, INC.
WHITE PLAINS N.Y.

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, NY 10017

SCALE 1" = 200' | MADE BY P.E.V. DATE 3-11-85 | CHKD BY F.A. DATE 3-11-85 | FILE NO. 6102

BORING LOCATION PLAN | DRAWING NO. B-1P | S3C067-11G

RECEIVED

FEB 28 1985

MRCE

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 11

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: 2/21/85

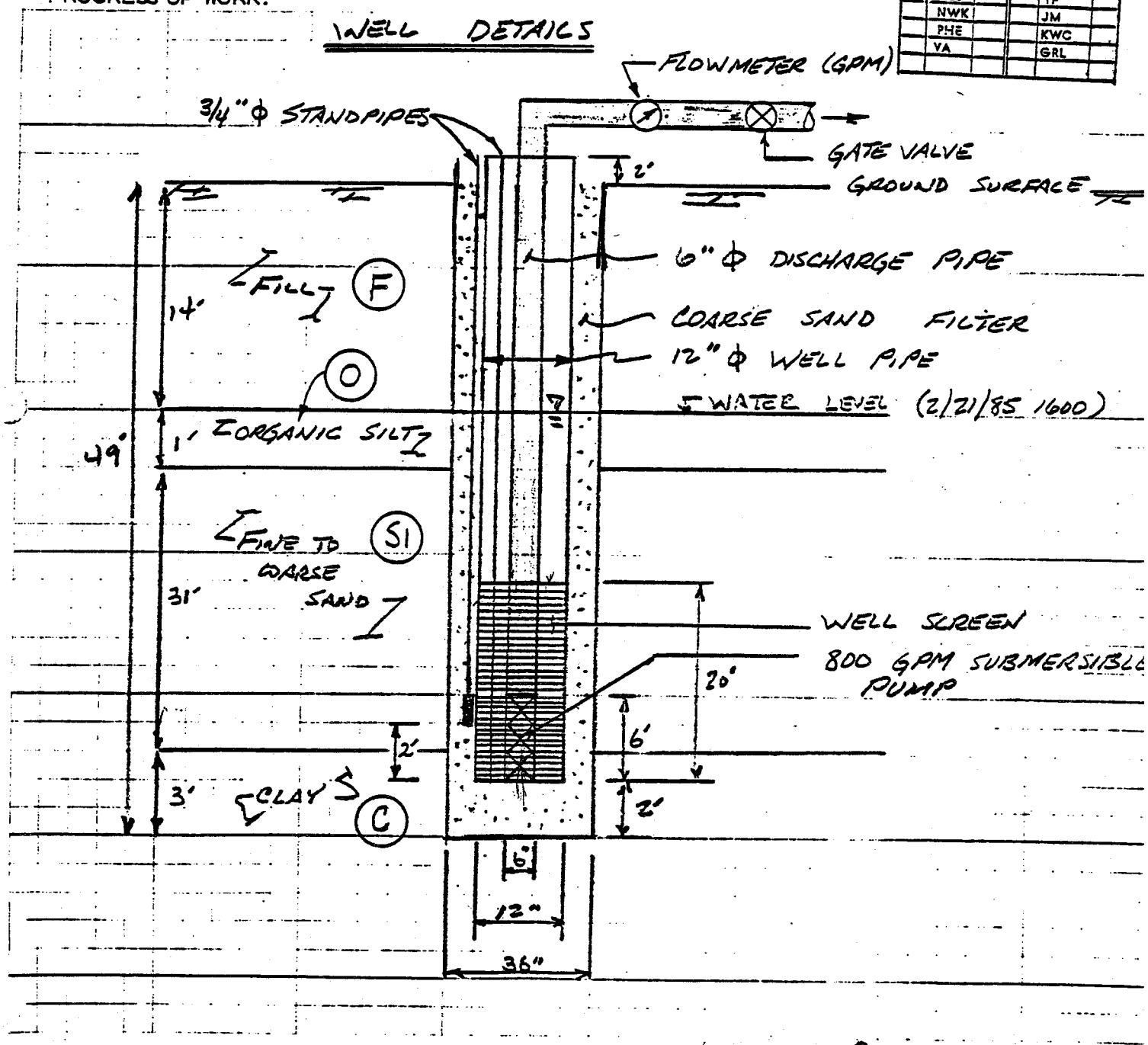
WEATHER

TEMPERATURE

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

To	Name	R	To	Name	R
	JPG			WW	
	EAR			HSL	
	EMI			AHB	
	DAZ			JLK	
	GJT			WGS	
	WHA			SLT	
	RCJ			TF	
	NWK			JM	
	PHE			KWC	
	VA			GRL	

PROGRESS OF WORK:



Visitors:

Resident Engr.

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

SHEET 1 OF 29

MUESER. RUTLEDGE. JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 1 OF

PROJECT CEDAR CREEK WPCP (TEST WELL 36"ϕ) FILE NO. 610 2

LOCATION WANTAGH, NEW YORK RES. ENGR. FRANK ARLANO BORING NO.

DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
1830		0-6"		Topsoil (MAL)				Hole advanced
								with bucket auger
								approx 7 ft &
		6"-10		Dark Brown medium to fine				then cased with
				sand, tr silt (SP)		5		10' section.
					(F)			
		10-14		Dark Brown medium to fine		10		
				sand, tr wood pieces, silt				
				pockets (SP-SM)		12		Revert & water
								added to hole to
					14			keep open.
		14-15		Black Organic Silt, sm	0	15		(Water table not
				fibers, tr silty clay				reached)
				pockets. (OL)				
		15-		Brown fine to coarse sand,				
				tr gravel (SP)		20		
				DO		25		
					(SI)			
				DO		30		
				DO		35		
				DO		40		
				DO		45		

SHEET 2 OF 29

FORM No. B-1

BORING NO. WELL

SURFACE EL. 13.8

MUESER. RUTLEDGE. JOHNSTON & DESIMONE - CONSULTING ENGINEERS

SHEET 2 OF

PROJECT CEDAR CREEK WPCP (TEST WELL 36" ϕ) FILE NO.

LOCATION WANTAGH, NEW YORK RES. ENGR. FRANK ARLANDO BORING NO.

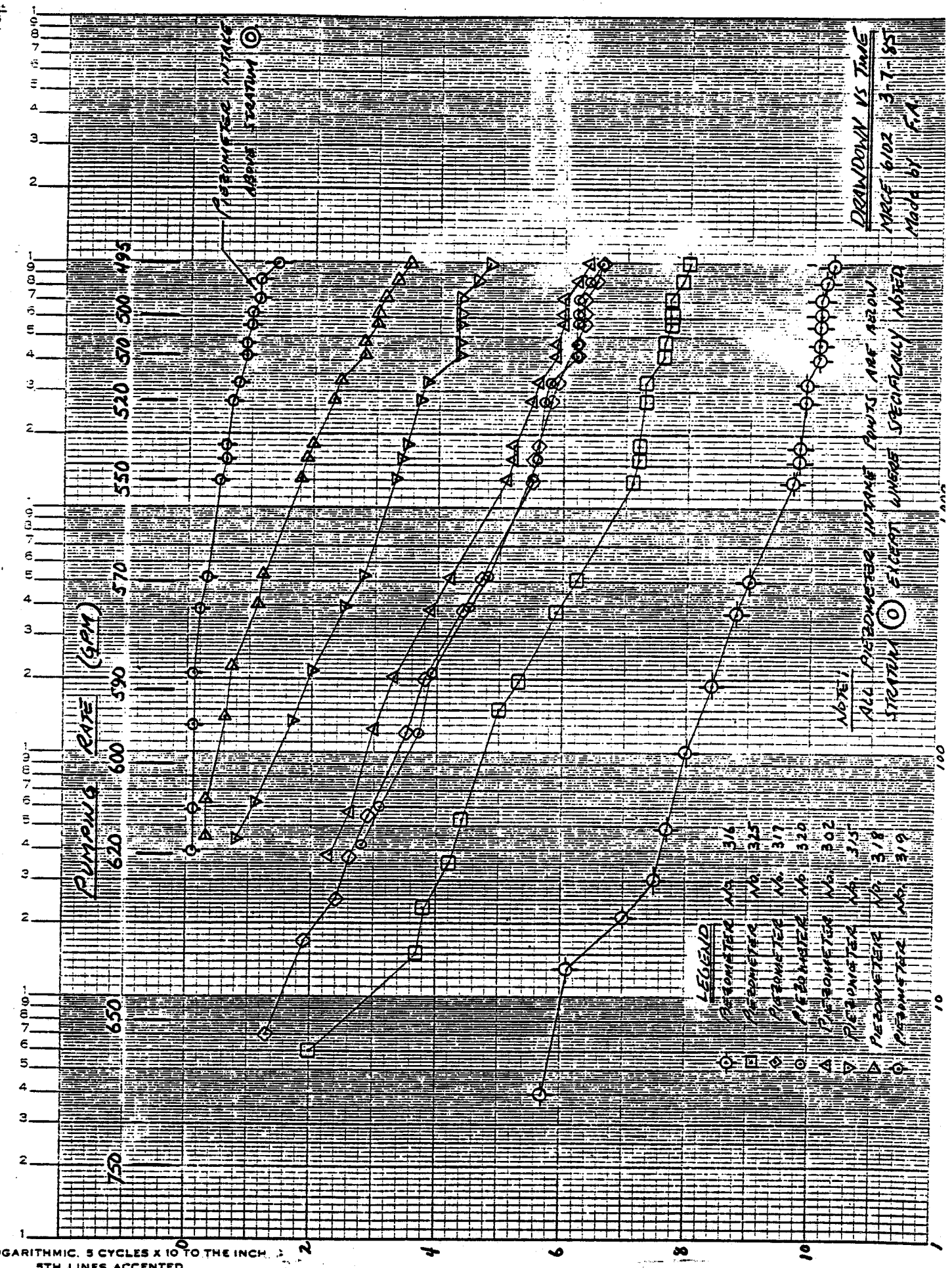
DAILY PROGRESS	SAMPLE NO.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRATA	DEPTH	CASING BLOWS	REMARKS
CLEAR/SUNNY								
					S1			
				Do		45		
				Dark gray silty clay, to fine sand (CL)	46			
					C			
30					49			End of hole @ 49'.
						50		

SHEET 3 OF 29

FORM No. B-1

BORING NO. WELL 13.8

PUMPING TEST DATA (PUMPDOWN)


DRAWDOWN VS TIME
MARCH 6102
PUMPING RATE (GPM)
495
500
520
550
570
590
600
620
650
750
LEGEND
PIEZOMETER No. 316
PIEZOMETER No. 325
PIEZOMETER No. 317
PIEZOMETER No. 320
PIEZOMETER No. 302
PIEZOMETER No. 318
PIEZOMETER No. 319
SEMI-LOGARITHMIC, 5 CYCLES X 10 TO THE INCH
5TH LINES ACCENTED
SHEET 4 OF 2

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

DATE AS SHOWN BELOW

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

MORETRENCH AMERICAN CORP

1 FOREMAN (START TEST)

PROGRESS OF WORK:

PUMP TEST DATA (PUMP DOWN)

Piez No. WELL - GS EL. ——— RADIUS 0.0
(TOP Piez. 16.46)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From top Piez.	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	0946	(min)		14.4				STATIC READING
	1045	0		—	0			START OF PUMPING
	1047	2		30.0	15.6			750 gpm
	1053	8		31.5	17.1			650
	1104	19		40.5	26.1			650
	1112	27		40.7	26.3			630
	1133	38		41.1	26.7			620 clear, no fines
	1215	90		41.3	26.9			600
	1345	180		41.5	27.1			590
	1645	360		41.9	27.5			580 clear, no fines
	1900	495		42.1	27.7			570
2/26/85	0800	1275		42.8	28.4			550 (RAIN)
	1245	1560		42.8	28.4			540
	1630	1785		42.9	28.5			535 clear, no fines
2/27/85	0830	2715		43.4	29.0			520
	1630	3225		43.6	29.2			515
2/28/85	0810	4155		43.9	29.5			510 clear, trace fine
	1630	4665		43.9	29.5			510
3/1/85	0800	5595		43.9	29.5			500 clear, trace fine
	1600	6075		43.9	29.5			500
3/2/85	0830	7035		44.0	29.6			500 overnight rain
3/3/85	0830	8505		44.0	29.6			500 clear, trace fine
3/4/85	0830	9945		44.0	29.6			495

Visitors:

Resident Engr.

SHEET 5 OF

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMP DOWN)

PIEZ No. FILTER G.S. EL. — (Top Piez. 15.83) RADIUS 7" from ℄ WELL (FIELD MEAS.)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER from top Piez.	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	0948			13.6				STATIC READING
	1045	0.0		—	0			START OF PUMPING
	1056	11		39.5	25.9			
	1105	20		39.9	26.3			
	1113	28		39.9	26.3			
	1135	50		40.1	26.5			
	1220	95		40.3	26.7			
	1346	181		40.5	26.9			
	1646	361		41.0	27.4			
	1901	496		41.2	27.6			
2/26/85	0802	1277		41.8	28.2			(RAIN)
	1247	1562		41.9	28.3			
	1632	1787		42.0	28.4			
2/27/85	0802	2717		42.4	28.8			
	1632	3227		42.7	29.1			
2/28/85	0802	4157		43.0	29.4			
	1632	4667		43.0	29.4			
3/1/85	0802	5597		43.0	29.4			
	1602	6077		43.0	29.4			
3/2/85	0802	7037		43.0	29.4			(OVERNIGHT RAIN)
3/3/85	0832	8507		43.2	29.6			
3/4/85	0832	9947		43.1	29.5			

Visitors:

Resident Engr.

SHEET 6 OF 2

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMPDOWN)

REF No. 316 GS EL. 13.7 (TOP REG. 14.55) RADIUS 22' FROM ℄ WELL (FIELD MEAS.)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From Top Reg.	DRAWDOWN s (START)	DRAWDOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1007			12.5				STATIC READING
	1045	0		—	0			START PUMPING
	1049	4		18.2	5.7			
	1058	13		18.6	6.1			
	1106	21		19.5	7.0			
	1115	30		20.0	7.5			
	1136	49		20.2	7.7			
	1225	100		20.5	8.0			
	1355	190		20.9	8.4			
	1655	370		21.3	8.8			
	1905	500		21.5	9.0			
2/26/85	0805	1280		22.2	9.7			(RAIN)
	1250	1565		22.3	9.8			
	1635	1790		22.3	9.8			
2/27/85	0805	2720		22.4	9.9			
	1635	3230		22.4	9.9			
2/28/85	0805	4160		22.6	10.1			
	1635	4670		22.6	10.1			
3/1/85	0805	5600		22.6	10.1			
	1605	6080		22.6	10.1			
3/2/85	0805	7040		22.6	10.1			(OVERNIGHT RAIN)
3/3/85	0835	8510		22.7	10.2			
3/4/85	0825	9950		22.8	10.3			

Visitors:

Resident Engr.

Resident Engineer is to report in detail progress of work, all instructions issued, all orders certifying or releasing the execution of work. Discrepancies of work completed to be reported promptly.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMPDOWN)

Piez No. 325 G.S. EL. 14.50 (Top Piez. 16.34) RADIUS 40' from ℄ WELL (FIELD MEAS.)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From Top Piez.	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1011			13.7				STATIC READING
	1045	0		—	0			START PUMPING
	1051	6		15.7	2.0			
	1100	15		17.4	3.7			
	1108	23		17.5	3.8			
	1120	35		17.9	4.2			
	1138	53		18.1	4.4			
	1240	115		18.7	5.0			
	1400	195		19.0	5.3			
	1700	375		19.6	5.9			
	1910	505		19.9	6.2			
2/26/85	0810	1285		20.8	7.1			(RAIN)
	1255	1570		20.9	7.2			
	1640	1795		20.9	7.2			
2/27/85	0810	2725		21.0	7.3			
	1640	3235		21.0	7.3			
2/28/85	0810	4165		21.3	7.6			
	1640	4675		21.3	7.6			
3/1/85	0810	5605		21.4	7.7			
	1610	6085		21.4	7.7			
3/2/85	0810	7045		21.4	7.7			(OVERNIGHT RAIN)
3/3/85	0840	8515		21.6	7.9			
3/4/85	0840	9955		21.7	8.0			

Visitors:

Resident Engr.

SHEET 8 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders relating to or affecting the execution

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER

TEMPERATURE

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMPDOWN)

PIEZ No. 317 GS EL. 16.10 (Top Pez. 16.84) RADIUS 77' FROM ℄ WELL (FIELD MEAS)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From Top Piez.	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1016			14.8				STATIC READING
	1045	0		—	0			START PUMPING
	1052	7		16.1	1.3			
	1102	17		16.7	1.9			
	1110	25		17.2	2.4			
	1122	37		17.4	2.6			
	1140	55		17.7	2.9			
	1245	120		18.3	3.5			
	1405	200		18.6	3.8			
	1705	380		19.2	4.4			
	1915	510		19.5	4.7			
2/26/85	0815	1290		20.3	5.5			(RAIN)
	1300	1575		20.3	5.5			
	1645	1800		20.4	5.6			
2/27/85	0815	2730		20.6	5.8			
	1645	3240		20.7	5.9			
2/28/85	0815	4170		21.0	6.2			
	1645	4680		21.0	6.2			
3/1/85	0815	5610		21.1	6.3			
	1615	6090		21.1	6.3			
3/2/85	0815	7050		21.1	6.3			(OVERNIGHT RAIN)
3/3/85	0845	8520		21.3	6.5			
3/4/85	0845	9960		21.4	6.6			

Visitors:

Resident Engr.

SHEET 9 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delivering or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMPDOWN)

PIEZ No. 302 G.S. EL. 13.00 RADIUS 99' FROM ℄ WELL
(TOP PIEZ. 14.02) (FIELD MEAS)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER FROM TOP PIEZ.	DRAWDOWN s (START)	DRAWDOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1018			12.0				STATIC READING
	1045	0		—	0			START PUMPING
	1123	38		14.3	2.3			
	1142	57		14.6	2.6			
	1250	125		15.0	3.0			
	1410	205		15.3	3.3			
	1710	385		15.9	3.9			
	1920	515		16.2	4.2			
2/26/85	0820	1295		17.1	5.1			(RAIN)
	1305	1580		17.2	5.2			
	1650	1805		17.2	5.2			
2/27/85	0820	2735		17.5	5.5			
	1650	3245		17.6	5.6			
2/28/85	0820	4175		17.9	5.9			
	1650	4685		17.9	5.9			
3/1/85	0820	5615		18.0	6.0			
	1620	6095		18.0	6.0			
3/2/85	0820	7055		18.0	6.0			OVERNIGHT RAIN
3/3/85	0850	8525		18.2	6.2			
3/4/85	0850	9965		18.4	6.4			

Visitors:

Resident Engr.

SHEET 10 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMPDOWN)

PIEZ No. 319 GS EL. 13.75 (Top Pez. 14.85) RADIUS 79½' from ℄ WELL (FIELD MEAS.)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From Top Piez.	DRAW-DOWN δ (START)	DRAW-DOWN δ' (STOP)	CALC. REC. δ-δ'	REMARKS
2/25/85	1020			12.1				STATIC READING
	1045	0		—	0			START PUMPING
	1125	40		12.2	0.1			
	1144	59		12.2	0.1			
	1255	130		12.2	0.1			
	1415	210		12.2	0.1			
	1715	390		12.3	0.2			
	1925	520		12.4	0.3			
2/26/85	0825	1340		12.6	0.5			(RAIN)
	1310	1585		12.7	0.6			
	1655	1910		12.7	0.6			
2/27/85	0825	2740		12.8	0.7			
	1655	3250		12.9	0.8			
2/28/85	0825	4180		13.0	0.9			
	1655	4690		13.0	0.9			
3/1/85	0825	5620		13.1	1.0			
	1625	6100		13.1	1.0			
3/2/85	0825	7060		13.2	1.1			(OVERNIGHT RAIN)
3/3/85	0855	8530		13.2	1.1			
3/4/85	0855	9970		13.5	1.4			

Visitors:

Frank Clark
Resident Engr.

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Presence at site [illegible]

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMPDOWN)

PIEZ No. 320 GS EL. 13.60 (Top Pipe 14.52) RADIUS 87' FROM ℄ WELL (FIELD MEAS)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From top Piez.	DRAWDOWN s (START)	DRAWDOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1023			12.4				STATIC READING
	1045	0		—	0			START PUMPING
	1127	42		15.2	2.8			
	1145	60		15.5	3.1			
	1246	121		16.1	3.7			
	1416	211		16.3	3.9			
	1716	391		16.9	4.5			
	1926	521		17.2	4.8			
2/26/85	0826	1301		17.9	5.5			(RAIN)
	1311	1586		18.0	5.6			
	1656	1811		18.0	5.6			
2/27/85	0826	2741		18.1	5.7			
	1656	3251		18.2	5.8			
2/28/85	0826	4181		18.6	6.2			
	1656	4691		18.6	6.2			
3/1/85	0826	5621		18.6	6.2			
	1626	6101		18.6	6.2			
3/2/85	0826	7061		18.6	6.2			(OVERNIGHT RAIN)
3/3/85	0856	8531		18.8	6.4			
3/4/85	0856	9971		19.0	6.6			

Visitors:

Resident Engr.

Resident Engineer is to report in detail progress of work. All instructions issued, and orders delaying or releasing the execution of work. Occurrence of ...

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMPDOWN)

PIEZ No. 315 G.S. EL. 15.50 (Top Pez. 16.82) RADIUS 176' from ℄ WELL (FIELD MEAS)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From Top Piez.	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1027			14.8				STATIC READING
	1045	0		—	0			START PUMPING
	1129	44		15.6	0.8			
	1147	62		15.9	1.1			
	1300	135		16.5	1.7			
	1420	215		16.8	2.0			
	1720	395		17.3	2.5			
	1930	525		17.6	2.8			
2/26/85	0830	1305		18.1	3.3			(RAW)
	1315	1590		18.2	3.4			
	1700	1815		18.3	3.5			
2/27/85	0830	2745		18.5	3.7			
	1700	3255		18.6	3.8			
2/28/85	0830	4185		19.1	4.3			
	1700	4695		19.1	4.3			
3/1/85	0830	5625		19.1	4.3			
	1630	6105		19.1	4.3			
3/2/85	0830	7065		19.1	4.3			(OVERNIGHT RAIN)
3/3/85	0900	8535		19.4	4.6			
3/4/85	0900	9975		19.6	4.8			

Visitors:

Resident Engr.

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (PUMPDOWN)

PIEZ No. 318 G.S. EL. 18.60 (Top Piez. 18.99) RADIUS 219½' FROM ℄ WELL (FIELD MEAS)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER from Top Piez.	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1030			16.9				STATIC READING
	1045	0		—	0			START PUMPING
	1130	45		17.2	0.3			
	1149	64		17.2	0.3			
	1305	140		17.5	0.6			
	1425	220		17.6	0.7			
	1725	400		18.0	1.1			
	1935	530		18.1	1.2			
2/26/85	0835	1310		18.7	1.8			(RAIN)
	1320	1595		18.8	1.9			
	1705	1820		18.9	2.0			
2/27/85	0835	2750		19.2	2.3			
	1705	3260		19.3	2.4			
2/28/85	0835	4190		19.7	2.8			
	1205	4700		19.7	2.8			
3/1/85	0835	5630		19.9	3.0			
	1635	6110		19.9	3.0			
3/2/85	0835	7070		20.0	3.1			(OVERNIGHT RAIN)
3/3/85	0905	8540		20.2	3.3			
3/4/85	0905	9980		20.5	3.5			

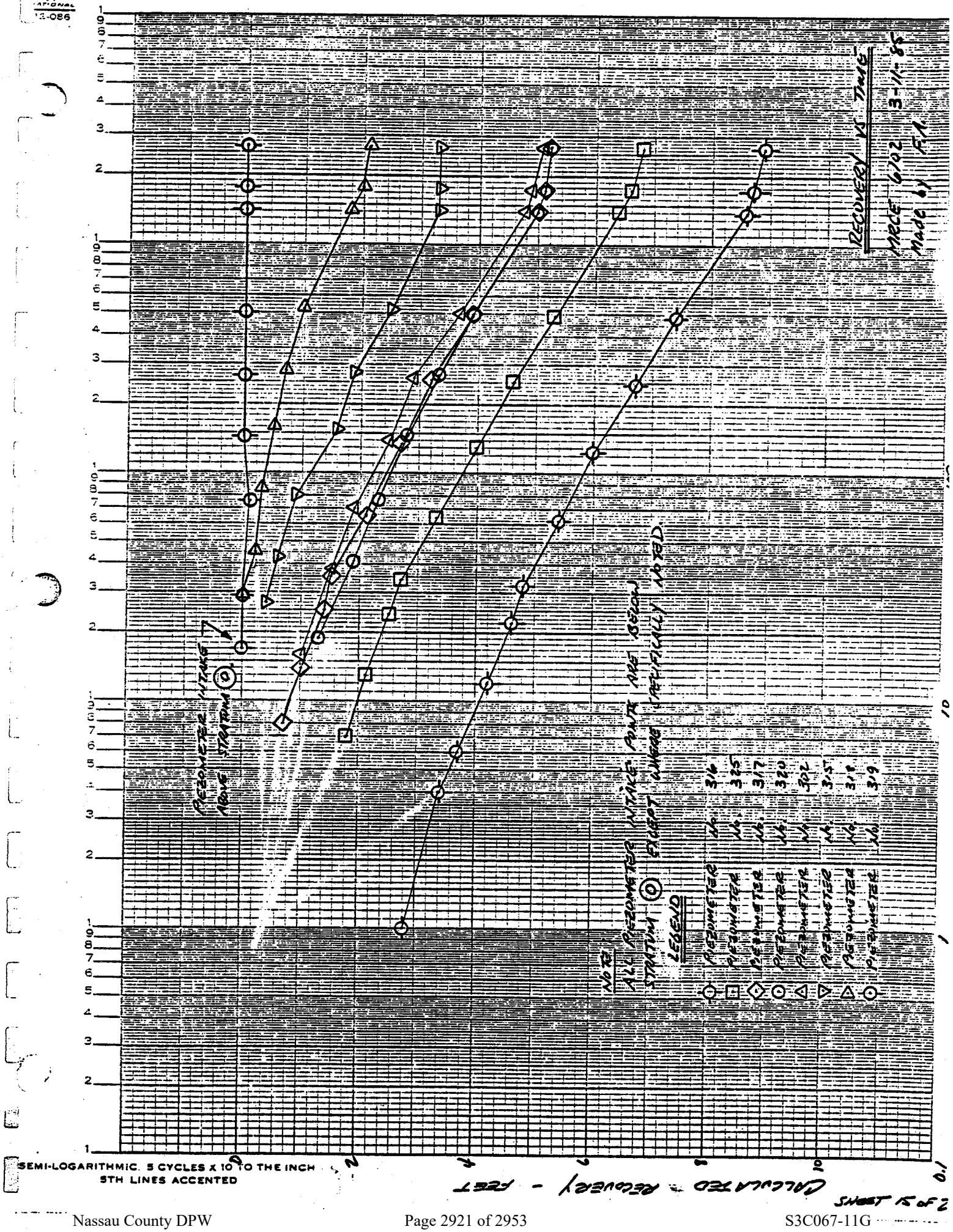
Visitors:

Resident Engr.

SHEET 14 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders covering or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

PUMPING TEST DATA (RECOVERY)


RECOVERY VS TIME
MADE 6 TO 2 3-11-58
MADE BY F.A.
RECOVERY - FEET
CALCULATED
SEMI-LOGARITHMIC. 5 CYCLES X 10 TO THE INCH
5TH LINES ACCENTED
SHEET 15 OF 2
LEGEND
PIEZOMETER No. 316
PIEZOMETER No. 325
PIEZOMETER No. 317
PIEZOMETER No. 320
PIEZOMETER No. 322
PIEZOMETER No. 321
PIEZOMETER No. 318
PIEZOMETER No. 319
STATION ⊙ EIGHT INCHES (INTAKE) PAST SECOND (ARTIFICIALLY MIXED)
NO 13
ALL PIEZOMETERS AT INTAKE
PIEZOMETER INTAKE STATION ⊙

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. WELL = G.S. EL. ____ RADIUS 0.0

(TOP PIEZ = 16.46)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN s (START) (EXTRAP.)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/4/85	1110	10105	0		29.6			PUMPING STOPED
	1110½	10105½	.5	24.0		9.6	20.0	SNOW
	1112	10107	2	22.3		7.9	21.7	
	1115	10110	5	21.6		7.2	22.4	
	1119	10114	9	20.9		6.2	23.4	
	1130	10125	20	20.3		5.9	23.7	
	1140	10135	30	20.0		5.6	24.0	
	1210	10145	60	19.5		5.1	24.5	
	1310	10225	120	18.8		4.4	25.2	Rain
	1510	10345	240	18.2		3.8	25.8	
	1910	10585	480	17.5		3.1	26.5	
3/5/85	1015	11490	1385	16.2		1.8	27.8	
	1615	11850	—	—				LEVEL NOT RECORDED
3/6/85	0700	12735	—	—				(SEE FILTER)

Visitors:

Frank McCue
Resident Engr.

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

SHEET 16 OF 29

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. FILTER - G.S. EL. — RADIUS 7" Well ℄
(Top Pier. 15.83)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
3/4/85	1110	10105	0		29.5			PUMPING STOPPED
	1113	10108	3	21.4		7.8	21.7	SNOW
	1120	10115	10	20.2		6.6	22.9	
	1131	10126	21	19.5		5.9	23.6	
	1141	10136	31	19.3		5.7	23.8	
	1211	10166	61	18.8		5.2	24.3	
	1311	10226	121	18.1		4.5	25.0	RAIN
	1511	10346	241	17.5		3.9	25.6	
	1911	10586	481	16.7		3.1	26.4	
3/5/85	1015	11490	1385	15.4		1.8	27.7	
	1615	11850	1745	15.4		1.8	27.7	
3/6/85	0700	12755	2630	15.1		1.5	28.0	

Visitors:

Frank Clark
Resident Engr.

SHEET 17 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. 316 GS EL. 13.7 (TOP PIPE 14.55) RADIUS 22' WELL ℄

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
3/4/85	1110	10105	0	-	10.3			PUMPING STOPPED
	1111	10106	1	20.0		7.5	2.8	SNOW
	1114	10109	4	19.4		6.9	3.4	
	1116	10111	6	19.1		6.6	3.7	
	1122	10117	12	19.6		6.1	4.2	
	1132	10127	22	18.2		5.7	4.6	
	1142	10137	32	18.0		5.5	4.8	
	1212	10167	62	17.4		4.9	5.4	
	1315	10230	125	16.8		4.3	6.0	RAIN
	1515	10350	245	16.1		3.6	6.7	
	1915	10590	485	15.4		2.9	7.4	
3/5/85	1020	11495	1390	14.2		1.7	8.6	
	1620	11855	1750	14.1		1.6	8.7	
3/6/85	0705	12740	2635	13.9		1.4	8.9	

Visitors:

Frank Adams
Resident Engr.

SHEET 18 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. 325 G.S. EL. 14.50 RADIUS 45' Well ℄
(Top Pipe 16.34)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
3/4/85	1110	10105	0	-	8.0			PUMPING STOPPED
	1117	10112	7	19.9		6.2	1.8	SLOW
	1123	10118	13	19.6		5.9	2.1	
	1134	10129	24	19.2		5.5	2.5	
	1144	10139	34	19.0		5.3	2.7	
	1214	10169	64	18.4		4.7	3.3	
	1320	10235	130	17.7		4.0	4.0	RAM
	1520	10355	250	17.1		3.4	4.6	
	1920	10595	490	16.4		2.7	5.3	
3/5/85	1025	11500	1395	15.3		1.6	6.4	
	1625	11860	1755	15.1		1.4	6.6	
3/6/85	0710	12745	2640	14.9		1.2	6.8	

Visitors:

Frank Clark
Resident Engr.

SHEET 19 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. 317 G.S. EL. 16.10 (Top Pipe 16.54) RADIUS 77' Well ℄

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
3/4/85	1110	10105	0	-	6.6			PUMPING STOPPED
	1118	10113	8	20.7		5.9	0.7	SNOW
	1124	10119	14	20.4		5.6	1.0	
	1135	10130	25	20.0		5.2	1.4	
	1145	10140	35	19.9		5.1	1.5	
	1215	10170	65	19.3		4.5	2.1	
	1325	10240	135	18.7		3.9	2.7	RAIN
	1525	10360	255	18.2		3.4	3.2	
	1915	10600	495	17.5		2.7	3.9	
3/5/85	1030	11505	1400	16.4		1.6	5.0	
	1630	11865	1760	16.3		1.5	5.1	
3/6/85	0715	12750	2645	16.2		1.4	5.2	

Visitors:

Frank Clark
Resident Engr.

SHEET 20 OF 29

Resident Engineer is to report in detail progress of work. All instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. 302 = GS EL. 13.00 RADIUS 99' to well ℄
(TOP PIPE 14.02)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN δ (START)	DRAW-DOWN δ' (STOP)	CALC. REC. δ-δ'	REMARKS
3/4/85	1110	10105	0		6.4			PUMPING STOPPED
	1126	10121	16	17.4		5.4	1.0	SNOW
	1148	10143	38	16.9		4.9	1.5	
	1220	10175	70	16.5		4.5	1.9	
	1330	10245	140	15.9		3.9	2.5	RAIN
	1530	10365	260	15.5		3.5	2.9	
	1930	10605	500	14.7		2.7	3.7	
3/5/85	1035	11570	1405	13.6		1.6	4.8	
	1635	11870	1765	13.5		1.5	4.9	
3/6/85	0720	12755	2650	13.3		1.3	5.1	

Visitors:

Resident Engr.

SHEET 21 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported monthly. Progress to be filed [illegible]

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

DATE: AS SHOWN BELOW

FILE NO. 6102

WEATHER _____

PROJECT CEDAR CREEK WPCP

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

Rez No. 319 = GS EL. 13.75 RADIUS 29½' Well ℄
(Top Rez 14.85)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumping)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
3/4/85	1110	10105	0		1.4			PUMPING STOPPED
	1127	10122	17	13.6		1.5	0.0	SNOW
	1139	10134	29	13.5		1.4	0.0	↓
	1225	10180	75	13.4		1.3	0.1	↓
	1335	10250	145	13.5		1.4	0.0	RAIN
	1535	10370	265	13.5		1.4	0.0	↓
	1935	10610	505	13.5		1.4	0.0	↓
3/5/85	1040	11515	1410	13.5		1.4	0.0	
	1640	11875	1770	13.5		1.4	0.0	
3/6/85	0725	12760	2655	13.5	↓	1.4	0.0	

Visitors:

Resident Engr.

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported monthly. Reports to be mailed daily.

SHEET 22 OF 29

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. 320 = GS EL. 13.60 RADIUS 87' WELL ℄
(TOP PIEZ. 14.52)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN δ (START)	DRAW-DOWN δ' (STOP)	CALC. REC. δ-δ'	REMARKS
3/4/85	1110	10105	0		6.6			PUMPING STOPPED
	1129	10124	19	17.7		5.3	1.3	SNOW
	1151	10146	41	17.1		4.7	1.9	
	1227	10182	77	16.7		4.3	2.3	
	1337	10252	147	16.2		3.8	2.8	RAIN
	1537	10372	267	15.7		3.3	3.3	
	1937	10612	507	15.1		2.7	3.9	
3/5/85	1042	11517	1412	14.0		1.6	5.0	
	1642	11877	1772	13.9		1.5	5.1	
3/6/85	0727	12762	2657	13.8		1.4	5.2	

Visitors:

Resident Engr.

SHEET 23 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Occurrence of work considered to be covered by...

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER

TEMPERATURE

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. 315 - G.S. EL. 15.50 (T.o.Pipe 16.82) RADIUS 176 Well ℄

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN δ (START)	DRAW-DOWN δ' (STOP)	CALC. REC. δ-δ'	REMARKS
2/4/85	1110	10105	0		4.8			PUMPING STOPPED
	1137	10132	27	19.2		4.4	0.4	SLOW
	1153	10148	43	19.0		4.2	0.6	
	1230	10185	80	18.7		3.9	0.9	
	1345	10260	155	18.0		3.2	1.6	RAW
	1545	10380	275	17.7		2.9	1.9	
	1945	10620	515	17.1		2.3	2.5	
3/5/85	1045	11520	1415	16.3		1.5	3.3	
	1645	11880	1775	16.3		1.5	3.3	
3/6/85	0730	12765	2660	16.3		1.5	3.3	

Visitors:

Resident Engr.

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Occurrence of work stoppages

SHEET 24 OF 29

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 10P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (RECOVERY)

PIEZ No. 218 = GS EL. 18.00 (Top Pipe 18.99) RADIUS 25'2" Well 2

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
3/4/85	1110	10105	0		3.5			PUMPING STOPPED
	1139	10134	29	20.4		3.5	0.0	
	1155	10150	45	20.2		3.3	0.2	
	1235	10190	85	20.1		3.2	0.3	
	1350	10265	160	19.9		3.0	0.5	
	1550	10385	280	19.7		2.8	0.7	
	1950	10625	520	19.4		2.5	1.0	
3/5/85	1050	11525	1420	18.6		1.7	1.8	
	1650	11885	1780	18.4		1.5	2.0	
3/6/85	0735	12770	2665	18.3	↓	1.4	2.1	

Visitors:

Resident Engr.

SHEET 25 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders delaying or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

ADDITIONAL PIEZOMETER READINGS

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA (ADDITIONAL PIEZOMETER READINGS)

PIEZ No. MW1 G.S. EL. — RADIUS —
(TOP PIEZ 12.44)

DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER from Top Pipe	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/22/85	1500			10.3				STATIC
2/25/85	1045	0						START PUMPING
2/26/85	1015	1410		11.1				(RAIN)
	1550	1745		11.0				
2/27/85	0855	2770		11.2				
2/28/85	0905	4220		11.9				LOW tide, winds offshore
	1005	4280		11.9				Tide coming in
	1405	4520		11.7				high tide, winds offshore
	1605	4640		11.6				
3/1/85	0905	5660		11.7				
	1105	5780		11.7				
	1305	5900		11.7				winds onshore
	1505	6020		11.6				winds onshore
3/2/85	0905	7100		11.5				OVERNIGHT RAIN
3/3/85	0915	8550		11.9				LOW tide (going out) winds offsh
3/4/85	0915	9990		11.9				High tide, Winds: onshore
	1110		0					PUMPING STOPPED
3/5/85	1105		1435	10.9				High tide
	1305		1555	11.0				
	1505		1675	11.1				
3/6/85	0805			11.1				High tide

Visitors:

Resident Engr.

SHEET 26 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, all orders delaying or changing the execution of work. Decisions of unit completed to be approved promptly.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA

PIEZ No. MW2 GS EL. — (TOP PIEZ 14.98) RADIUS 700 ±

DATE	TIME	ELAPSED TIME (t) FROM START (Pumping)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From Top Piez.	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1045	0		-				START PUMPING
2/26/85	1000	1395		13.9				RAIN
	1330	1685		13.9				
	1610	1765		13.9				
2/27/85	0850	2765		14.0				
	1715	3270		14.1				
2/28/85	0900	4215		14.5				
	1000	4275		14.5				
	1200	4395		14.5				
	1400	4515		14.5				
	1600	4635		14.5				
3/1/85	0900	5655		14.5				
	1100	5775		14.5				
	1300	5895		14.5				
3/2/85	0900	7095		14.5				OVERNIGHT RAIN
3/3/85	0920	8555		14.9				
3/4/85	0920	9995		14.9				
	1110		0					PUMPING STOPPED
3/5/85	1100		1430	13.6				
	1300		1550	13.6				
	1500		1670	13.6				
3/6/85	0800			13.6				

Visitors:

Frank Clark
Resident Engr.

SHEET 27 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders relaying or releasing the execution of work. Presence of each employee on the work

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA

PIEZ No. 206 G.S. EL. 16.1 (Top Pipe 16.9) RADIUS —

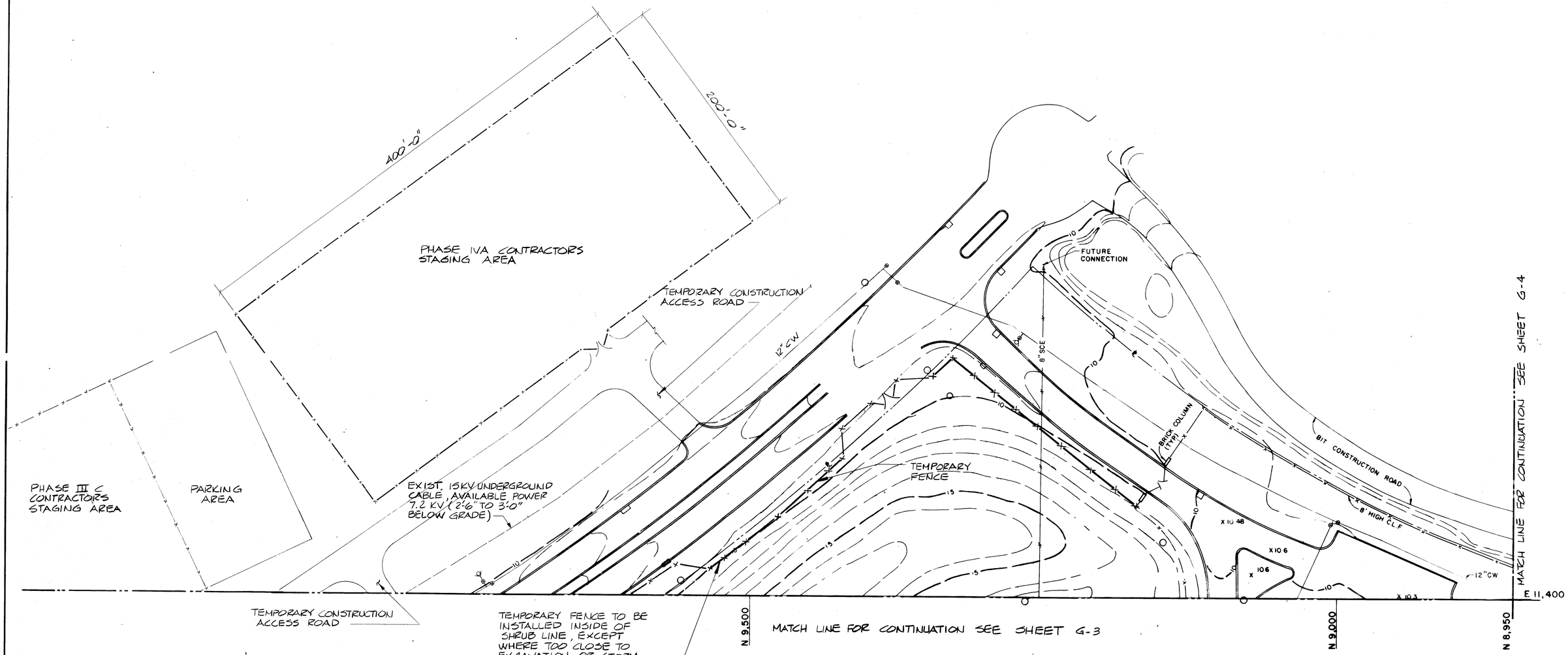
DATE	TIME	ELAPSED TIME (t) FROM START (Pumpdown)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From Top Pipe	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1045	0						START PUMPING (RAIN)
2/26/85	1115	1470		15.2				
	1555	1750		15.1				
2/27/85	0905	2780		15.1				
2/28/85	0910	4225		15.7				
3/1/85	0910	5665		15.7				
3/2/85	0935	7130		16.0				
3/3/85	0935	8570		16.0				OVERNIGHT RAIN
3/4/85	0935	10010		16.0				
	1110							PUMPING STOPPED
3/5/85	1115			15.5				
3/6/85	0750			15.8				

Visitors:

Resident Engr.

SHEET 28 OF 29

Resident Engineer is to report in detail progress of work, delays, instructions issued, and orders relative or pertaining to the same



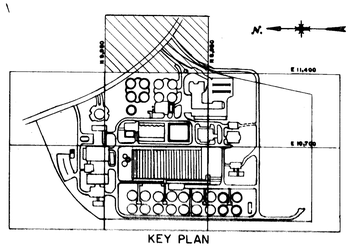
LEGEND

- BORING
- MW Groundwater Monitoring Well

"P" indicates a piezometer was installed in the borehole.

"U" indicates undisturbed samples were obtained in the boring.

"(A)" indicates the boring was offset from its original drilled location because an obstruction was encountered.



KEY PLAN

WARNING IT IS A VIOLATION OF NEW YORK EDUCATION LAW SECTION 7209.2 FOR ANY PERSON UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR TO ALTER THIS DOCUMENT IN ANY WAY IF ALTERED THE ALTERING PERSON SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATION LAW SECTION 7209.2

FOR REFERENCE ONLY

MALCOLM PIRNIE

REVISIONS			
NO	BY	DATE	REMARKS

DES GD
DWN GD
CKD

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK W.P.C.P. IMPROVEMENTS

PHASE IVA CONTRACT NO S3C042G

GENERAL

BORING LOCATION PLAN I

SCALE: 1"= 40'

MALCOLM PIRNIE, INC.

DATE APRIL 1987

SHEET 1 OF 7

DWG NO.

EXIST. CIRCUIT BREAKER

PHASE IIIC ELECT. SERVICE POINT

PHASE III C CONTRACTORS STAGING AREA

EXIST. 15 KV UNDERGROUND CABLE

EXIST. SAN SEWER

6" TEE

EXIST. 10" SAN. SEWER

12"CW

8,000 GAL LUBE OIL STORAGE TANK

6"CW

TANK NO.2
B-408U
TANK NO.1

2,000 GAL. LUBE OIL WASTE TANK

2,000 GAL. FUEL OIL WASTE TANK

B-407

50,000 GAL. FUEL OIL STORAGE TANKS

8"D

B-328UP

INV EL.-21.38

108" RWS

LIMIT OF PILES

GUARD HOUSE

SEWER 2"W.O. 1½"TDS, 2½"FOR, 2½"FDS, 2½"FD2

ADMINISTRATION BUILDING
FF EL 15.50

B-11

B-401P

B-402

B-403

20" SCE RETURN
20" SCE SUPPLY

GENERATOR BUILDING
FIN. FL. EL. 15.50
("B" BUILDING ANNEX)

8"DG
6"NG
6"AGRUA

B-406U

24" TD

MATCH LINE - FOR CONTINUATION SEE SHEET No. G-5

MATCH LINE - FOR CONTINUATION SEE SHEET G-3

N 10,500

N 9,950

E 11,000

E 10,700

LEGEND

- BORING
- MW Groundwater Monitoring Well

"P" indicates a piezometer was installed in the borehole.

"U" indicates undisturbed samples were obtained in the boring.

"(A)" indicates the boring was offset from its original drilled location because an obstruction was encountered.

KEY PLAN

WARNING - IT IS A VIOLATION OF NEW YORK EDUCATION LAW, SECTION 7209 2, FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED, THE ALTERING PERSON SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATION LAW, SECTION 7209 2

MALCOLM PIRNIE

LICENSED PROFESSIONAL ENGINEER PAUL LOUIS BUSCH LIC. NO. 065 STATE OF NEW YORK

REVISIONS			
NO.	BY	DATE	REMARKS

DES RC
DWN FC
CKD PLB

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK W.P.C.P. IMPROVEMENTS

PHASE IVA CONTRACT NO. S3C0426

GENERAL

BORING LOCATION PLAN II

SCALE: 1"= 40'

MALCOLM PIRNIE, INC.

DATE APRIL 1987

SHEET 2 OF 7

DWG NO.

EXIST. 15KV UNDERGROUND CABLE

TEMP. CONSTRUCTION ACCESS ROAD

TEMPORARY FENCE TO BE INSTALLED INSIDE OF SHRUB LINE, EXCEPT WHERE TOO CLOSE TO EXCAVATION OR STORM RUN-OFF BERM

MATCH LINE - FOR CONTINUATION SEE SHEET No. G-1

MATCH LINE - FOR CONTINUATION SEE SHEET No. G-2

MATCH LINE - FOR CONTINUATION SEE SHEET No. G-4

MATCH LINE - FOR CONTINUATION SEE SHEET No. G-6

N 9,950 E 11,400

N 8,950 E 11,400

N 9,950 E 10,700

N 8,950 E 10,700

DIGESTER NO.7

DIGESTER NO.5

DIGESTER NO.8

DIGESTER NO.6

DIGESTER NO.9

DIGESTERS & DIGESTER CONTROL BUILDING

DIGESTERS & DIGESTER CONTROL BUILDING F.F. EL. 15.00

SEE SHEET G-36 FOR PIPE PROFILE

TEMPORARY FENCE

16" D.G. SEE SHEET G-36 FOR PROFILE AND B502 FOR PART PLAN CB 2D-7

SLUDGE THICKENING TANKS ODOR CONTROL BUILDING

SLUDGE THICKENING TANKS & BUILDING F.F. EL. 17.00

SLUDGE THICKENING TANKS & BUILDING

SUBSTATION NO. 12

18" SUBMATALT EFFLUENT

WASTE GAS BURNERS

STAIR TOWER #1

STAIR TOWER #2

ROAD "D"

ROAD "E"

ROAD "E-2"

TEMP. PAVE. ROAD "E"

TEMP ACCESS PAVEMENT

MEET EXIST. GRADES

SEWER MAINTENANCE BUILDING F.F. EL. 12.00

GUARD RAIL SEE SHT. G-41

BULK STORAGE F.F. EL. 12.00

SEE NOTE 1

SEE NOTE 1

GRIT TANKS ODOR CONTROL BUILDING

GRIT TANKS AND BUILDING F.F. EL. 20.67

CONC APRON

PRIMARY SEDIMENTATION TANKS

PST ODOR CONTROL BUILDING

PRIMARY SEDIMENTATION BUILDING F.F. EL. 19.77

SLUDGE DEWATERING BUILDING F.F. EL. 16.50

ADMINISTRATION BUILDING

SUBSTATION NO. 11

TUNNEL (BELOW)

TUNNEL (EEL NW)

TRANSF PAD

LIMIT OF PILES

HYDRANT

UNDERDRAIN RISER PIPE (S) SEE SHT. G-39

B501 B502 B503 B504 B505

B1 (MR) B2 (HR) B3 (HR)

B-1 B-2 B-3 B-8 B-10 B-13

B-203 (14.9) B-205 (17.6) B-208 (19.7) B-209 (19.7) B-210 (19.2) B-211 (20.1) B-212 (17.7) B-213 (14.3) B-214 (15.3) B-314

MH 48-3 MH 48-3A MH 48-3B MH 2D-1 MH 2D-1A MH 2D-3 MH 2D-4

CB 2D-8 CB 5E-1

EHH 27 EHH 28 EHH 29 EHH 30 EHH 31 EHH 33 EHH 34 EHH 35

℄ COORDINATES FOR ELECT. MANHOLES & HANDHOLES	
EHH 28	N 9854.58 E 10961.50
EHH 29	N 9604.01 E 10961.50
EHH 30	N 9562.00 E 10978.26
EHH 31	N 9380.50 E 10981.25
EHH 32	N 9332.50 E 10982.25
EHH 33	N 9486.50 E 11123.64
EHH 34	N 9248.00 E 10,989.00
EHH 35	N 9215.25 E 11185.83
EHH 36	N 9371.83 E 10999.67
EHH 37	N 9647.00 E 11086.91

LEGEND

- BORING
- MW Groundwater Monitoring Well

"P" indicates a piezometer was installed in the borehole.

"U" indicates undisturbed samples were obtained in the boring.

"(A)" indicates the boring was offset from its original drilled location because an obstruction was encountered.

KEY PLAN

WARNING IT IS A VIOLATION OF NEW YORK EDUCATION LAW, SECTION 7209 2, FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED, THE ALTERING PERSON SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATION LAW, SECTION 7209.2.

MALCOLM PIRNIE

REVISIONS			
NO.	BY	DATE	REMARKS

DES RL
DWN RC
CKD

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK W.P.C.P. IMPROVEMENTS

PHASE IVA CONTRACT NO. S3C042G

GENERAL

BORING LOCATION PLAN III

SCALE: 1"= 40'

MALCOLM PIRNIE, INC.

DATE APRIL, 1987

G SHEET 3 OF 7

DWG NO.

MATCH LINE - FOR CONTINUATION SEE SHEET NO. G-3

SEWER MAINTENANCE BUILDING

EXIST. AWT. STAGING AREA TRANSFORMER

PHASE IID CONTRACTOR'S STAGING AREA

PHASE IID TEMP. SERVICE POINT

MW-1 (10.9)

TEMP. PHASE IID POWER POLE (TYP.)

STORAGE AREA

STORAGE AREA

STORAGE BINS (TYP)

BULK STORAGE FF EL 12.00

SLUDGE DEWATERING BUILDING FF EL 16.50

TERTIARY TREATMENT BUILDING FF EL 16.50

CONC APRON

TRANSF PAD

18" CATE
30" WB
24" D
INACTIVE

SW (TYP)

PHASE IIIA CONTRACTOR'S STAGING AREA

E 10,700

N 8,950

MATCH LINE - FOR CONTINUATION SEE SHEET NO. G-7

LEGEND

- BORING
- MW Groundwater Monitoring Well
- "P" indicates a piezometer was installed in the borehole.
- "U" indicates undisturbed samples were obtained in the boring.
- "A" indicates the boring was offset from its original drilled location because an obstruction was encountered.

KEY PLAN

WARNING - IN LOCATION OF NEW YORK EDUCATION LAW, SECTION 7209.2, FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED, THE ALTERING PERSON SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATION LAW, SECTION 7209.2.

MALCOLM PIRNIE

LICENSED PROFESSIONAL ENGINEER LOUIS PARISI STATE OF NEW YORK

REVISIONS			
NO.	BY	DATE	REMARKS

DES RC
DWN
CKD PAP

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK W.P.C.P. IMPROVEMENTS

PHASE IVA

GENERAL

BORING LOCATION PLAN IV

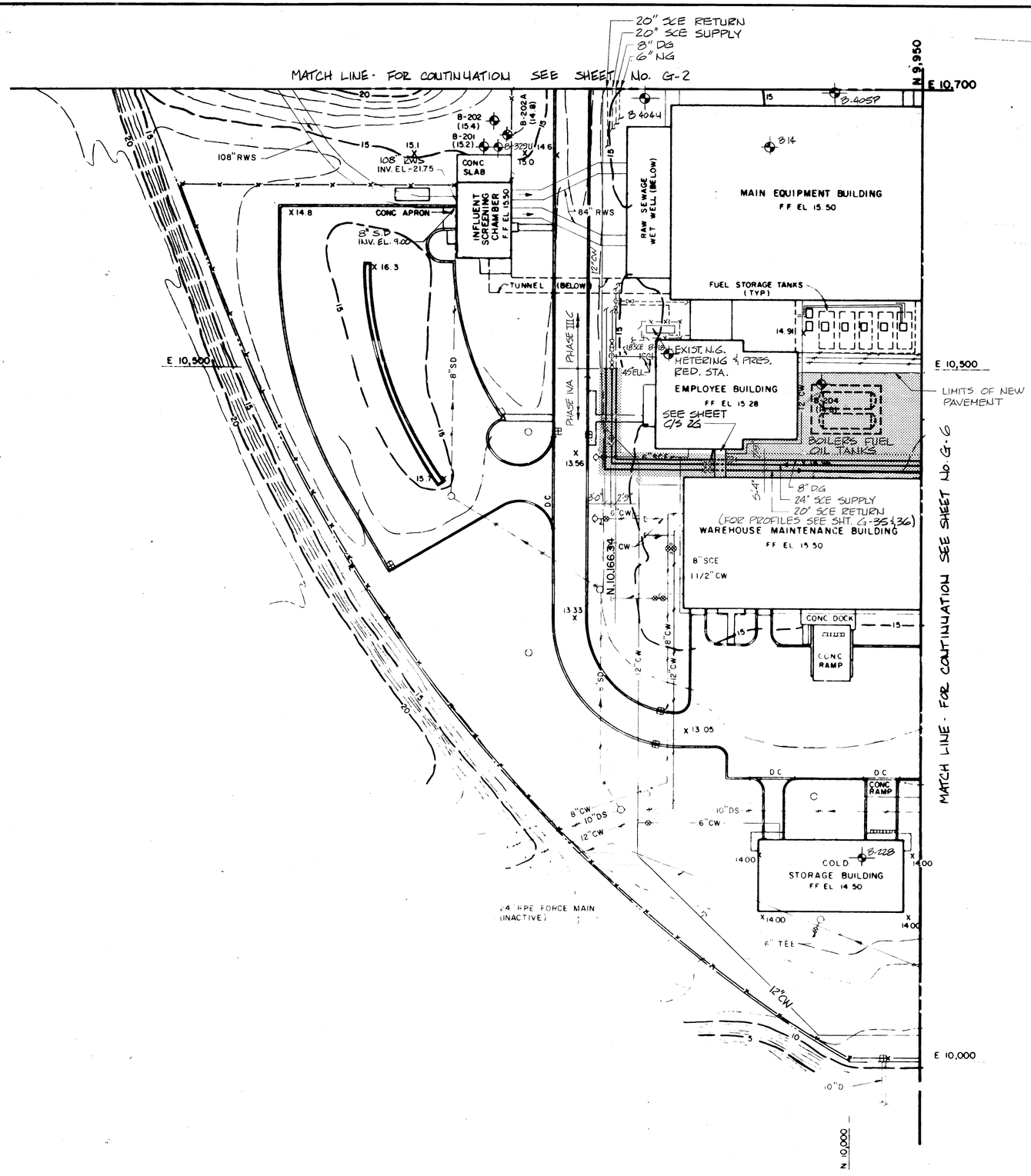
SCALE 1"=40'

MALCOLM PIRNIE, INC.

DATE APRIL, 1987

G SHEET 4 OF 7

DWG NO



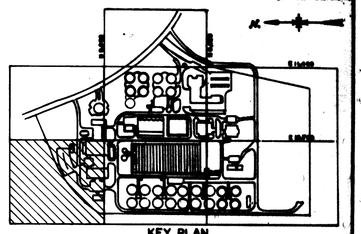
LEGEND

- BORING
- MW Groundwater Monitoring Well

"P" indicates a piezometer was installed in the borehole.

"U" indicates undisturbed samples were obtained in the boring.

"(A)" indicates the boring was offset from its original drilled location because an obstruction was encountered.



KEY PLAN

WARNING - IT IS A VIOLATION OF NEW YORK EDUCATION LAW, SECTION 7209.2, FOR ANY PERSON UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED, THE ALTERING PERSON SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATION LAW, SECTION 7209.2

MALCOLM PIRNIE

LICENSED PROFESSIONAL ENGINEER PAUL LOUIS ENGEL No. 049870 STATE OF NEW YORK

REVISIONS			
NO.	BY	DATE	REMARKS

DES RC
DWN FC
CKD PAE

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK W.P.C.P. IMPROVEMENTS

PHASE IVA

CONTRACT NO. S3C042G

GENERAL

BORING LOCATION PLAN V

SCALE: 1"=40'

MALCOLM PIRNIE, INC.

DATE APRIL 1987

G SHEET 5 OF 7

DWG NO.

N 9,950 E 10,700

MATCH LINE - FOR CONTINUATION SEE SHEET NO. 3

N 8,950 E 10,700

MATCH LINE - FOR CONTINUATION SEE SHEET NO. G-5

MATCH LINE - FOR CONTINUATION SEE SHEET NO. 7

E 10,500

E 10,000

N 9,500

N 9,000

MAIN EQUIPMENT BUILDING F.F. EL 15.50

MAINT BUILDING F.F. EL 8.50

WAREHOUSE MAINT BUILDING F.F. EL 5.50

SEE PARTIAL PLAN ON SHEET C/S 2G

SEE SHEET G-36 FOR PROFILE

EXISTING PLANTING TO REMAIN (TYP.)

GAS STORAGE SPHERE

WATER STORAGE TANK

AERATION TANKS TOP EL 18.42

TUNNEL (BELOW)

TUNNEL (BE.CW)

SUBSTATION NO. 13

E 10421.83

N 9204.67

R A S PUMPING STATION SLAB EL 18.42

EFFLUENT SCREENING, CHLORINATION & PUMPING FACILITIES FF EL 13.5

FOR RETURN ACTIVATED SLUDGE DRY WELLS SEE SHEET C/S-12A

24" SCE - FOR PROFILE SEE SHEET G-35

10"OVF (INACTIVE)

20"ML (INACTIVE)

18"RAS

8"SM

20"SCE RETURN SEE PROFILE SHT. NO. G-35

LIMIT OF PILES

LIMITS OF NEW PAVEMENT

EXH 29

EXH 26

EXH 25

EXH 24

E10,630.0

E10,430.92

E10,301.91

N9,800.42

NO 1 TOP EL. 14.50

NO 2 TOP EL. 14.50

NO 3 TOP EL. 14.50

NO 4 TOP EL. 14.50

NO 5 TOP EL. 14.50

RAS PUMPING STAT. (INACTIVE)

NO 6 TOP EL. 14.50

NO 7 TOP EL. 14.50

NO 8 TOP EL. 14.50

NO 9 TOP EL. 16.50

NO 10 TOP EL. 16.50

NO 11 TOP EL. 16.50

NO 12 TOP EL. 16.50

FINAL SEDIMENTATION TANKS

JUNCTION CHAMBER

24"RPE FORCE MAIN (INACTIVE)

SEE DETAIL 1 / 35 / 12A / G / C/S

LEGEND

- BORING
- MW Groundwater Monitoring Well

"P" indicates a piezometer was installed in the borehole.

"U" indicates undisturbed samples were obtained in the boring.

"(A)" indicates the boring was offset from its original drilled location because an obstruction was encountered.

KEY PLAN

WARNING - IT IS A VIOLATION OF NEW YORK EDUCATION LAW, SECTION 7209.2, FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED, THE ALTERING PERSON SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATION LAW, SECTION 7209.2.

MALCOLM PIRNIE

REVISIONS			
NO.	BY	DATE	REMARKS

DES RC

DWN RC

CKD

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK W.P.C.P. IMPROVEMENTS

PHASE IVA CONTRACT NO. S3C042G

GENERAL

BORING LOCATION PLAN VI

SCALE: 1"= 40'

MALCOLM PIRNIE, INC.

DATE APRIL, 1987

SHEET 6 OF 7

DWG NO.

MATCH LINE - FOR CONTINUATION SEE SHEET NO. G-4

E 10,700 N 8,950

FOR CONTINUATION SEE SHEET NO. G-6

E 10,500

E 10,000

N 8,810.00

N 8,500

N 8,000

B-326 B-323 B-308 B-321 B-304 B-225 (12.7) B-103 B-306 B-226 (14.2) B-307 B-305 B-224

TRAILER
TRAILER
CONSTRUCTION HOUSE
INACTIVE 15" GATE 30" WB 24" DI
SW (TYP)
4"PY
2"SCE
3"SCE
4"SCE
6" SW
84" FSE
36" SE
96" SE
42" ML
20" RAS
15" SE (PLUGGED)
MW-2 (13.6)
R.A.S. PUMPING STATION SLAB EL 18.42
SM MH 3
FINAL SEDIMENTATION TANKS
NO 13
TOP EL 16.50
NO 14
TOP EL 16.50
MAIN SUBSTATION
JUNCTION CHAMBER NO. 4
RIM EL 13.04
INV EL +5.50
RIM EL.
INV EL -5.50

14.40 14.60 14.80 14.07 15.1 14.83 14.67 15.83 16.48 15.70 15.83 15.83 X 18.25 18.25 18.66 18.27 18.57 14.50 18.00 13.25 15.38 15.64 X 14.42 X 13.50 12.7 10.5 10.5 X 10.4 10.4 X X 10.3 10.3 X 10.2 10.2 10.1 10.1 10.0 10.0

LEGEND

BORING

MW Groundwater Monitoring Well

"P" indicates a piezometer was installed in the borehole.

"U" indicates undisturbed samples were obtained in the boring.

"(A)" indicates the boring was offset from its original drilled location because an obstruction was encountered.

KEY PLAN

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MALCOLM PIRNIE

LICENSED PROFESSIONAL ENGINEER PAUL LOUIS OTTSEN LIC. NO. 064442 STATE OF NEW YORK

REVISIONS		
NO.	DATE	REMARKS

DES. PSC
DWN. EPC
CKD PAR

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK W.P.C.P. IMPROVEMENTS

PHASE IVA CONTRACT NO. S3C042G

GENERAL

BORING LOCATION PLAN VII

SCALE: 1"= 40'

MALCOLM PIRNIE, INC.

DATE APRIL, 1987

G SHEET 7 OF 7

DWG. NO.

MUESER RUTLEDGE CONSULTING ENGINEERS

DAILY FIELD REPORT

REPORT NO. 3P

FILE NO. 6102

PROJECT CEDAR CREEK WPCP

DATE: AS SHOWN BELOW

WEATHER _____

TEMPERATURE _____

CONTRACTORS WORKING: 1ST SHIFT 2ND SHIFT 3RD SHIFT

PROGRESS OF WORK:

PUMP TEST DATA

PIEZ No. 206A G.S. EL. 16.1 (Top Piez. 17.1) RADIUS —

DATE	TIME	ELAPSED TIME (t) FROM START (Pumping)	ELAPSED TIME (t') FROM STOP (Rec.)	DEPTH TO WATER From Top Piez.	DRAW-DOWN s (START)	DRAW-DOWN s' (STOP)	CALC. REC. s-s'	REMARKS
2/25/85	1045	0		-				START PUMPING
2/26/85	1130	1485		14.2				(RAIN)
	1556	1751		14.1				
2/27/85	0906	2781		14.1				
2/28/85	0911	4226		14.2				
3/1/85	0911	5666		14.2				
3/2/85	0936	7131		14.4				OVERNIGHT RAIN
3/3/85	0936	9571		14.4				
3/4/85	0936	10041		14.4				
	1110		0					PUMPING STOPPED
3/5/85	1116			14.4				
3/6/85	0751			14.6				

Visitors:

Frank Clark
Resident Engr.

SHEET 29 OF 29

Resident Engineer is to report in detail progress of work, all instructions issued, and orders relieving or releasing the execution of work. Percentage of work completed to be reported weekly. Reports to be mailed Daily.

MALCOLM PIRNIE

MUESER RUTLEDGE

MRCE REPORTS REGARDING THE CEDAR CREEK WPCP

1. "Pumping Test Data Report, Cedar Creek WPCP Expansion, Wantagh, NY", March 18, 1985.

2. "Geotechnical Data Report, Cedar Creek WPCP Expansion, Wantagh, NY", April 3, 1985.

3. "Driller's Logs of Borings, Cedar Creek WPCP, Wantagh, NY", April 15, 1985.

4. "Evaluation of Effects of Construction Dewatering on Existing Structures, Phase IIIA Construction, Cedar Creek WPCP Expansion, Wantagh, NY", April 30, 1985.

5. "Foundation Support for Proposed Primary Sedimentation Tanks and Odor Control Building, Cedar Creek WPCP Expansion, Wantagh, NY", May 13, 1985.

6. "Potential Effects of Pile Driving on Existing Structures, Cedar Creek WPCP Expansion, Wantagh, NY", May 30, 1985.

7. "Foundation Recommendations, Cedar Creek WPCP Expansion, Phase IV Construction, Wantagh, New York", June 21, 1985.

8. "Investigation of Alternative Construction Methods, Influent Screening Chamber, Cedar Creek WPCP Expansion, Wantagh, New York", August 21, 1985.

- October 1988 -

9. "Foundations for 96" PST Influent Conduit, Cedar Creek WPCP Expansion, Wantagh, New York, October 21, 1985.

10. "Soil Borings at Odor Control Building, Phase IIIA Construction, Cedar Creek WPCP Expansion, Wantagh New York", November 19, 1985.

11. "Excavation Dewatering at Aeration and Final Tanks, Cedar Creek WPCP, Phase IIIA Construction, Wantagh, New York", November 27, 1985.

12. "Foundation Support, Electrical Substations and Duct Banks, Phase IV Construction, Cedar Creek WPCP Expansion, Wantagh, New York", December 18, 1985.

13. "Dewatering System Performance Criteria, Influent Screening Chamber, Cedar Creek WPCP Expansion, Wantagh, New York", January 9, 1986.

14. "Site Meeting and Inspection, Cedar Creek WPCP Expansion, Phase IIIA, Wantagh, New York", February 20, 1986.

15. "Vibration Monitoring Study, 96" Effluent and 84" Outfall Pipes, Phase IIIA Construction, Cedar Creek WPCP Expansion, Wantagh, New York", February 25, 1986.

- October 1988 -

16. "Foundation Support Interim Generator Building and Fuel Storage Tanks, Phase IIIC, Construction, Cedar Creek WPCP Expansion, Wantagh, New York", March 25, 1986.

17. "Excavation Dewatering of Aeration and Final Tanks, Cedar Creek WPCP, Phase IIIA Construction, Wantagh, New York", March 31, 1986.

18. Letter "Underdrainage System for Digesters 5 thru 8, Cedar Creek WPCP, Wantagh, New York", May 28, 1986.

19. "Foundation support for Phase IIIC and IVA Construction of Piping and Miscellaneous Structures, Cedar Creek WPCP, Wantagh, New York", June 10, 1986.

20. "Field Soil Test Boring Data-Meuser Rutledge Consulting Engineers-Power Generating Building, Cedar Creek", June 10, 1986.

21. "Construction Dewatering for Digesters 5 thru 8, Phase IVA Construction, Cedar Creek WPCP, Wantagh, New York", July 16, 1986.

22. "Subsurface Investigation Power Generating Building, Cedar Creek WPCP, Wantagh, New York", July 24, 1986.

- October 1988 -

23. "Subsurface Investigation for Phase IVA Piping in Northeast Quadrant of Plant, Cedar Creek WPCP, Wantagh, New York", August 19, 1986.

24. "Foundation Support North Digester Tunnel and Digester No. 9, Cedar Creek WPCP Expansion, Phase IVA Construction, Wantagh, New York", January 28, 1987.

25. "Construction Dewatering for Digesters 5 thru 9 and North Digester Tunnel, Phase IVA Construction", February 27, 1987.

26. "Excavation support Phase IVA Digesters and Digester Control Building", March 24, 1987.

27. "Construction Dewatering for Phase IVA Digester Tanks, Sludge Thickening Tanks and Fuel Storage Tanks, Cedar Creek WPCP, Wantagh, New York", MRCE #6102A, March 26, 1987.

28. "Piles in Fill Area Power Generating Building, Cedar Creek WPCP, Wantagh, New York", MRCE #6500, May 1, 1987.

29. "Foundation Support Odor Control Building at Influent Screening Building, Cedar Creek WPCP Expansion, Wantagh, New York", June 23, 1987.

- October 1988 -

30. "Augered Grout-Injected Pile Load Test Program Power Generating Building, Cedar Creek WPCP, Wantagh, New York", July 7, 1987.

31. "Power Generating Building, Cedar Creek WPCP, Wantagh, New York", July 9, 1987.

- October 1988 -

TO : DISTRIBUTION

FROM : DAVID N. ELLIS

DATE : THURSDAY FEBRUARY 28, 1991

RE.: WP - 103 WARDS ISLAND WPCP
MPI JOB/TASK NUMBERS - 2175 - 01 - 1

THE FOLLOWING SEQUENCE OF TASK NUMBERS HAVE BEEN SET-UP:

EACH INDIVIDUAL WORKING ON THE PROJECT IS RESPONSABLE FOR CHARGING THE CORRECT TASK NUMBER FOR THE WORK THEY ARE INVOLVED WITH.

TASK TITLE	CONTRACT TASK D E P	CONTRACT TASK M P I	MPI - MIS TASK No.	MPI - MIS LDR.	OPEN/ CLOSED
PROJECT PLANNING	NONE	NONE	040	DNE	OPEN
PROJECT MANAGEMENT	NONE	NONE	050	DNE	OPEN
QUALITY ASSURANCE MANAGEMENT	NONE	NONE	060	DNE	OPEN
TECHNICAL TYPING	NONE	NONE	095	GLP	OPEN
PROJECT CLOSURE	NONE	NONE	096	DNE	OPEN
PROJECT WORK PLAN	NONE	C1	100	DNE	OPEN
SCHEDULE	NONE	C2	100	DNE	OPEN
WET WELL DIVISION:	A3	--	--		--
WET WELL DIVISION ANALYSIS	A3	A3.1	100	DNE	OPEN
WET WELL DIVISION FACILITY PLAN	A3	A3.2	132	DNE	CLOSED
DEFINE EXISTING CONDITIONS:	B1	--	--		--
ASSEMBLE AND CATALOG EXISTING INFORMATION	B1.1	B1.1.1	100	DNE	OPEN
PROJECT HISTORY	B1.1	B1.1.2	100	DNE	OPEN
FACILITIES DESCRIPTION	B1.1	B1.1.3	100	DNE	OPEN
ALTERNATIVE EXPANSION PLANS:	A2	--	--		--
BASIS FOR EVALUATION	A2 & B4	A2.1	121	AMDV	OPEN
IDENTIFY AND EVALUATE ALTERNATIVE EXPANSION SCHEMES	A2	A2.2	122	AMDV	OPEN
EXPANSION PLAN	A2	A2.3	123	AMDV	CLOSED
FACILITY PLAN	A4	?	140	AMDV	CLOSED
FINAL PRELIMINARY DESIGN AND SUMMARY REPORT	A5	?	150	AMDV	CLOSED
PRESENTATION	A6 & B7	A6	160	DNE	CLOSED
PROGRESS MEETINGS AND REPORTS	A7 & B8	A7	170	DNE	OPEN

PUMP STA. EXP. 021-102

GRIT CHAM. EXP. 021-101

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TASK TITLE	CONTRACT TASK D E P	CONTRACT TASK M P I	MPI - MIS TASK No.	MPI - MIS LDR.	OPEN/ CLOSED
PLANT INSPECTION	B1.2	B1.2	210	HQM	OPEN
OPERATIONS REVIEW:	B2	--	--		--
PLANT HYDRAULIC ANALYSIS	B2	B2.1	221	HQM	OPEN
PLANT TREATMENT ANALYSIS	B2	B2.2	222	AMDV	OPEN
PLANT OPERATING PROCEDURES AND CHARACTERISTICS	B2	B2.3	223	HQM	OPEN
PLANT WIDE PROCESS DIAGRAMS	B2	B2.4	224	HQM	OPEN
UNIT PROCESS ANALYSIS	B2	B2.5	225	HQM	OPEN
DIGESTER GAS USE FEASIBILITY SYSTEM:	B3	--	--		--
DEFINE EXISTING CONDITION	B3	B3.1	231	HQM	OPEN
DEVELOP AND ANALYZE ALTERNATIVE ON-SITE GAS SYSTEMS	B3	B3.2	231	HQM	OPEN
COMPARE OFF-SITE TO ON-SITE GAS USE SYSTEMS AND PREPARE TECHNICAL MEMORANDUM	B3	B3.3	233	HQM	CLOSED
EVALUATION OF REMEDIAL ALTERNATIVES AND PRELIMINARY DESIGN OF ALTERNATIVES:	B4	--	--		--
IDENTIFY AND EVALUATE REMEDIAL ALTERNATIVES	B4	B4.1	241	HQM	OPEN
PRELIMINARY DESIGN	B4	B4.2	242	AMDV	CLOSED
PROJECT COST AND PRIORITIZATION	B4	B4.3	243	AMDV	CLOSED
IMPLEMENTATION PLAN (MOPO)	B4	B4.4	244	AMDV	CLOSED
REVISED OPERATING PLAN	B5	B5	250	AMDV	CLOSED
SUMMARY REPORT	B6	B6	260	AMDV	CLOSED
TOTALS	--	--	--		--

Appendix F Release and Waiver

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COUNTY OF NASSAU

STATE OF NEW YORK

DEPARTMENT OF PUBLIC WORKS

RELEASE AND WAIVER

In consideration of the Work as part of the Project, herein referred to as the "Project", more specifically the use of the existing monorails and hoists located at the facility for the loading and unloading of materials and equipment or any other County owned equipment used by the Contractor during the performance of the Work, the Contractor shall assume full responsibility as it relates to the use of the monorails, hoists or other Owner owned equipment and any subsequent damage to materials, equipment and/or injury to personnel thereto, and does hereby agree on behalf of themselves, their heirs, successors and assigns, subcontractors and any third parties who may have claim by, through or against the Contractor, to forever release and discharge the County of Nassau, its officials, representatives, employees, agents, successors and assigns, and CDM Smith, Inc. from any and all claims, obligations, demands, causes of action, agreements, promises, variances, fees, costs and damages whatsoever, which the Contractor has or may have which relate in any way to the use of any of the monorails, hoists or any other County owned equipment used by the Contractor in performance of the Work located at the County Facilities, including without limitation failure or inoperability of the equipment while in use by the Contractor during performance of the Work.

IN WITNESS WHEREOF, Contractor has executed this Release and Waiver on _____.

WITNESS	CONTRACTOR
_____	_____
Date:_____	Date:_____
_____	
Date:_____	