TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
1.	NOT USED	**6" Ø Cured-in-Place Pipe Liner** _____				
2.	18,100 LF	**8" Ø Cured-in-Place Pipe Liner** _____				
3.	550 LF	**10" Ø Cured-in-Place Pipe Liner** _____				
4.	150 LF	**12" Ø Cured-in-Place Pipe Liner** _____				
5.	NOT USED	**14" Ø Cured-in-Place Pipe Liner** _____				
6.	NOT USED	**15" Ø Cured-in-Place Pipe Liner** _____				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
7.	1,300 LF	**18" Ø Cured-in-Place Pipe Liner** _____				
8.	400 EA	**Internally Reinstate Building Connections on Lined Sewer** _____				
9.	10 EA	**Protruding Lateral Removal** _____				
10.	NOT USED	**Lateral Rehabilitation – Injection Grouting** _____				
11.	NOT USED	**Lateral Rehabilitation – CIPP Lining** _____				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
12.	NOT USED	**External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil**				
12.1.	NOT USED	**External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil**				
12.2.	NOT USED	**External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil**				
12.3.	NOT USED	**External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil**				
12.4.	NOT USED	**External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair**				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
13.	30 EA	**External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil**				
13.1.	10 EA	**External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil**				
13.2.	5 EA	**External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil**				
13.3.	5 EA	**External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil**				
13.4.	50 LF	**External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair**				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
14.	5 EA	**External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil** _____				
14.1.	5 EA	**External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil** _____				
14.2.	5 EA	**External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil** _____				
14.3.	5 EA	**External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil** _____				
14.4.	50 LF	**External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Additional LF > 8 LF Repair** _____				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
15.	5 EA	**External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil** _____				
15.1.	5 EA	**External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil** _____				
15.2.	5 EA	**External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil** _____				
15.3.	5 EA	**External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil** _____				
15.4.	50 LF	**External Point Repair - 16" Ø - 24 Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair** _____				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
16.	100 EA	**Top Hat for Lateral Connections** _____				
17.	NOT USED	**Internal Point Repair/Spot Liner - 6" Ø Pipe** _____				
18.	40 EA	**Internal Point Repair/Spot Liner - 8" Ø Pipe** _____				
19.	NOT USED	**Internal Point Repair/Spot Liner - 10" Ø Pipe** _____				
20.	NOT USED	**Internal Point Repair/Spot Liner - 15" Ø Pipe** _____				
21.	40 EA	**Manhole Inspection – NASSCO MACP Level 2** _____				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
22.	5 EA	**Internal Manhole Drop Assembly Reinstatement**				
23.	5 EA	**External Manhole Drop Assembly Reinstatement**				
24.	15 EA	**Rebuild Invert and Bench**				
25.	190 LF	**Full Manhole Rehabilitation**				
26.	60 SF	**Manhole Chimney Sealing**				
27.	15 EA	**Manhole Casting Adjustment**				
28.	15 EA	**Manhole Casting Replacement**				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
29.	600 SF	**Roadway Restoration – County** _____				
30.	NOT USED	**Roadway Restoration – Town of Oyster Bay** _____				
31.	NOT USED	**Roadway Restoration – Village of Massapequa Park** _____				
32.	NOT USED	**Roadway Restoration – Village of Lawrence** _____				
33.	NOT USED	**Roadway Restoration – Village of Cedarhurst** _____				
34.	2,500 SF	**Roadway Restoration – City of Glen Cove** _____				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
35.	60 SY	**Concrete Pavement** _____				
36.	80 LF	**Concrete Curb** _____				
37.	60 LF	**Concrete Sidewalk** _____				
38.	50 SY	**Landscape Restoration – Grading and 4-Inch Topsoil** _____				
39.	50 SY	**Landscape Restoration – Sodding** _____				
40.	100 LF	**Removal and Disposal of Asbestos Pipe - 4" Ø - 24" Ø** _____				

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON CONTRACT NO. S30052-03G						
ITEM NO.	APPROX. QUANTITIES					
41.	Overtime Salary Account Allowance	For overtime hours worked by Owner's operations staff associated with after-hour tie-in work. Fifty Thousand No	N/A	N/A	$50,000	00
42.	Independent Laboratory Testing Allowance	For costs associated with independent testing laboratory services. Twenty Thousand No	N/A	N/A	$20,000	00
43.	Unmarked Utility Conflict Allowance	For furnishing all labor, materials, equipment, and incidentals for unforeseen conditions and associated additional work related to unmarked utilities. One Hundred Thousand No	N/A	N/A	$100,000	00
44.	Utility Relocation Allowance	For furnishing all labor, materials, equipment, and incidentals for unforeseen conditions and associated additional work related to utility relocation. Eighty Thousand No	N/A	N/A	$80,000	00
45.	Contingency Allowance	For furnishing all labor, materials, equipment, and incidentals for unforeseen conditions and associated additional work. Two Hundred Fifty Thousand No	N/A	N/A	$250,000	00

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 5
ARTICLE GC11 - LAWS AND ORDINANCES 5
ARTICLE GC12 - PERMITS 5
ARTICLE GC13 - ACCIDENTS 5
ARTICLE GC14 - CONTRACTOR SUBMISSIONS 6
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 33
ARTICLE GC24 - BARRICADES, WARNING SIGNS AND LIGHTS 33
ARTICLE GC25 - DUST CONTROL AND SPILLAGE 33
ARTICLE GC26 - VERMIN CONTROL 33
ARTICLE GC27 - FIRST AID FACILITIES 34
ARTICLE GC28 - LAYOUT AND LEVELS 34
ARTICLE GC29 - CUTTING AND PATCHING 35
ARTICLE GC30 - OPENINGS AND CHASES 36
ARTICLE GC31 - SLEEVES, INSERTS AND WALL CASTINGS 37

ARTICLE GC32 - SCAFFOLDING, RIGGING AND HOISTING 37
ARTICLE GC33 - CLEANING 37
ARTICLE GC34 - PIPING AND EQUIPMENT IDENTIFICATION 38
ARTICLE GC35 - OPERATION AND MAINTENANCE MANUALS 38
ARTICLE GC36 - RECORD DRAWINGS 38
ARTICLE GC37 - PHOTOGRAPHS 39
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

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.

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 them to produce or guarantee a first-class piece of Work, they 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.

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 they 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 their 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 their 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 their 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 their 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. An updated copy 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 a digital copy of their schedule of shop drawings submissions to 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 forty-five days after the Notice to Proceed as indicated in Division 1, Special Conditions 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, Special Conditions 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.

2. The schedules shall provide the information and be in the form indicated in Division 1, Special Conditions 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 their 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 their 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, manufactures, 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) digital copy of each submittal to the Engineer for review. Digital copies 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 notations or comments on the submittal. Equipment and/or material may be released for manufacture.

"Approved as Noted" - Confirmation of the notations and comments IS NOT required. Equipment and/or material may be released for manufacture; however, all notations and comments must be incorporated into the final product.

"Approved as Noted/ Confirm" - Confirmation of the notations and comments IS required. The Contractor may, at their own risk, release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 14 calendar days of the date of the Engineer's transmittal requiring the confirmation.

"Approved as Noted/ Resubmit" - Extensive notations and comments. Resubmit and address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 14 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

"Not Approved" - Submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

"Submitted for the Record" - Submitted information for record purposes.

f. If a submittal is satisfactory to the Engineer, the Engineer will annotate the submittal, "Approved" and return to the Contractor.

g. If a Resubmittal is required, the Engineer will annotate the submittal "Approved as Noted/ Resubmit" or "Not Approved" and to the Contractor for appropriate action. 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 their 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 their 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 their use, they 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 their material and equipment in accordance with the requirements of Division 1, Special Conditions 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 them. 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 insure 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 insure 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 insure 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 they 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 manufactures 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 their 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 their 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 they shall arrange their 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 their 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 their 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 they shall arrange their 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 their 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 they 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 insure 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 their 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 insure 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 their 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 their 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 their 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 their 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 their 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 their 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. They 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 they shall designate a responsible member of their 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. They 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 their 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 their 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 their 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, they 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 72 hours 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, Special Conditions 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 their 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 insure 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 their 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 their 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 they 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 they 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 their 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 their Work.

B. All Other Work

Each Contractor is responsible for layout of their 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 them 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 of patching.

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 them. 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 their Work to fit their 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 their 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 their 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, they 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 they 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 their Work to one location in their 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 EQUIPMENT IDENTIFICATION

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, Special Conditions 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 their 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 their 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. Taking a minimum of ten (10) color photographs at each work location 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.

2. Supplying one (1) digital file of each photograph.

B. One digital file of each photograph shall be submitted to the Engineer with the Contractor's monthly estimate. The digital files shall be annotated with 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.

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

ARTICLE GC38 - PROJECT CLOSEOUT

Division 1, Special conditions, 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 their 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.

+ + NO TEXT ON THIS PAGE + +

TECHNICAL SPECIFICATIONS INDEX

DIVISION 1 – GENERAL REQUIREMENTS

011100 SUMMARY OF WORK

011400 WORK RESTRICTIONS

012100 ALLOWANCES

012200 UNIT PRICES

012500 SUBSTITUTIONS

012900 PAYMENT PROCEDURES

013100 PROJECT MANAGEMENT AND COORDINATION

013119 PROGRESS MEETINGS

013216 CONSTRUCTION SCHEDULES

013233 CONSTRUCTION PHOTOGRAPHS

013300 SHOP DRAWINGS AND SUBMITTALS

014100 RELEVANT PROJECT REQUIREMENTS

014213 ABREVIATIONS, UNITS OF MEASURE, INTITUTIONS, STANDARDS, & CODES

014216 GLOSSARY OF TERMS AND DEFINITIONS

014219 REFERENCE STANDARDS

014223 SPECIFICATION FORMAT

014500 QUALITY CONTROL

014523 TESTING AND INSPECTION

014536 ENVIRONMENTAL QUALITY CONTROL

015134 TEMPORARY SANITARY WASTEWATER CONVEYANCE

015526 TRAFFIC CONTROL

015719 DUST PALLIATIVE

016000 MATERIALS, SERVICES, AND FACILITIES

017400 PROJECT CLEANUP

017800 CLOSEOUT SUBMITTALS

017839 PROJECT DOCUMENTS AND RECORD PLANS (AS-BUILT DRAWINGS)

DIVISION 2 – EXISTING CONDITIONS

022100 CONSTRUCTION SURVEYS, LAYOUTS, AND LEVELS

023000 SUBSURFACE INVESTIGATION

026400 REMOVAL AND REPLACEMENT OF CURBS, CURBS AND GUTTERS, SIDEWALKS, DRIVEWAYS, AND DRIVEWAY APRONS

028213.33 ASBESTOS CEMENT PIPE HANDLING

DIVISION 3 – CONCRETE

032100 STEEL REINFORCEMENT

033000 CONCRETE

DIVISIONS 4 – MASONRY

042000 BRICK AND BLOCK MASONRY

DIVISIONS 31 – EARTHWORK

311100 CLEARING AND GRUBBING

312316 EARTH EXCAVATION

312319 DEWATERING AND DISPOSAL OF WATER

312321 REMOVE AND DISPOSE UNSUITABLE MATERIALS

312333 BACKFILL

314100 SHORING OF EXCAVATION

DIVISIONS 32 – EXTERIOR IMPROVEMENTS

321200 ROADWAY PAVEMENT

329000 PLANTING

329219 SEEDING & SODDING

329600 REMOVAL, PRESERVATION, AND RESTORATION OF SHRUBBERY AND SMALL CALIPER TREES

DIVISIONS 33 – UTILITIES

330130.11 INSPECTION OF UNDERGROUND PIPELINES

330130.16 SANITARY SEWER MANHOLE INSPECTION

330130.41 CLEANING SEWERS

330130.61 INJECTION GROUTING (PRE-REHABILITATION)

330130.63 INJECTION GROUTING (LONG-TERM)

330130.72 CURED-IN-PLACE PIPE LINING

330130.73 CURED-IN-PLACE SPOT LINING

330130.81 MANHOLE REHABILITATION

330561.05 CASTINGS

333100 SANITARY SEWERAGE GRAVITY PIPING

333116 HOUSE CONNECTIONS, RISERS, AND CLEAN-OUT ASSEMBLIES

+ + END OF SECTION + +

PART 1 - GENERAL

1.01 BRIEF PURPOSE OF PROJECT / GENERAL

A. The purpose of the project is rehabilitate lateral sewers within the Nassau County Collection System.

B. All work shown and specified in the Contract Documents shall be the work of this Construction Contract. The Owner does not anticipate awarding other prime contracts for this project.

C. This Section provides an abbreviated summary of the work for this Contract associated with the Owner's program to construct the project.

1.02 NOMENCLATURE

A. Where the terms "Engineer/Architect", "Architect/Engineer", "Engineer", or "Architect" are used throughout these Contract Documents, they shall mean the firm of H2M architects + engineers as may be abbreviated by H2M.

B. The terms "Contractor" and/or "Prime Contractor" where used shall refer to the individual or company who has entered into an agreement with the Owner to perform the work contained within these Contract Documents. The lack of word capitalization shall be incidental.

C. The terms "Contractor" and/or "Prime Contractor" shall refer to the individual or company who has entered into an agreement with the Owner to perform the work contained within these Contract Documents. The lack of word capitalization shall be incidental.

D. Where the terms "owner" or "owner's construction representative" are used, they will be defined as a person selected by the owner, or the actual owner.

1.03 ABBREVIATED SUMMARY OF CONTRACT S WORK

A. Furnish all labor, equipment, materials, tools, means, methods, and incidentals necessary to complete the Work as required by the Contract Documents for this Construction Contract.

B. This following abbreviated summary is provided in order to briefly describe the work covered by the Contract Documents for this Construction Contract. It is not all inclusive of the work under the Contract. The work includes, but is not limited to, the following:

1. CCTV inspection.
2. Preliminary site work including: utility mark-out and erosion control facilities.
3. Maintenance and protection of pedestrian and vehicular traffic.
4. Sheeting, bracing, excavation, soil erosion protection, slope protection, earth movement, subgrade preparation, removal of excess and/or unsuitable excavated material, dewatering, and import of suitable material, as necessary to install and construct all the work defined within the Contract Documents.
5. Temporary bypass pumping, equipment and process installations to facilitate the rehabilitation of sanitary sewer piping and sanitary manholes.
6. Rehabilitation of sanitary sewer piping including: CIPP lining, external point repairs, and short-lining.
7. Internal reinstatement of building connections on lined sewer, removal of protruding laterals, and rehabilitation of laterals via injection grouting and CIPP lining.
8. Level 1 and Level 2 NASSCO MACP manhole inspection.
9. Manhole rehabilitation including: bench repair, invert rebuilding, chimney sealing, patching and sealing, chemical injection grouting, epoxy coating, and cementitious coating.
10. Asphalt paving.
11. Replacement of sidewalks, concrete paving, and concrete curbing.
12. Landscape restoration including: stripping, stockpiling and replacing topsoil, importing additional topsoil, removal of stumps and roots, grading, sod placement, raking, mulching, and fertilizer.
13. Project closeout submittals.

C. All other work shown and specified in the Contract Documents.

1.04 PARTIAL LISTING OF SPECIFIC CONTRACT REQUIREMENTS

A. The Contract Documents detail the work included in the Contract. Related requirements and conditions covered by the Contract Documents include, but are not limited to, the following:
   1. Work restrictions as specified in Section 012100. Such restrictions include, but are not limited to:
      a. Guidelines and requirements of the "Owner"
      b. Guidelines and requirements of the Nassau County Department of Health (NCDH).
      c. Local laws and ordinances of the Town of Hempstead.
      d. Local laws and ordinances of the Village of Massapequa Park.
      e. Each Contractor shall comply with MBE/WBE requirements as contained in the Contract Documents.
   2. Comply with the requirements of Section 312316 - Earth Excavation. The cost associated with test holes and utility mapping shall be as specified therein, and is subject to change based on conditions existing at the time of construction.

1.05 PARTIAL LISTING OF OVERALL CONTRACT REQUIREMENTS

A. The Contract Documents detail the work included in the Contract. Related requirements and conditions covered by the Contract Documents include, but is not limited to, the following:
   1. Debris removal and daily and final cleaning up.
   2. Product and equipment storage and handling requirements.
   3. Site safety in accordance with all applicable federal, state, and local regulations.
   4. Project submittals, meetings, professional photographs, testing services, work plans, schedules, shop drawings, closeout procedures and documents, manuals, as-built drawings, and final commissioning of the work shall be provided as required by the Contract.

1.06 OWNER SUPPLIED PRODUCTS AND UTILITIES

A. The Owner will not be supplying equipment, labor, or tools for the project.

1.07 EXISTING CONDITIONS

A. The Drawings show certain information that has been obtained by the Owner regarding various pipelines, utilities and structures that exist at the location of the project both below and at grade.

B. The Owner and the Engineer expressly disclaims all responsibility for the accuracy or completeness of the information given on the Drawings with regard to existing facilities.

C. In the case where the Contractor discovers an obstruction not indicated on the Drawings or not described via specification reference, then the Contractor shall immediately notify the Engineer of the obstructions' existence.

D. The Engineer will determine if the obstruction is to be relocated or removed.

E. Compensation for this extra work will be paid for in accordance with the provisions in the Contract for "Extra Work".

F. The Engineer will determine the remedy for the situation as specified in the General Conditions, Section G4.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 011100

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Site access and control of areas outside of site.

B. Contractor use of the premises.

C. Contractor storage, parking and deliveries.

D. Work hours, employee conduct and miscellaneous employee requirements.

E. Contract requirements related to maintaining Owner's current operations and excess inspection required.

F. Required minimum safety and confined space access requirements for NCDPW projects.

G. Suggested construction sequence.

1.02 SITE ACCESS AND CONTROL

A. Employ methods to prevent construction materials and/or debris from leaving the site. The Contractor is responsible to routinely monitor the areas surrounding the site during the day as well as at the end of the work-day and to immediately clean up any area to its previous condition.

B. Employ methods to prevent the transmission of dirt from vehicles driving on exposed areas of the site from reaching the surrounding roadways. Immediately clean the roadway should the measures being taken by the Contractor not satisfactorily control the transmission of any dirt to the roadway.

C. Any damages to areas outside the site, spills of soil, liquid, or any other material shall immediately be repaired, cleaned and restored to its previous condition.

D. Comply with all state and local requirements for allowable weight limits of vehicles on all roads.

E. The Owner reserves the right to back charge the Contractor for all costs associated with maintaining the grounds of the site as well as maintaining areas outside the site, which may be disturbed by the Contractor should the Contractor fail to maintain or repair the aforementioned in a condition acceptable to the Owner.

F. Do not not close any road for any period in time unless approved ahead of time by appropriate road agency. Take whatever measures are necessary to not cause any inconvenience to the area’s residents.

G. Maintain the premises in a safe condition throughout the construction period. Compliance with OSHA regulations and site safety shall be the responsibility of the Contractor as it relates to work of the Contract. The posting of all applicable OSHA safety signs shall be the responsibily of the Contractor.

H. Protect the Owner's property and private property. All existing buildings, structures, shrubs, trees, lawn fixtures, sculptures and misc. equipment shall be protected at all times. Any removals or relocation of said objects, if allowed shall be as directed by the Engineer or Owner. Protect all of the physical structures, property, and improvements on the site from damage by their Work and immediately repair or replace damage caused by construction operations, employees, or equipment employed by the Contractor. All labor, materials, equipment, and outside contractors that are employed by the Owner to repair damage caused by the Contractor will be billed to the Contractor directly or withheld from money due the Contractor for work already completed.

I. Keep all existing driveways, roads, and parking areas free and clear of materials and equipment. Do not unreasonably encumber the work area with materials and equipment.

J. Immediately remove excess excavated material or relocate to areas on the site requiring placement of fill. Do not stockpile excess material.

K. Clean up the work area. Failure to maintain a clean work site, daily, will result in others performing the work and the Contractor being back charged for the cleaning cost plus construction administration fees.

L. Do not discard or dispose of any waste on-site.

M. The Contractor shall be responsible for managing dust.

1.03 CONTRACTOR USE OF THE PREMISES

A. Premises, for the purpose of this Contract, shall mean the work locations which are primarily in the public right of way.

B. Use and manage the premises and the associated construction activities as follows:
   1. To not hinder the Owner's ability to operate their facilities.
   2. To allow for stockpiling of construction material and debris without any significant hardship, as defined by the Owner's Construction Representative, on the Owner.
   3. To allow for the stockpiling of excavated soil and imported fill, when called for, without any significant hardship, as defined by the Owner's Construction Representative, on the Owner or other contractors.
   4. To allow utility companies to install their work and to maintain their facilities.
   5. To allow for the delivery of equipment and materials by independent trucking companies by leaving enough space for backing in and out of areas.
   6. To allow for the safe, unimpeded travel way of the Owners vehicles, Owner's Construction Representative's vehicles, Engineer's vehicles, construction vehicles and heavy construction equipment about the entire site.

C. Protect the Owner's public and provate property. All existing buildings, structures, shrubs, trees, lawn fixtures, sculptures and misc. equipment shall be protected at all times. Any removals or relocation of said objects, if allowed shall be as directed by Owner's Construction Representative.

D. Protect all of the physical structures, property and improvements upon the site from damage by the Work and immediately repair or replace damage caused by construction operations, employees or equipment employed by the Contractor. All labor, materials and equipment and outside contractors that are employed by the Owner to repair damage caused by the Contractor shall be billed to the Contractor directly or withheld from money due the Contractor for work already completed.

E. Keep all existing operations areas, driveways, roads, and parking areas free and clear of materials and equipment. Do not unreasonably encumber the site with materials and equipment. Confine stockpiling of excess excavated material, materials and equipment to areas selected under the Site Utilization Plan or as designated by the Owner's construction representative. Locate storage sheds and trailers to areas designated in the plan or by the Owner's Construction Representative.

F. Immediately remove excess excavated material or relocate to areas on the site requiring placement of fill. Do not stockpile excess material on the site without written approval of the Owner's Construction Representative.

G. Do not discard or dispose of any waste on-site.

H. Open fires will not be permitted on the site.

I. Employ erosion control measures to protect wetlands located adjacent to the work as required by regulatory agencies.

J. Install erosion control measures as indicated in the Contract. Confine stormwater runoff to the site.

K. Dewatering is anticipated. Comply with the requirements contained in Section 312319 - Dewatering.

L. Manage dust as specified in Section 015719.

1.04 CONTRACTOR STORAGE, PARKING AND DELIVERIES

A. Do not unreasonably encumber the premises with materials and equipment.

B. Confine premises storage areas to locations designated by the Owner. Immediately repair or replace damaged facilities to the satisfaction of the Owner and to a condition that existed before the damage occurred as determined by preconstruction photographs, or if photographs are unavailable, to that deemed by the Owner.

C. No materials storage will be permitted outside of the Contractor's designated staging area(s).

D. Storage of chemicals and paint materials shall follow manufacturer's storage/handling guidelines.

E. Compressed gas containers shall be properly stored and secured per OSHA, to the satisfaction of the Owner. Failure to do so will result in a $250 back charge, per occurrence.

F. Provide minimum of 48 hours advance written notice to the Owner's Construction Representative for deliveries of materials, site visits by inspectors, manufacturer's representatives or any other occasion that impacts the use of the site. Contractor shall be responsible for any costs that are incurred by the owner, for failure to meet previously agreed upon appointments or work schedules.

G. Deliveries sent to the Owner will not be signed for or unloaded by the Owner. They will be directed to the construction site and if no employee is on site, the delivery will be rejected, at the contractor's expense.

H. Night deliveries of equipment (past the designated quitting time) will not be permitted. Delivery trucks shall not sit within the neighborhood causing an obstruction or perceived nuisance, nor be left idling on or off the site for any period of time.

1.05 WORK HOURS, EMPLOYEE CONDUCT AND MISCELLANEOUS EMPLOYEE REQUIREMENTS

A. Schedule working days and hours as specified in the General Terms and Conditions, if no times are specified therein then the work hours shall be Monday - Friday 7:00 am - 3:30 pm.

B. Employees are to act in a professional manner. Any employee using inappropriate language or who is disruptive to the work environment will be banned from the site.

C. Proper work attire is required. Shirts are to be worn at all times and no short pants are permitted.

D. Employees shall not converse with local residents or Owner's employees.

E. Any employee found under the influence of any drug or alcohol will be banned from the site.

1.06 CONTRACT REQUIREMENTS RELATED TO MAINTAINING OWNER'S CURRENT OPERATIONS AND EXCESS INSPECTION REQUIRED

A. Schedule working days and hours as specified. Pay all excess costs for inspection services provided by the Owner/Engineer for working beyond the times specified.

B. The hourly rate charged for inspection services beyond normal working hours shall be at a maximum billing rate of $200 per hour, per inspector. The actual amount charged will be calculated in accordance with Section G29 of the General Conditions.

1.07 MINIMUM SAFETY AND CONFINED SPACE ACCESS REQUIREMENTS

A. The following minimum requirements are to be provided in addition at all applicable Federal, State, County and Local health and safety requirements and all OSHA requirements

B. **Fall Protection:**

1. Fall prevention shall be provided by the Contractor for all personnel working more than 5 feet above the next closest lower floor/grade level.
2. All personnel shall connect to a suitable fall prevention device when climbing or descending between any levels greater than 5 feet vertically via any ladder or non-staircase type access way.

C. **Confined Space Areas:**

1. Any space over five (5) feet in depth and not designated for continuous occupation shall be considered a Confined Space, i.e., tanks, pits, vaults, manholes, wet wells, etc.
2. Any tank or structure being constructed becomes a confined space once all sides of the structure are formed or constructed thus leaving access via the top side only.
3. All new structures shall be considered Confined Space until they are physically connected to any other Permit Confined Space via a pipeline or passage way, at which time the space shall be classified as Permit Confined Space.
4. Confined Space Requirements

a. These minimum requirements shall be provided for by the Contractor when their personnel are required to enter a classified Confined Space during the work.
b. These minimum requirements are in addition to all required safety and precautionary provisions as required by all OSHA, Federal, State, County or local requirements.
    1) Space shall be checked for atmospheric hazards prior to any entry, each day and at all times during the entry.
    2) Furnish and install one (1) four (4) gas - Oxygen (O2), Carbon Dioxide (CO), Hydrogen Sulfide (HS) and Lower Explosive Limit (LEL) - portable monitor to test the space before and during the entry period.
    3) All entrants shall be outfitted with a full body harness with D-ring attachment and shall attach to fall protection when entering or exiting the space.
    4) Rescue winch and hoist retrieval system set up and in place at the space.
    5) Hard hat.

D. **Permit Confined Space Areas:**
1. Any space over five (5) feet in depth and not designated for continuous occupation and that contained sewage or chemicals at some time shall be considered a Permit Confined Space, i.e., tanks, pits, vaults, manholes, wet wells, etc.
2. Any tank or structure being constructed becomes a Permit Confined Space once all sides of the structure are formed or constructed thus leaving access via the top side only and the top side has a deck or limited entry/exit access point less than 50% of the total tank floor area.
3. All new structures shall be as a Permit Confined Space when they are physically connected to any other Permit Confined Space via a pipeline or passage way.
4. All existing structures that contained sewage or chemicals at some time shall be considered Permit Confined Space until such time as they are permanently disconnected from any other Permit Confined Space and the interior of the structures is suitably cleaned of all containments, at which time they shall be considered as a Confined Space.
5. Permit Confined Space Requirements:
    a. These minimum requirements shall be provided for by the Contractor when their personnel are required to enter a classified Confined Space during the work.
    b. These minimum requirements are in addition to all required safety and precautionary provisions as required by all OSHA, Federal, State, County or local requirements.
        1) Permit/Entry form submission to Owner two working days in advance of entry.
        2) Space shall be checked for atmospheric hazards prior to any entry, each day.
        3) Furnish and install four (4) gas - Oxygen (O2), Carbon Dioxide (CO), Hydrogen Sulfide (HS) and Lower Explosive Limit (LEL) - portable monitors to test the space before and during the entry period. Provide sufficient number of monitors as required by the size of the space. Place monitors throughout space, every 25 feet.
        4) Each entrant shall be equipped with a 10 minute Emergency Escape Breathing Apparatus (EEBA).
        5) Entry/Exit supervisor on site at entrance at all times.
        6) All entrants shall be outfitted with a full body harness with D-ring attachment and shall attach to fall protection when entering or exiting the space.
        7) Rescue winch and hoist retrieval system set up and in place at the space.
        8) Fully equipped and trained retrieval/rescue person stationed at the top entrance outfitted with the EEBA and full body harness.
        9) Hard hat.

1.08 SUGGESTED CONSTRUCTION SEQUENCE

A. The following is one suggested general, not all-inclusive, sequence of construction that may be used to complete all the work under the Contract within the time specified.

B. Work restrictions may be noted throughout the suggested sequence provided below. The Contractor shall comply with all noted work restrictions that appear.

C. The following suggested sequence is provided for information only:

1. Mobilization
2. Traffic Control Operations
3. Bypass Operations
4. Pre-Rehabilitation Inspection
5. Rehabilitation Work
6. Final Restoration of Surfaces and Post-Rehabilitation Inspection
7. De-Mobilization

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 011400

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Allowance pricing for the following items:
   1. Overtime Salary Account.
   2. Independent Laboratory Testing Allowance.
   3. Unmarked Utility Conflict Allowance.
   4. Utility Relocation Allowance.
   5. Contigency Allowance.
   6. Railroad Protective Forces.

B. This Section covers the requirements for use of the cash allowances listed above contained in the proposal (Bid Forms, Price Schedule) and included in the Contract Price bid by the Contractor and defines and stipulates the charges that will be paid for out of the stipulated allowances.

C. Include the cash allowances stipulated in this Section in the amount bid (Base Bid).

D. Eligible costs described in this Section, and Sections referenced herein, will be the only costs paid for out of the stipulated allowances.

E. All other costs associated with the project as specified and/or shown, including but not limited to the delivery, installation and all Contractor overhead and/or collateral expenses shall be distributed among the other portions of the work and shall be included in other bid items.

1.02 SUBMITTALS

A. Make all submissions under the provisions of Section 013300.

B. For each type of product/material specified to be furnished under allowance pricing provide documentation of the unit pricing on manufacturer's letterhead certifying pricing of the product/material.

C. Submit additional backup information to substantiate the invoiced amount(s) as the Engineer may require for review and approval, prior to order or payment of item.

D. Provide written breakdowns for extra work as the Owner may require.

1.03 CHANGES TO STIPULATED (CASH) ALLOWANCE

A. If the actual cost of services differs from the cash allowance, then the Contract Price will be adjusted accordingly.

1.04 PAYMENTS TO BE MADE OUT OF "OVERTIME SALARY ACCOUNT"

A. Include the cash allowance of $50,000 (FIFTY THOUSAND Dollars and Zero Cents) in the amount bid for use upon the Owner's instructions.

B. Funds will be drawn from this account to pay for overtime hours worked by Owner's operations staff associated with after hour tie-in work as specified in Section 011400.
   1. Overtime hours worked by the Contractor's employees are not eligible for payment under this allowance item.
   2. Overtime hours worked by the Engineer's representative(s), as a result of the Contractor's operations, shall be paid for by the contractor as provided under other terms and conditions contained in the Contract and General Conditions at the Engineer's billing rate as specified in Section 011400 - Work Restrictions.

C. Funds remaining at project closeout shall be credited to the Owner.

1.05 PAYMENTS TO BE MADE OUT OF "INDEPENDENT LABORATORY TESTING ALLOWANCE"

A. Include the cash allowance of $20,000 (TWENTY THOUSAND Dollars and Zero Cents) in the amount bid for independent testing laboratory services specified in Section 014500.

B. The actual invoiced charges of the testing laboratory, including toning companies where called for, incurred for field and laboratory tests, as specified only in Section 014500 - Quality Control, shall be paid for out of the cash allowance.

1. Any other requirement specified herein throughout these specifications for providing the services of an independent testing laboratory, underground utility location company, or similar outside independent service are to be borne by the Contractor.
2. All costs for quality control services are to be included as part of the Contract Price (as-bid).

C. One (1) week prior to each partial payment, submit a certified invoice from each company listing and detailing the total costs incurred since the last invoice.
1. The invoice shall be on company letterhead signed by an authorized representative of the company and shall include man-hours, tests conducted, date of tests and associated costs and fees.
2. Payment for costs will not be made unless the information is provided and certified. Payment for costs will not be made unless the typed test data reports have been received by the Engineer.
3. In the case of pipe toning, flags shall be set to delineate the route of underground pipes and utilities prior to submission of partial payment request.

D. If in the event test results (provided by the independent testing laboratory) show non-compliance with these specifications, then at the option of the Contractor and only with the approval of the Owner, re-test samples to verify the original test results at own expense.

E. Costs for re-testing failed components of the work, when ordered by the Engineer, will not be paid for out of the cash allowance and will be directly borne by the Contractor.

F. Funds remaining at project closeout shall be credited to the Owner.

1.06 PAYMENTS TO BE MADE OUT OF "UNMARKED UTILITY CONFLICT ALLOWANCE"

A. Include the cash allowance of $100,000 (EIGHTY THOUSAND Dollars and Zero Cents) in the amount bid for use upon the Owner's instructions.

B. Determine the exact location and elevation of existing utilities by field investigation. The Engineer shall be notified of any conflicts between existing utilities and the installation of the sewer lines. If the Owner and Architect/Engineer determine a modification to the contract documents requires additional work, the Owner will draw funds from the unmarked utility conflict allowance. No payment will be made for loss of production based on additional utility crossings.

1.07 PAYMENTS TO BE MADE OUT OF " UTILITY RELOCATION ALLOWANCE"

A. Include the cash allowance of $80,000 (EIGHTY THOUSAND Dollars and Zero Cents) in the amount bid for use upon the Owner's instructions.

B. Utility Relocation allowance includes the cost(s) of the actual invoiced charges of the utility incurred in connection with the relocation of utilities. This item only applies to labor, materials and equipment furnished and installed by the utility or authorized contractor in connection with the relocation of existing utilities. Labor, materials, equipment, and services provided by the Contractor are not eligible under this allowance if they are not authorized by the utility. Written authorization from the utility shall be submitted to the Engineer for approval prior to the Contractor being eligible for payment under this allowance.

C. Funds remaining at project closeout shall be credited to the Owner.

1.08 PAYMENTS TO BE MADE OUT OF "CONTINGENCY ALLOWANCE"

A. Include the cash allowance of $250,000 TWO HUNDRED FIFTY THOUSAND Dollars and Zero Cents) in the amount bid for use upon the owners instruction

B. The Owner will draw funds from the contingency account only upon prior written approval by the Owner's Construction Field Representative and Engineer.

C. Funds remaining at project closeout shall be credited to the Owner.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 012100

PART 1 - GENERAL

1.01 GENERAL

A. This Section specifies the requirements for measurements and records made for payment purposes and describes the item(s) under which payment(s) will be made for the Work performed under this Contract.

B. Items not specified to be measured or paid for (for which no specific pay item exists in the Price Schedule) shall be included in an appropriate unit price item or in a lump-sum item.

1.02 MEASUREMENT REQUIREMENTS

A. All required measurements shall be made by the Contractor with the Engineer and or Owner's construction representative.

B. Any measurements not witnessed by Engineer and/or Owner's construction representative and which cannot be verified or substantiated by Engineer and/or Owner's construction representative will not be approved and payment under the item(s) requiring such measurements will not be made.

C. Coordinate measurements monthly, for the preparation of periodic pay estimates.

D. Where payments will be made for removing existing materials, or materials generated by work, notify Engineer and/or Owner's construction representative so that measurements can be witnessed.

1. All materials removed without conforming to the above procedures, which Engineer and/or Owner's construction representative cannot verify or substantiate, will not be paid for.

2. Maintain complete, neat, clean, and legible field notes for all measured items.

3. Notes will contain spaces for Contractor's and Engineer's and/or Owner's construction representative's signatures plus additional space for comments.

4. An original and a carbon copy will be made for all notes, and one copy shall be turned over to Engineer and/or Owner's construction representative daily.

5. The Engineer's and/or Owner's construction representative's signature will not be constituted as an acceptance of the work, or the measurements made, but will mean that a representative was present when the measurements were made.

1.03 SUBMITTALS

A. See Section 013300.

B. Field notes of all measurements for payment purposes delivered to Engineer and/or Owner's construction representative daily.

C. Record Drawings showing the locations and quantities of all items measured for payment purposes.

1.04 SCHEDULING

A. Notify Engineer and/or Owner's construction representative, as far in advance as possible, of the recording of measurements so that Engineer and/or Owner's construction representative may observe existing conditions, work being performed, and measurements being made.

B. Allow for and afford Engineer and/or Owner's construction representative ample time, space, and equipment to observe measurements and to verify measurements and elevations.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide all labor, materials, facilities, levels, measuring devices and all other equipment and items necessary to perform all measurements properly and accurately for payment purposes.

B. Payment for certain items not specifically listed in the bid forms but otherwise required by the technical specifications will be deemed included as part of the General Conditions and the individual unit price and lump sum bid items provided for in the proposal.

PART 3 – EXECUTION

3.01 GENERAL

A. Perform all measuring required under this Section.

B. Record all measurements and calculated quantities on the Record Drawings.

C. No measurement will be made for work performed within the limits of Lump Sum Items.

ITEM NO.	ITEM DESCRIPTION AND MEASUREMENTS
1.	**6" Ø Cured-in-Place Pipe Liner –** NOT USED
2.	**8" Ø Cured-in-Place Pipe Liner -** Measure the actual horizontally projected length of pipe lined from inside wall of the insertion manhole to the inside wall of the downstream manhole, unless the manhole is lined through. If the manhole is lined through, payment will be made from the interior face of the outlet wall of the starting manhole to the interior face of the inlet wall of the ending manhole.
3.	**10" Ø Cured-in-Place Pipe Liner -** Measure the actual horizontally projected length of pipe lined from inside wall of the insertion manhole to the inside wall of the downstream manhole, unless the manhole is lined through. If the manhole is lined through, payment will be made from the interior face of the outlet wall of the starting manhole to the interior face of the inlet wall of the ending manhole.
4.	**12" Ø Cured-in-Place Pipe Liner -** Measure the actual horizontally projected length of pipe lined from inside wall of the insertion manhole to the inside wall of the downstream manhole, unless the manhole is lined through. If the manhole is lined through, payment will be made from the interior face of the outlet wall of the starting manhole to the interior face of the inlet wall of the ending manhole.
5.	**14" Ø Cured-in-Place Pipe Liner -** NOT USED

6. **15" Ø Cured-in-Place Pipe Liner -** NOT USED

7. **18" Ø Cured-in-Place Pipe Liner -** Measure the actual horizontally projected length of pipe lined from inside wall of the insertion manhole to the inside wall of the downstream manhole, unless the manhole is lined through. If the manhole is lined through, payment will be made from the interior face of the outlet wall of the starting manhole to the interior face of the inlet wall of the ending manhole.

8. **Internally Reinstate Building Connections on Lined Sewer –** Count the actual number of building connections internally reinstated on lined sewer.

9. **Protruding Lateral Removal –** Count the actual number of protruding laterals removed.

10. **Lateral Rehabilitation – Injection Grouting** – NOT USED

11. **Lateral Rehabilitation – CIPP Lining** – NOT USED

12. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil –** NOT USED

12.1. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil –** NOT USED

12.2. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil –** NOT USED

12.3. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil –** NOT USED

12.4. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair –** NOT USED

13. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in suitable soil and with no dewatering.

13.1. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in unsuitable soil and with no dewatering.

13.2. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in suitable soil and with dewatering.

13.3. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in unsuitable soil and with dewatering.

13.4. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair –** Measure the actual linear feet (LF) of sewer pipe replaced over the eight (8) feet included in Item 13 through 13.3 as measured along the longitudinal axis of the sewer.

14. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in suitable soil and with no dewatering.

14.1. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in unsuitable soil and with no dewatering.

14.2. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in suitable soil and with dewatering.

14.3. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in unsuitable soil and with dewatering.

14.4. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Additional LF > 8 LF Repair –** Measure the actual linear feet (LF) of sewer pipe replaced over the eight (8) feet included in Item 14 through 14.3 as measured along the longitudinal axis of the sewer.

15. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in suitable soil and with no dewatering.

15.1. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in unsuitable soil and with no dewatering.

15.2. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in suitable soil and with dewatering.

15.3. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil –** Count the actual number of point repairs up to 8 linear feet in length as measured along the longitudinal axis of the sewer in unsuitable soil and with dewatering.

15.4. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair –** Measure the actual linear feet (LF) of

sewer pipe replaced over the eight (8) feet included in Item 15 through 15.3 as measured along the longitudinal axis of the sewer.

16. **Top Hat for Lateral Connections –** Count the actual number of top hats installed on lateral connections.

17. **Internal Point Repair/Spot Liner - 6" Ø Pipe –** NOT USED

18. **Internal Point Repair/Spot Liner - 8" Ø Pipe –** Count the actual number of internal point repairs at a minimum 5 linear feet (LF) and up to 10 linear feet (LF) in length.

19. **Internal Point Repair/Spot Liner - 10" Ø Pipe –** NOT USED

20. **Internal Point Repair/Spot Liner - 15" Ø Pipe –** NOT USED

21. **NASSCO MACP Level 2 Manhole Inspections** – Count the actual number of manholes inspected.

22. **Internal Manhole Drop Assembly Reinstatement –** Count the actual number of internal manhole drop assemblies repaired.

23. **External Manhole Drop Assembly Reinstatement –** Count the actual number of external manhole drop assemblies repaired.

24. **Rebuild Invert and Bench –** Count the actual number of manhole benches rebuilt.

25. **Full Manhole Rehabilitation** – Measure the vertical linear feet (LF) of internal manhole surface rehabilitated.

26. **Manhole Chimney Sealing** – Measure the square footage (SF) of surface area sealed.

27. **Manhole Casting Adjustment –** Count the actual number of manhole castings adjusted.

28. **Manhole Casting Replacement –** Count the actual number of manhole castings replaced.

29. **Roadway Restoration – County –** Measure the square footage (SF) of roadway restored.

30. **Roadway Restoration – Town of Oyster Bay –** NOT USED

31. **Roadway Restoration – Village of Massapequa Park –** NOT USED

32. **Roadway Restoration – Village of Lawrence –** NOT USED

33. **Roadway Restoration – Village of Cedarhurst –** NOT USED

34. **Roadway Restoration – City of Glen Cove –** Measure the square footage (SF) of roadway restored.

35. **Concrete Pavement –** Measure the actual square yardage (SY) of concrete pavement replaced.

36. **Concrete Curb –** Measure the actual linear feet (LF) of concrete curb replaced.

37. **Concrete Sidewalk –** Measure the actual linear feet (LF) of concrete sidewalk replaced.

38. **Landscape Restoration – Grading and 4-Inch Topsoil –** Measure the square yardage (SY) of 4-inch-deep topsoil placed and graded. This Item will only pay for imported topsoil as required. Reuse of topsoil will not be paid for under this Item.

39. **Landscape Restoration – Sodding –** Measure the square yardage (SY) of sodding placed.

40. **Removal and Disposal of Asbestos Pipe - 4" Ø - 24" Ø –** Measure the actual linear foot of asbestos pipe removed.

PART 4 - PAYMENTS

4.01 GENERAL REQUIREMENTS AND STIPULATIONS

A. No separate payments will be made for the Work under this Contract except for the pay items stipulated in this Part 4.

B. All costs in connection with the Work will be included in one or more of the pay items, as appropriated.

C. Each pay item will be full compensation for all costs in connection with the item including, but not limited to:

1. the furnishing of all materials, labor, equipment, tools, and all incidentals,

2. the installation of all materials, equipment, facilities, accessories, and appurtenant items,

3. proper share of overhead and profit,

4. mobilization/demobilization,

5. submittals,

6. General and Supplemental Conditions,

7. all temporary facilities and controls

8. restoration of surfaces not scheduled to be paid for by bid items

9. all related and incidental work and items necessary or required to complete the Work and to provide completely connected, operational and approved systems capable of performing as required.

D. In addition to those items described above, Paragraph 4.02 lists specific items of work under each pay item to assist Contractor in appropriating the costs to the proper pay item.

4.02 PAY ITEMS

A. The name of the following pay item is the abbreviated form of the Bid Item as contained on the Price Schedule in the Bid Forms. The name, as shown below or on the Bid Form, will not be construed to represent a complete description of all or the Work included under such time as is provided only as a means of identification and for ease of conversation.

ITEM NO.	PAYMENT
1.	**6" Ø Cured-in-Place Pipe Liner -** NOT USED
2.	**8" Ø Cured-in-Place Pipe Liner -** Payment will be made at the unit price bid per linear foot of pipe lined and measured as indicated in 3.01. Include costs for all materials, labor, equipment and incidental required to insert and cure the liner in the host pipe. Payment for the liner shall include type testing, wet-out, insertion, sealing the liner at manholes and cut edges, pre- and post- television inspection, pipe cleaning, sewer bypass, NASSCO MACP Level 1 manhole inspections, and all work incidental thereto and necessary therefore.
3.	**10" Ø Cured-in-Place Pipe Liner -** Payment will be made at the unit price bid per linear foot of pipe lined and measured as indicated in 3.01. Include costs for all materials, labor, equipment and incidental required to insert and cure the liner in the host pipe. Payment for the liner shall include type testing, wet-out, insertion, sealing the liner at manholes and cut edges, pre- and post- television inspection, pipe cleaning, sewer bypass, NASSCO MACP Level 1 manhole inspections, and all work incidental thereto and necessary therefore.
4.	**12" Ø Cured-in-Place Pipe Liner -** Payment will be made at the unit price bid per linear foot of pipe lined and measured as indicated in 3.01. Include costs for all materials, labor, equipment and incidental required to insert and cure the liner in the host pipe. Payment for the liner shall include type testing, wet-out, insertion, sealing the liner at manholes and cut edges, pre- and post- television inspection, pipe cleaning, sewer bypass, NASSCO MACP Level 1 manhole inspections, and all work incidental thereto and necessary therefore.
5.	**14" Ø Cured-in-Place Pipe Liner -** NOT USED
6.	**15" Ø Cured-in-Place Pipe Liner -** NOT USED
7.	**18" Ø Cured-in-Place Pipe Liner -** Payment will be made at the unit price bid per linear foot of pipe lined and measured as indicated in 3.01. Include costs for all materials, labor, equipment and incidental required to insert and cure the liner in the host pipe. Payment for the liner shall include type testing, wet-out, insertion, sealing the liner at manholes and cut edges, pre- and post- television inspection, pipe cleaning, sewer bypass, NASSCO MACP Level 1 manhole inspections, and all work incidental thereto and necessary therefore.
8.	**Internally Reinstate Building Connections on Lined Sewer –** Payment will be made at the unit price for each connection reinstated and accepted complete. Include costs for all materials, labor and equipment and all work incidental thereto and necessary therefore.

9. **Protruding Lateral Removal –** Payment will be made at the unit price for each protruding lateral removed by way of cutting and/or grinding and accepted complete. Include costs for labor, equipment, removal of debris, and all work incidental thereto and necessary therefore.

10. **Lateral Rehabilitation – Injection Grouting** – NOT USED

11. **Lateral Rehabilitation – CIPP Lining** – NOT USED

12. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil –** NOT USED

12.1. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil –** NOT USED

12.2. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil –** NOT USED

12.3. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil –** NOT USED

12.4. **External Point Repair - 4" Ø - 6" Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair –** NOT USED

13. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly.

13.1. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes costs for additional shoring of unsuitable soils, filter fabric, removal, hauling, and disposal of unsuitable soils, select fill, gravel and crushed stone, and for all labor, equipment, materials, and all other costs incidental thereto and necessary therefore.

13.2. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes all costs associated with dewatering such as, but not limited to, labor, materials, equipment, and incidentals necessary for the design, permits, installation, operation, and removal of temporary dewatering system. Include all costs to remove and properly dispose of groundwater from all excavations including but not limited to pipes, fittings, headers, hoses, well points, sediment control, pumps, consumables and all other work incidental thereto and necessary thereof.

13.3. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes all costs associated with dewatering such as, but not limited to, labor, materials, equipment, and incidentals necessary for the design, permits, installation, operation, and removal of temporary dewatering system. Include all costs to remove and properly dispose of groundwater from all excavations including but not limited to pipes, fittings, headers, hoses, well points, sediment control, pumps, consumables and all other work incidental thereto and necessary thereof. Includes costs for additional shoring of unsuitable soils, filter fabric, removal, hauling, and disposal of unsuitable soils, select fill, gravel and crushed stone, and for all labor, equipment, materials, and all other costs incidental thereto and necessary therefore.

13.4. **External Point Repair - 8" Ø - 15" Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair –** Payment will be made at the unit price per linear foot of additional point repair length contiguous to point repair made under Items 13 through 13.3 and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction and all work incidental thereto and necessary therefore.

14. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly.

14.1. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes costs for additional shoring of unsuitable soils, filter fabric, removal, hauling, and disposal of unsuitable soils, select fill, gravel and crushed stone, and for all labor, equipment, materials, and all other costs incidental thereto and necessary therefore.

14.2. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes all costs associated with dewatering such as, but not limited to, labor, materials, equipment, and incidentals necessary for the design, permits, installation, operation, and removal of temporary dewatering system. Include all costs to remove and properly dispose of groundwater from all excavations including but not limited to pipes, fittings, headers, hoses, well points, sediment control, pumps, consumables and all other work incidental thereto and necessary thereof.

14.3. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil –** Payment will be made at the unit price for each point repair and accepted complete.

Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes all costs associated with dewatering such as, but not limited to, labor, materials, equipment, and incidentals necessary for the design, permits, installation, operation, and removal of temporary dewatering system. Include all costs to remove and properly dispose of groundwater from all excavations including but not limited to pipes, fittings, headers, hoses, well points, sediment control, pumps, consumables and all other work incidental thereto and necessary thereof. Includes costs for additional shoring of unsuitable soils, filter fabric, removal, hauling, and disposal of unsuitable soils, select fill, gravel and crushed stone, and for all labor, equipment, materials, and all other costs incidental thereto and necessary therefore.

14.4. **External Point Repair - 8" Ø - 15" Ø Sewers - 12-ft to 20-ft Deep - Additional LF > 8 LF Repair –** Payment will be made at the unit price per linear foot of additional point repair length contiguous to point repair made under Items 14 through 14.3 and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction and all work incidental thereto and necessary therefore.

15. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Suitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly.

15.1. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – No Dewatering – Unsuitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include

replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes costs for additional shoring of unsuitable soils, filter fabric, removal, hauling, and disposal of unsuitable soils, select fill, gravel and crushed stone, and for all labor, equipment, materials, and all other costs incidental thereto and necessary therefore.

15.2. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Suitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes all costs associated with dewatering such as, but not limited to, labor, materials, equipment, and incidentals necessary for the design, permits, installation, operation, and removal of temporary dewatering system. Include all costs to remove and properly dispose of groundwater from all excavations including but not limited to pipes, fittings, headers, hoses, well points, sediment control, pumps, consumables and all other work incidental thereto and necessary thereof.

15.3. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Up to 8 LF Repair – With Dewatering – Unsuitable Soil –** Payment will be made at the unit price for each point repair and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting pavements, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each point repair shall include replacing a section of sewer main up to 8 linear feet in length, reconnection of up to one (1) service lateral, including all necessary pipe, fittings and couplings for complete reinstatement of piping assembly. Includes all costs associated with dewatering such as, but not limited to, labor, materials, equipment, and incidentals necessary for the design, permits, installation, operation, and removal of temporary dewatering system. Include all costs to remove and properly dispose of groundwater from all excavations including but not limited to pipes, fittings, headers, hoses, well points, sediment control, pumps, consumables and all other work incidental thereto and necessary thereof. Includes costs for additional shoring of unsuitable soils, filter fabric, removal, hauling, and disposal of unsuitable soils, select fill, gravel and crushed stone, and for all labor, equipment, materials, and all other costs incidental thereto and necessary therefore.

15.4. **External Point Repair - 16" Ø - 24" Ø Sewers - Up to 12-ft Deep - Additional LF > 8 LF Repair –** Payment will be made at the unit price

per linear foot of additional point repair length contiguous to point repair made under Items 15 through 15.3 and accepted complete. Include costs for materials, equipment, excavation, test pits, removal and disposal of existing pipe, excavated materials and pavements, sawcutting, excavation support and protection system, utility support, bypass pumping, pipe bedding, pipe couplings, final backfill, compaction and all work incidental thereto and necessary therefore.

16. **Top Hat for Lateral Connections –** Payment will be made at the unit price for each top hat installed and accepted complete. Includes costs for all materials, labor and equipment and all work incidental thereto and necessary therefore.

17. **Internal Point Repair/Spot Liner - 6" Ø Pipe –** NOT USED

18. **Internal Point Repair/Spot Liner - 8" Ø Pipe –** Payment will be made at the unit price for each point repair, accepted complete. Include costs for all labor, materials, equipment, wet-out, insertion, curing, sealing the liner at manholes/cut edges, pre- and post- television inspection, pipe cleaning, sewer bypass, NASSCO MACP Level 1 manhole inspections for manholes upstream and downstream of point repair location, and all work incidental thereto and necessary therefore. Each internal point repair shall include replacing a section of sewer main up to 10 linear feet in length.

19. **Internal Point Repair/Spot Liner - 10" Ø Pipe –** NOT USED

20. **Internal Point Repair/Spot Liner - 15" Ø Pipe –** NOT USED

21. **NASSCO MACP Level 2 Manhole Inspections** – Payment will be made at the unit price for each manhole inspected and accepted complete based on NASSCO MACP level 2 manhole inspection requirements. Includes costs for all labor, safety equipment, inspection equipment, traffic control equipment, and all work incidental thereto and necessary therefore. This is a contingency bid item, and this work is to be performed at the discretion of the Engineer following NASSCO MACP Level 1 Manhole Inspection.

22. **Internal Manhole Drop Assembly Reinstatement –** Payment will be made at the unit price for each internal manhole drop assembly reinstated and accepted complete. Include costs for all materials, labor and equipment and all work incidental thereto and necessary therefore.

23. **External Manhole Drop Assembly Reinstatement –** Payment will be made at the unit price for each external manhole drop assembly reinstated and accepted complete. Include costs for all materials, labor and equipment and all work incidental thereto and necessary therefore.

24. **Rebuild Invert and Bench –** Payment will be made at the unit price bid for each bench rebuilt, complete and accepted. Include cost for labor, equipment, materials, tools, surface preparation, flow diversion/bypass, cleaning, reforming invert(s) and all other work incidental thereto and necessary thereof.

25. **Full Manhole Rehabilitation** – Payment will be made at the unit price per vertical linear feet of internal manhole surface rehabilitated and accepted complete. Full manhole rehabilitation includes patching and sealing, chemical injection grouting, epoxy coating, and cementitious coating. Include cost for labor, equipment, materials, tools, surface preparation and cleaning, drilling, cutting/grinding of intruding connections, removal of steps, flow diversion/bypass, patching, sealing of active leaks, cleanup, inspection, quality assurance testing, and all other work incidental thereto and necessary thereof. This item does not include chimney sealing, bench rebuilding, or invert rebuilding. This is a contingency bid item, and this work is to be performed at the discretion of the Engineer following NASSCO MACP Level 2 Manhole Inspection.

26. **Manhole Chimney Sealing** – Payment will be made at the unit price bid per square foot of chimney sealing completed and accepted. Includes cost for labor, equipment, materials, tools and all other work incidental thereto and necessary thereof. This is a contingency bid item, and this work is to be performed at the discretion of the Engineer following NASSCO MACP Level 2 Manhole Inspection.

27. **Manhole Casting Adjustment –** Payment will be made at the unit price for each manhole casting adjusted and accepted complete. Includes cost for labor, equipment, materials, tools and all other work incidental thereto and necessary thereof. This is a contingency bid item, and this work is to be performed at the discretion of the Engineer.

28. **Manhole Casting Replacement –** Payment will be made at the unit price for each manhole casting replaced and accepted complete. Includes cost for labor, equipment, materials, tools and all other work incidental thereto and necessary thereof. This is a contingency bid item, and this work is to be performed at the discretion of the Engineer.

29. **Roadway Restoration – County –** Payment will be made at the unit price per square foot for roadway installed, completed and accepted based on Nassau County requirements. Include costs for hauling, dumping, placing, grading, and leveling, compacting, all material, tools and labor necessary therefore and incidental thereto.

30. **Roadway Restoration – Town of Oyster Bay –** NOT USED

31. **Roadway Restoration – Village of Massapequa Park –** NOT USED

32. **Roadway Restoration – Village of Lawrence –** NOT USED

33. **Roadway Restoration – Village of Cedarhurst –** NOT USED

34. **Roadway Restoration – City of Glen Cove –** Payment will be made at the unit price per square foot for roadway installed, completed and accepted based on City of Glen Cove requirements. Include costs for hauling, dumping, placing, grading, and leveling, compacting, all material, tools and labor necessary therefore and incidental thereto.

35. **Concrete Pavement –** Payment will be made at a unit per square yard of concrete pavement installed, completed and accepted. Include costs for all labor, equipment, material, including sawcutting, removal and

disposal of existing pavement, formwork and concrete, reinforcement, transporting, joint assemblies, placing, grading, leveling, curing and all other work incidental thereto and necessary therefore.

36. **Concrete Curb –** Payment will be made at a unit per linear foot of concrete curb installed, completed and accepted. Include costs for all labor, equipment, material, including sawcutting, removal and disposal of existing curb, formwork and concrete, reinforcement, transporting, placing, grading, leveling, curing and all other work incidental thereto and necessary therefore.

37. **Concrete Sidewalk –** Payment will be made at a unit per linear foot of concrete sidewalk installed, completed and accepted. Include costs for all labor, equipment, material, including sawcutting, removal and disposal of existing sidewalk, formwork and concrete, reinforcement, transporting, placing, grading, leveling, curing and all other work incidental thereto and necessary therefore.

38. **Landscape Restoration – Grading and 4-Inch Topsoil –** Payment will be made at the unit price per square yard of 4-inch deep topsoil installed, completed, and accepted. Includes costs for stripping, stockpiling and replacing topsoil, importing additional topsoil, removal of stumps and roots in the limits as shown on the drawings, transporting, grading and leveling, and all material, tools, labor, equipment, maintenance, water and watering, moving and all other work incidental thereto and necessary therefore.

39. **Landscape Restoration – Sodding –** Payment will be made at the unit price per square yard of sod installed, completed and accepted. Include costs for transporting, sod placement, raking, mulching, fertilizer, and all material, tools, labor, equipment, maintenance, water and watering, moving and all other work incidental thereto and necessary therefore.

40. **Removal and Disposal of Asbestos Pipe - 4" Ø - 24" Ø –** Payment will be made at the unit price per linear foot of asbestos pipe removal and disposal. Include costs for labor, materials, equipment, hazardous material containment, permits, waste disposal, hauling, air monitoring and all work incidental thereto and necessary therefore.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes requirements related to the Contractor's responsibilities for substitutions.

1.02 EQUIVALENT MATERIALS AND EQUIPMENT

A. Whenever a material or article is specified or described by using the name of a proprietary product or the name of a particular manufacturer(s) or vendor(s), followed by the phrase "or equal," the specific item mentioned shall be understood as establishing the type, function, dimension, appearance, and quality desired, and is to be the basis upon which bids are to be prepared. Other manufacturer's products not named will be considered as substitutions provided required information is submitted in the manner set forth herein and provided substitution will not require substantial revisions of Contract Documents.

B. Whenever a material or article is specified or described without the phrase "or equal," the phrase "or equal" shall be deemed included.

1.03 SUBMITTAL OF REQUESTS FOR SUBSTITUTIONS

A. Submit his request for substitutions and any monetary changes associated therewith to the Engineer. The Contractor's submittal shall include all necessary data for County evaluation. The following listing summarizes the data required:

1. Complete date substantiating compliance of proposed substitution with Contract Documents. Substitution shall not change design intent.
2. For Products:
    a. Product identification, including manufacturer's name and address.
    b. Manufacturer's literature including, but not necessarily limited to, product description, performance and test date and reference data.
    c. Samples where appropriate.
    d. Name and address of similar projects on which product was used, and date of installation.
3. Itemized comparison of proposed substitution with product or method specified. Different types of products and methods will be considered provided final performance is at least equal to that specified.
4. Data relating to impact on construction schedule occasioned by the proposed substitution.
5. Relation to other contracts.
6. Accurate cost data on proposed substitution in comparison with product or method specified, including costs of all redesigns required.
7. In making request for substitution, the Contractor represents:
    a. They have personally investigated proposed product or method, and determined that it is equal or superior in all respects to that specified.
    b. Installation of accepted substitution into work shall be corrdinated, making such design and construction changes as may be required for work to be completed in all respect.
    c. The same guarantee for substitution as for product or method specified will be provided.
8. Substitutions will not be considered at any time if:
    a. They are indicated or implied on shop drawings or project data submittals without formal request submitted in accordance with this section.
    b. Acceptance will require substantial revision of Contract Documents.
    c. Acceptance will create problems in stocking of repair parts and in future maintenance by the Owner.
9. The Owner's decision regarding evaluation of substitutions shall be considered final and binding. Request for time extension and additional costs based on submission of, acceptance of, or rejection of substitutions will not be allowed.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this Section specifies the procedures used to process partial payments and the Final Payment Request.

1.02 TIME FOR COMPLETION

A. Inasmuch as the provisions of the Contract relating to the time for performance and completion of the Work are for the purposes of enabling the Owner to proceed with the construction of a public improvement in accordance with a predetermined program, and inasmuch as failure to complete the Work within the period herein specified may result in damage or loss to the Owner, time is of the essence of the Contract.

B. Time for completion of the Work shall be in accordance with that stipulated in the Contract Documents.

C. The date for completion will be calculated from the date shown on the Notice to Proceed. The Contractor shall execute the Work with diligence from day to day, and complete it within the time fixed.

D. For the purpose of defining the date of substantial completion, the Project will be considered complete when all Work covered by the Contract has been performed and all installations and equipment have been tested and are ready for permanent use. Contractor shall provide a copy of the final Certificate of Occupancy from the AHJ prior to issuance of the final payment. Removal of the Contractor's plant and equipment and other minor adjustments which do not prevent use of the Project will not be a factor in establishing the date of substantial completion.

E. Notwithstanding the foregoing, the Engineer will establish the date of substantial completion when the project is accepted and ready for operation, and no large or major items of work are as yet outstanding. At such time, the Engineer will issue a punch list, itemizing the items of work remaining. The punch list will include "minor" items only, as defined solely by the Engineer. Any prior punch lists, which include "major" or significant items, as defined by the Engineer, shall not be a criterion in establishing the date of substantial completion.

1.03 PARTIAL COMPENSATION

A. At the Owner's discretion, the Contractor may receive compensation for materials and products delivered to the site yet not installed providing:
   1. A canceled check or paid bill from the supplier is submitted to the Engineer indicating that the Contractor has paid the supplier for the material or equipment.
   2. The material or piece of equipment is properly stored and protected from the elements and/or vandalism in accordance with the manufacturer's written requirements for long term storage.
   3. A certificate of insurance is provided for the material or piece of equipment in the event of a fire, vandalism, theft, etc.
   4. A bill of material is delivered to the Engineer at the time of delivery itemizing the subject material or equipment. Payment will be made for on-site material and/or equipment in the amount of 80% of the gross amount of the paid invoice. This payment will be subject to the normal retainage of the partial estimate.
   5. The Engineer has agreed to the pre-purchasing of the materials.

B. The Contractor may not receive compensation for materials and products stored in the Contractor's yard or shop unless permitted by the Owner.

1.04 APPLICATIONS FOR PAYMENT

A. Review the percentage of work completed during the payment period with the Engineer, based on the bid items in the proposal. The Engineer shall make the final decision on the percentage of work completed.

B. The form of application for payment shall be as provided by the Owner.

C. Submit one (1) copy of each payment application, completed, signed and notarized.

D. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

E. The payment application shall include a Contractor Invoice and an Owner Claim Voucher.

F. Provide completed Labor Affidavit Form for each pay period included in the certified payroll reports for each payment application for both the contractor and any subcontractor(s).

G. Submit payment application to Engineer no later than the first day of each month. Payments received after the first day of each month shall be reviewed and processed after the first day of the following month. Only one application for payment will be reviewed and processed each month.

H. Submit certified payroll receipts for all workers and subcontractors. Payroll receipts shall be submitted with every application for payment. All payroll receipts shall be certified correct and notarized by a Notary in the State of New York. Application for Payment will not be processed unless all payroll receipts are received.

I. Contractor shall pay all workers and have all subcontractors pay all workers the prevailing New York State Wage Rates.

J. Provide proof of OSHA certifications for all workers and subcontractor workers prior to payment approval.

K. Owner may conduct on-site interviews with all workers to verify payments of prevailing wage rates are enforced.

L. The Engineer shall submit the documentation along with an Engineer's Payment Report to the Owner for payment.

M. Retainage in the amount of 5% will be held from each partial payment. Retainage will only be released upon full completion of the project and will be included in the final payment.

1.05 ACCEPTANCE OF FINAL PAYMENT REQUEST

A. The Contractor shall be conclusively deemed to have accepted the Final Payment Request as a correct statement of the total liability of the Owner and of the compensation paid and to be paid to the Contractor by the Owner unless within seven (7) days after delivery of their copy of the Final Payment Request to them, the Contractor shall return such copy to the Owner together with a statement of their objections to such request and of any claim for damages or compensation in excess of the amounts shown on the Request. The acceptance by the Contractor of the Final Payment Request approved by the Owner shall constitute a release and shall discharge the Owner from all further claims by the Contractor arising out of or relating to the Contract, including but not limited to, a release from all impact costs.

1.06 SCOPE OF PAYMENTS

A. The Contractor shall receive and accept the compensation as herein provided, in full payment for furnishing all materials, labor, tools, and equipment and for performing all work contemplated and embraced under the Contract, also for all loss or damage arising out of the nature of the Work or from the action of the elements, or from any unforeseen difficulties or obstructions which may arise or be encountered during the prosecution of the Work, and for all risks of every description connected with the prosecution of the Work, until its final acceptance by the Owner, also for all expenses incurred by, or in consequence of, the suspension or discontinuance of the said prosecution of the Work as herein specified, and for all actual or alleged infringements of patent, trademark, or copyright, and for completing the Work and the whole hereof, in an acceptable manner, according to the Plans, Specifications, and other Contract Documents. The payment of any partial or final estimate shall in no way or in no degree prejudice or affect the obligation of the Contractor, at their own cost and expense, to renew or replace all defects and imperfections, or damages. The Engineer shall be the judge, and the said Contractor shall be liable to the Owner for failure so to do.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requests for Interpretation or for information
   1. Coordination between contractors, if applicable

B. Administration of subcontracts

C. Coordination of work with utility companies and the Owner/Engineer

D. Communication and coordination requirements

E. Qualifications of Contractor's job site superintendent

F. Site staffing requirements for the Contractor's superintendent, the costs for which shall be included in the Contract price.

1.02 REQUEST FOR INTERPRETATION OR INFORMATION

A. Use the Request for Interpretation/Information Form included within this Section when the Contractor feels that additional information is needed to perform the work of the Contract.

B. The Engineer will respond to requests utilizing the form provided herein.

C. The Engineer's verbal response(s) to the Contractor's formal requests, if provided, shall not constitute an official response and if acted upon by the Contractor are done so at the Contractor's own risk and liability and shall not be subject to claims for additional compensation.

D. The original of the form shallbe signed and provided to the Engineer's project manager

E. The Engineer will respond in writing to the request as soon as possible.

1.03 SUBCONTRACTOR ADMINISTRATION AND COORDINATION

A. Terms and conditions of the Contract shall be binding upon each subcontractor.

B. Furnish each subcontractor and major equipment vendor at least one (1) copy of the Plans and Technical Specifications.

C. Provide at least one (1) copy of each approved shop drawing to each subcontractor whose work may depend upon the contents of the shop drawing submittal. The Owner reserves the right to stop all work, without claims for delay, until such time as appropriate subcontractors are furnished with appropriate shop drawings.

D. Sequence and schedule the work of subcontractors. Coordinate construction and administration activities of subcontractors. The Engineer and Owner will not accept telephone calls, facsimiles, email, or office visits from any subcontractors on the project. Subcontractor and vendor questions and clarifications shall be directed to the Engineer by the Contractor.

E. The Contractor's on-site project superintendent shall inspect all subcontractor work, as it is being constructed. The Contractor's subcontractors shall not be permitted to do any work on the site without the Contractor's job site superintendent also being there to inspect the work as it is being performed.

1.04 UTILITY COORDINATION

A. Comply with the requirements of 16 NYCRR Part 753 - Protection of Underground Facilities. Submit a letter stating the case number.

B. Comply with the utility coordination requirements contained in the General Conditions.

1.05 PUBLIC/PRIVATE UTILITIES

A. Notify all public and private utilities in accordance with Article 20, Section 322-a of the New York State General Business Law for location and markout of existing utilities in the vicinity of the work.

B. Repair all utilities damaged during the Work to the standards and approval of the respective utility at no cost to the Owner.

1.06 SPECIFIC COORDINATION REQUIREMENTS

A. Sequence and schedule work so as not to interfere with the work by others. Coordinate the work of this Contract with the work by others. In case of conflicts due to improper coordination by the Contractor, the Owner/Engineer's resolution will be final. No compensation will be awarded for extra work required to resolve conflicts.

B. Coordinate space requirements, supports, and installation of mechanical, electrical and plumbing work which may be indicated diagrammatically on the Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practicable. Place runs parallel with building lines. Utilize spaces efficiently to maximize accessibility for other installations, maintenance, and to facilitate repairs.

C. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of all fixtures and outlets with finish elements and work by all other trades.

D. Coordinate the work by complying with the following:
   1. Email Account: Maintain an email account that shall be used to improve communication. An email shall not constitute a formal advisement regarding the terms and conditions of the contract. Email shall only be considered an informal way of notifying relevant parties of project related activities.
   2. Email List: Within five (5) calendar days from the Notice To Proceed, provide a list of email addresses for each major equipment supplier and local representative, if such exists. A contact person shall be provided for each email address.

E. Project Coordination Meetings: Participate in and attend the Project Coordination Meetings as specified below:
   1. A minimum of two (2) project coordination meetings will be held at the Owner’s office or project site.
   2. The meetings will be held when so called for by the Engineer.

F. Afford each Contractor the time to complete their contractual obligations with the Owner. Coordination includes, but is not limited to, the following:
   1. Schedule work with all trades throughout the project to prevent interference.
   2. In case of conflicts due to improper coordination by any Contractor, the Owner/Engineer’s resolution will be final. No compensation will be awarded for extra work required to resolve conflicts or to coordinate the work of all contracts.
   3. Coordinate space requirements, supports, and installation of mechanical, electrical and plumbing work which may be indicated diagrammatically on the Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practicable. Place runs parallel with building lines. Utilize spaces efficiently to maximize accessibility for other installations, maintenance, and to facilitate repairs.
   4. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of all fixtures and outlets with finish elements and work by all other trades.

G. Shop Drawings and Submittals Coordination Procedure:
   1. Immediately notify the Engineer should a purported conflict in the work be discovered so that the Engineer can investigate and take appropriate action.
   2. If a shop drawing was so provided by the Engineer and a conflict in the work was not brought to the attention of the Engineer, then the conflict shall be immediately corrected by the Contractor submitting the shop drawing.

H. Coordinate the work by complying with the following:
   1. Construction Schedule: Provide a construction schedule as specified in Section 013216 - Construction Schedules.
   2. Weekly Schedule: By 3:00 PM of each Friday during the construction period, the Contractor shall email a typed memo addressed to the Engineer/Owner’s resident field engineer/inspector and designated office project manager summarizing the work for the

following week. The memo shall also be emailed to each Prime Contractor's home office and the Owner. The memo shall briefly itemize the planned activities for the coming week. The memo shall also include a summary of expected material/equipment deliveries, concrete pours, utility tie-ins, excavated material removals and other heavy construction traffic that may impact the work activities for the coming week.

3. Work Plan: Within five (5) calendar days from the date of the Notice to Proceed, submit to the Engineer a type written work plan in bullet format of the sequence of construction activities from start to finish of construction. A facsimile will not be accepted. All work plans shall include a description of the different major phases of construction as pertaining to the individual construction contract. As a minimum each work plan shall include the tasks and subtasks specified in Section 013216 for the project schedule.
   a. The Contractor's work plan shall be complete and shall address every phase of the scope of the Contract.
   b. The Contractor shall then prepare a construction schedule as specified below using the work plans prepared by others and the work plans under this section.

I. Equipment and Startup Schedule: Submit a preliminary equipment delivery schedule and a preliminary startup schedule for all equipment and systems being furnished under the Contract. This schedule shall be submitted within 30 calendar days from the date of the Notice To Proceed.
   1. Include an early and late date for each item.
   2. Indicate the time necessary to physically install and ready each item so that other work can be completed by other Prime Contractors.
   3. The Engineer/Architect may waive this schedule if the Contractor has adequately shown the information on the construction schedule, in the opinion of the Engineer/Architect.

J. Project Schedule Coordination Meetings: Participate in and attend the Project Schedule Coordination Meetings as specified below:
   1. Up to three (3) project schedule coordination meetings will be held at the Engineer's or Owner's office as specified herein.
   2. The meetings will be held when so called for by the Engineer.
   3. Each meeting may last up to eight (8) hours with one hour for lunch.
   4. The Contractor will prepare the final agreed version of the schedule and submit it to the Owner and the Engineer.
   5. The Engineer reserves the right not to hold these meetings if in their opinion they are not needed.
   6. The time associated with attendance at the Engineer's scheduled meetings shall be included in the lump sum bid and be subject to a credit of $150 per hour for each unused hour that the Contractor choose to not attend.

1.07 CONTRACTOR'S JOB SITE SUPERINTENDENT

A. Employ an on-site superintendent as specified herein below. The superintendent shall be a full-time employee of the Contractor.

B. Name the job site superintendent within five (5) days of the Notice To Proceed. A letter to the Engineer shall be provided.

C. The superintendent shall have the authority to sequence and schedule the work, and to staff the project, so as not to interfere with the work by others and to complete the work daily within the time so required.

D. The superintendent shall have a minimum of five (5) years of experience as a job site superintendent for projects of equal size and complexity.

E. The superintendent shall not be a foreman or crew supervisor.

F. The superintendent shall be qualified to perform the duties so required to successfully complete the work in accordance with the Contract Documents.

G. Superintendents shall be on the project site while work under this contract is being performed, either by direct forces or by subcontractors as stipulated above for subcontractor coordination.

H. The superintendent shall speak English. If required by the Engineer, provide a resume for the proposed superintendent that shall be typed and shall list the qualifications of the superintendent. Prior to the Contractor assigning a superintendent to the project, arrange an interview with the Engineer to determine the proposed superintendent's ability to properly coordinate the work through the Owner/Engineer. Employ a superintendent acceptable to the Owner.

THIS SPACE LEFT INTENTIONALLY BLANK.

REQUEST FOR INTERPRETATION/INFORMATION (RFI)

OWNER'S NAME: Nassau County Department of Public Works

PROJECT NAME & CONTRACT DESIGNATION: Lateral Sewer Rehabilitation Program Glen Cove

CONSTRUCTION CONTRACT NO.: S30052-03G

Product, Item, or System:	
Request Date:	RFI No.:
Specification Section:	Paragraph Ref:
Contract Drawing Reference(s):	
Describe Request:	
Signed:	See Contractor's Attachments for Additional Description for Information
Owner/Engineer Response:	
Engineer (Printed):	See Engineer's Attachments for Additional Information
Engineer's Signature & Date	*Response Accepted By Contractor* *Contractor's Signature & Date*
The Work shall be carried out in accordance with these supplemental instructions without change in Contract amount or Contract time for completion. Prior to proceeding with these instructions, indicate your acceptance of these instructions by signing where indicated and returning this form to the Engineer.	

END OF SECTION 013100

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for progress meetings.

1.02 PRE-CONSTRUCTION CONFERENCE

A. Attend the pre-construction conference at a location, date, and time selected by the Owner.

B. The owner, a partner, or a corporate officer representing the Contractor shall attend the conference. The job site superintendent and office project manager for each Contractor shall also attend.

C. The Engineer will prepare an agenda for the conference.

1.03 PROGRESS MEETINGS

A. Progress meetings will be held approximately once every two (2) weeks during the project. The Owner may elect to hold meetings more or less frequently.

B. At least seven (7) calendar days advance notice will be given by the Engineer or the date for the upcoming meeting will be set during the progress meeting.

C. Attendance at progress meetings shall be mandatory. An amount of $1,000 shall be deducted from the Contract Amount for each announced meeting not attended by the Contractor.

D. The owner, a partner, or a corporate officer representing the Contractor shall attend each announced progress meeting. The job site superintendent and office project manager for each Contractor shall also attend.

E. Subcontractors shall attend when requested by the Owner or Engineer at no cost to the Owner.

F. Meetings will be conducted by Engineer at a location selected by the Owner, normally at or adjacent to the project site.

G. The minimum agenda will cover:
   1. Review minutes of previous meetings.
   2. Identify present problems and resolve them.
   3. Plan work progress during next work period.
   4. Review the status of off-site fabrication and delivery schedule.
   5. Review shop drawings and submittal schedules.
   6. Review change order status.
   7. Review status of construction progress schedule.
   8. Coordinate access requirements.
   9. Other business related to the work.

1.04 OTHER MEETINGS

A. Attend special meetings which may be required or called for by Federal, State or Local authorities, utility companies, Owner, Engineer or any other firm, person or organization related to the project.

1.05 CONDUCTING MEETINGS

A. General - This paragraph covers Owner and/or Engineer meetings with Contractor and/or his/her subcontractors. Neither Owner nor Engineer wishes to meet solely with a subcontractor and requests for such meetings will be discouraged. If a meeting with a subcontractor is deemed necessary, the Contractor shall attend. If, for some reason, circumstances do not allow such, the meeting may be held, minutes of the meeting will be sent to Contractor and decisions on any major questions will be reserved until Contractor has been consulted. Subcontractors may accompany contractor to meetings provided Contractor notifies Engineer in advance.

B. Chair - When Engineer/Owner attend meetings, Engineer, or their duly authorized representative, will act as chair. Should Owner-Contractor meetings be necessary, Owner will chair such meetings.

C. Notices - Engineer or Owner will issue notices of meetings to all parties concerned and will note, thereof, who must attend and who may attend if they so desire. When a Contractor desires a formal meeting, make a request through Engineer. Except when Engineer determines that a prompt meeting is essential, all notices will be issued at least one week in advance of the meeting date.

D. Agenda - All parties shall inform Engineer of items desired to be discussed and Engineer will notify all parties of all items to be considered. This is to allow each party to fully prepare for the meeting. This shall not be construed to mean that other items cannot be brought up at the meetings.

E. Time Limits - It is the intent to hold productive and efficient meetings and to keep them as short as is reasonably possible. The Chair will be the sole judge as to whether or not further discussion on any matter is warranted and all discussions shall cease when the Chair so orders.

F. Minutes - Minutes of meetings will be kept, written and distributed by the Chair or duly authorized representative. Minutes of all meetings will be available upon request to the Chair.

G. Conduct - It is the intent to conduct all meetings in an orderly manner, to reasonably discuss all items and to hear and observe the rights and opinions of all parties. The Chair will allow each party to speak, however, the Chair reserves the right to order any individual to leave the meeting at any time for any reason.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies the requirements for preparing construction schedules and for keeping them up to date.

B. Prepare a Gantt Chart type schedule and keep it up to date as specified hereinafter.

C. All schedules shall be submitted in accordance with the requirements contained herein in Section 013300.

D. Refer to Section 013100 regarding the requirements for attendance at Project Coordination Meetings and additional requirements concerning the submission of other project coordination and sequencing information.

E. Refer to Specification Section G27 of the General Conditions.

1.02 SCHEDULE PREPARATION MILESTONE DATES & REQUIREMENTS

A. Prepare Draft #1 Construction Schedule for presentation and discussion during Project Coordination Meeting No. 1.
   1. The Engineer will provide at least seven (7) calendar days written notice regarding the date of the first meeting.
   2. At the Engineer's discretion, Project Coordination Meeting No. 1 may immediately take place on the same date and directly following the Pre-Construction Conference. The Notice To Proceed will contain information regarding the Pre-Construction Conference and Project Coordination Meeting No. 1 should it be so decided by the Engineer.
   3. Draft #1 Construction Schedule shall be prepared as specified hereinafter.
      a. The schedule shall show all the major and subordinate tasks necessary to complete the project in the specified time and interim milestones.
      b. It shall allow adequate time for other Prime Contractors to complete their related work as best estimated by the Contractor. It being understood that the Contractor's allotted time for others to perform their work is non-binding and does not relieve the Contractor from completing all the work in the specified contract completion time in accordance with the Contract Documents. It also being understood that this is the Contractor's realistic best estimate of the time needed for others to complete their related work.
      c. The schedule shall also show the dependencies and time allocated for each task.
   4. The date, place, and time for Project Coordination Meeting No. 2 shall be established at the first meeting, but in no case be more than ten (10) calendar days from the date of the first meeting.

B. As a result of the first meeting, a better understanding of the Contractor's time requirements will have been achieved. Within five (5) working days of the date of *Project Coordination Meeting No. 1*, the Contractor shall prepare Draft #2 Construction Schedule and submit it to the Engineer for review. The Contractor shall email an electronic file of their schedule to all parties.
   1. *Project Coordination Meeting No. 2* shall be attended by the Contractors for the purpose of jointly developing a Combined Construction Schedule. The meeting shall focus on the time needed to complete each task and subordinate task and for establishing task dependencies.
   2. The Contractors shall deliver to the Engineer the electronic file of their Draft #2 Construction Schedule at the meeting. The Engineer will use the data files to prepare the Draft Combined Construction Schedule.
   3. The date, place, and time for *Project Coordination Meeting No. 3* shall be established at the meeting.

C. The purpose of *Project Coordination Meeting No. 3* is to review the Engineer's Draft Combined Construction Schedule and to make minor adjustments as are needed.

D. The Engineer, after the third meeting and as soon as possible, will make the agreed upon changes and provide final versions to all Prime Contractors for adoption as the Final Combined Construction Schedule.

1. The final schedule shall be implemented by all Prime Contractors on a daily basis. All tasks and subordinate tasks shall be completed on schedule.
2. Each Contractor shall increase resources as are needed to comply with the established milestone dates should the schedule start to lag.

E. The Engineer's decision regarding the time allotted for a given task shall be final and each Contractor shall apply necessary resources to accomplish the work. Submission of a bid shall be intended to mean that the Contractor agrees that the determination is binding.

1.03 PRIME CONTRACTORS SCHEDULE TYPES

A. Gantt Chart Type: The General Contractor shall prepare a Gantt Chart type schedule as specified hereinafter.

B. Critical Path Method (CPM): The General Contractor shall prepare a Critical Path Method (CPM) type schedule as specified hereinafter.

1.04 CONSTRUCTION SCHEDULE - GENERAL

A. Coordinate the work and maintain the construction schedule. In the event actual progress begins to lag the schedule, promptly employ additional means and methods of construction to make up the lost time.

B. Keep the construction schedule current and revise and resubmit as often as necessary to accurately reflect the conditions of the work, past progress and anticipated future progress.

C. The construction schedule shall be completed, submitted, and deemed received by the Engineer prior to the first payment application.

D. The schedule, when approved by the Engineer and the Owner, shall establish the dates for starting and completing work for the various portions of the Contract. It shall be the duty of the Contractor to conform to their own schedule and to perform the work within the time limits indicated. Failure to adhere to the approved schedule shall expose the Contractor to disputes, claims and additional costs incurred by others.

E. Coordinate letting of subcontracts, material purchases, shop drawing submissions, delivery of materials, and sequence of operations, to conform to the schedule.

F. Coordinate the construction schedule with the proposed schedules of the equipment suppliers and subcontractors.

G. The schedule shall show the critical sequence items where new units must come online before existing facilities go offline, if applicable to the project. The schedule shall also show, in detail, the proposed sequence of the work and the estimated date of starting and completing each stage of the work in order to complete the project within the contract time.

H. The schedule shall be plotted out in color and shall be 36-inch by 40-inch. It shall contain as many sheets as are necessary to show all rolled down tasks. Partially printed schedules will not be accepted. Arrange to have it plotted on a color plotter suitable for the intended application.

I. Prepare the schedule in a manner so that the actual progress of the work can be recorded and compared with the expected progress.

J. The schedule shall use the following convention:
1. Tasks for the General Contractor in blue ink.
2. Task links/task dependency in blue ink.
3. Work by others in green ink.
4. Milestone dates (zero duration) by a red diamond.
5. The end date for each task and subtask at the end of a bar.
6. The description of all major tasks within the bar. The bar shall be red.
7. Critical path.

K. The construction schedule shall also show the following:
1. Critical sequence items where new units must come on-line before existing facilities go off-line, if applicable to the project.

1.05 CONSTRUCTION SCHEDULE - CPM TYPE

A. The schedule shall show, in detail, the proposed sequence of the work and the estimated date of starting and completing each stage of the work in order to complete the project within the contract time.

B. Prepare the schedule in a manner so that the actual progress of the work can be recorded and compared with the expected progress.

C. Coordinate the construction schedule with the proposed schedules of the equipment suppliers and subcontractors.

D. Show the "critical path" of the project and task resources.

E. The CPM schedule shall be prepared using Microsoft Project ®, latest version.

F. It shall be prepared by a qualified scheduler regularly engaged in the preparation of CPM construction schedules.

G. Project scheduling software manufactured by other companies may be acceptable if the contractor purchases two (2) fully licensed packages for the exclusive use of the Owner and the Engineer.

H. One licensed latest version of Microsoft Project ® shall be delivered to the Owner, which shall remain registered to the Owner after the project is completed.

I. Provide two (2) 8 hour training classes using the proposed or specified software at the office of the Owner or Engineer at a date and time selected by the Owner. The General Contractor's site superintendent shall attend both classes. The Owner and Engineer reserve the right to utilize the Draft Combined Construction Schedule as the training aid. The instructor for the training classes shall be the professional Engineers retained by the General Contractor who is preparing the schedule for the General Contractor as specified above.

1.06 CONSTRUCTION SCHEDULE - GANTT CHART TYPE

A. The schedule shall show, in detail, the proposed sequence of the work and the estimated date of starting and completing each stage of the work in order to complete the project within the contract time.

B. Prepare the schedule in a manner so that the actual progress of the work can be recorded and compared with the expected progress.

C. Coordinate the construction schedule with the proposed schedules of the equipment suppliers and subcontractors.

D. The schedule shall be plotted out in color and shall be 36-inch by 40-inch. It shall contain as many sheets as are necessary to show all rolled down tasks. Partially printed schedules will not be accepted. Arrange to have it plotted on a color plotter suitable for the intended application.

E. The schedule shall show the following:
   1. Task links/task dependency in blue ink.
   2. Work under the Contract in green ink.
   3. Work by others in blue ink.
   4. Milestone dates (zero duration) by a red diamond.
   5. The end date for each task and subtask at the end of a bar.
   6. The description of all major tasks within the bar. The bar shall be red.
   7. Critical path.

1.07 REVISION OF PROJECT PROGRESS SCHEDULE

A. Evaluate and provide updated construction schedules monthly in accordance with job requirements. Each update shall be submitted to the Engineer for information purposes and be provided by the last Friday of every month

B. Modify the construction schedule to accommodate coordination of the construction contracts by the Owner/Engineer without claims for additional compensation or delay.

C. From time to time, and at stages deemed appropriate by the Engineer, the Engineer may issue updated schedules to reflect the project's status. The percent complete for each task may be shown, as determined by the Engineer.

D. Refer to Supplementary Conditions – Sanitation, paragraph SC-4(F) for retainage withheld from monthly progress payments that are due to negative variance associated with the progress of the project.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 013216

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Construction photography.

1.02 PHOTOGRAPHY

A. Provide color photographs of the project produced by a photographer acceptable to the Engineer who is regularly engaged. Photographs taken by the Contractor will be accepted.

B. Pre-construction
   1. Photographs: Provide photographs, taken within the limits of the work, to document existing conditions. Engineer will designate the date and location of the exposures that will generally be taken just prior to the construction operations. The minimum number of photographs required shall be two hundred sixty-four (264). Two (2) duplicate CD sets of all photos in JPEG format shall be provided.
   2. Video: Provide video taken along the entire route of pipe installation to document existing conditions. Two (2) duplicate CD sets of all photos in JPEG format shall be provided.

C. Progress Photographs:
   1. Installed work will not be eligible for payment until photo-documentation is provided to the Resident Engineer.
   2. Collection Conveyance System Underground Piping Photo Documentation
      a. Document the location of all underground pipelines by taking digital photographs of the installed pipelines prior to backfilling. At least 3 digital photographs shall be taken of each lateral before it has been backfilled.
         1) Utilizing a 12” x 18” dry erase board, write the address, station and elevation of each sewer building connection at the property line. The dry erase board shall be positioned adjacent to the building connection piping, within the frame of the photograph, so that both the lateral sewer connection pipe and descriptive information written on the dry erase board is legible in the construction photograph.
      b. Each pipe installation crew shall be provided with a digital camera capable of a 5 mega-pixel quality picture using Smart Media, Compact Flash Media, or Memory Stick cards as the media within the camera by the Contractor.
      c. At the end of each day that a pipe has been installed, the crew foreman shall hand deliver to the Resident Engineer the removable media with all construction photos taken that day.
         1) The Engineer will then download the photographs onto the Owner’s computer and delete the photographs from the media.
         2) The media will be returned to the crew foreman within two working days from the date it was delivered.
         3) Have at least three (3) 8 GB media cards for each camera available, to enable memory card use on a rotating basis.
         4) Installed work will not be eligible for payment until photo-documentation is provided to the Resident Engineer.
   3. Pump Station Underground Piping Photo Documentation
      a. Ensure that all pipe lines shown in the pictures properly marked so that they can be easily named and referenced at a later date.
      b. Document the location of all underground pipelines by taking digital photographs of the installed pipelines prior to backfilling. At least 3 digital photographs shall be taken of each pipe section before it has been backfilled.
      c. Each pipe installation crew shall be provided with a digital camera capable of a 5 mega-pixel quality picture using Smart Media, Compact Flash Media, or Memory Stick cards as the media within the camera by the Contractor.

d. At the end of each day that a pipe has been installed, the crew foreman shall hand deliver to the Resident Engineer the removable media with all construction photos taken that day.
   1) The resident Engineer will then download the photographs onto the Owner's computer and delete the photographs from the media.
   2) The media will be returned to the crew foreman within two working days from the date it was delivered.
   3) Have at least three (3) 8 GB media cards for each camera available, to enable memory card use on a rotating basis.

e. In addition, the underground piping shall be marked with construction grade spray paint before the photos have been taken to indicate the names of the pipelines in the pictures, as indicated on the Plans and approved by the Resident Engineer in the field.
   1) Assign a separate paint color for each line to be shown in the picture, and submit a legend of assigned colors and abbreviated pipeline names to the Engineer for approval prior to any pipeline being installed.
   2) The paint color and associated legend, once submitted by the Contractor and approved by the Engineer, shall be used for the entire Contract.
   3) The marks shall be large and long enough to be visible in the picture. Where practical, spray paint the name of the contents that will be conveyed in the pipe.
   4) This requirement is necessary so that the pipelines shown in the pictures can be easily named and referenced at a later date.
   5) Installed work will not be eligible for payment until photo-documentation is provided to Resident Engineer.

D. Final Photographs: Provide post-construction photographs, taken within the limits of the work, to document the final project and the conditions at final payment and issuance of the Final Certificate. The Final Payment will not be processed until such time as the photographs are provided. Engineer will designate the date and location of the exposures that will be taken. The minimum number of photographs required shall be sixty-four (64). Two (2) duplicate CD sets of all photos in JPEG format shall be provided.

E. Annotate the following for each photo file:
   1. Project name and number.
   2. Contractor's identification, address, and telephone number.
   3. Date and time picture was taken.
   4. Location of picture relative to a specific location on the site, (for example, "100 Commerce Boulevard, looking eastward").
   5. Picture ID: identified by pump station number, date picture was taken, and sequential number in which the pictures were taken.
   6. Direction in which camera was aimed.
   7. Key map of each pump station site referencing the locations and perspectives from which all post-construction photographs were taken. Each photo marker on the key map shall be referenced to the specific Picture ID.

1.03 PRINTS

A. Paper Surface (Color): Smooth, glossy.

B. Contrast (Color): High.

C. Size for hand photographs: 4-inch x 6-inch.

D. Commercially purchased album pages suitable for a 3 ring binder shall protect the prints. Deliver to the Engineer prints placed in the protector page. One (1) print per slot. Do not cover the annotations on the backside of the photograph.

E. Panoramic photographs shall be taken at appropriate locations.

F. Bind each set of photographs in a large capacity binder with plastic cover front and back as manufactured by National or equal. Each binder shall be sequentially numbered and show the

name of the project on the binder and front cover using white on black ½ inch laminated lettering tape by Brother or equal. Provide an index with each set of photographs in a form acceptable to the Owner.

1.04 PHOTO FILES

A. Minimum 5 mega pixel resolution, JPEG format.

B. Landscape frame position.

C. JPEG files shall be turned over to the Owner with all rights for use and reproduction of the photos files for the Owner's own use.

D. Provide factual presentation. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

1.05 SUBMITTALS

A. Deliver prints within seven (7) working days after exposure with transmittal letter in accordance with the requirements of Section 013300.

1.06 AERIAL PHOTOGRAPHY

A. Provide pre- and post-construction aerial color photographs of the site produced by an aerial photography company who is professionally and regularly engaged in this type of service. Photographs taken by the Contractor will not be accepted.
   1. Photograph shall be oriented directly over the center of the project site at an elevation such that the limits of the project site shall fill the frame as suitable detail resolution.
   2. Submit a minimum of 12 aerial photos for selection by the Engineer/Owner. The Engineer shall be permitted to request cropping and/or enhancement of the selected photo as suited the final posters printing.
   3. Take pre- and post-construction aerial photographs at the same elevation. The scales shall be the same.

B. Preconstruction Photographs: Provide aerial photographs, taken of the limits of the work, to document existing conditions at the site. Photograph shall be oriented directly over the center of the project site at an elevation such that the limits of the project site shall fill the frame as suitable detail resolution. Submit a minimum of 12 aerial photos for selection by the Engineer/Owner. The Engineer shall be permitted to request cropping and/or enhancement of the selected photo as suited the final posters printing. Provide five (5) poster board size aerial photographs mounted on foam board; the same photo with 5 prints. One photograph shall be framed. The minimum size of the photograph shall be approximately 3 feet x 3 feet.

C. Post-construction Photographs: Provide aerial photographs, taken of the limits of the work, to document existing conditions at the site. Provide five (5) poster board size aerial photographs mounted on foam board; the same photo with 5 prints. All prints shall be framed in plastic. The minimum size of the photograph shall be approximately 3 feet x 3 feet.

D. JPEG files shall be turned over to the Owner with all rights for use and reproduction of the photos files for the Owner's own use.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 NOT USED

PART 1 - GENERAL

1.01 SUMMARY

A. This action includes requirements related to the Contractor's responsibilities for Shop Drawings and other Submittals.

1.02 SHOP DRAWINGS

A. Provide the Engineer with a list of all shop drawings that will be submitted. This list shall be provided to the Engineer within fifteen (15) calendar days from the date of the Notice to Proceed.

B. Shop Drawings for all materials, structures, and equipment to be furnished under this Contract and where called for in the Contract Specifications shall be submitted by the Contractor for approval within forty-five (45) working days of the Notice to Proceed. Shop Drawings shall be prepared in accordance with the current engineering practice. Drawings shall be of a size and scale to show clearly all necessary details.

C. All Submittals for approval shall have the following identification data, as applicable, contained thereon or permanently adhered thereto:
   1. Owner contract number.
   2. Project name and location.
   3. Submittal Numbers. Resubmittals shall bear original submittal number and be lettered.
   4. Product identification.
   5. Shop drawing title, drawing number, revision number, and date of drawing and revision.
   6. Applicable Contract Drawings and Specification Section numbers.
   7. Subcontractor's, Vendor's and/or Manufacturer's name, address, and phone number.
   8. Contractor's certification statement.
   9. Description of materials, gauges, and finishes.
   10. Locations at which the materials and/or equipment are to be incorporated into the work.
   11. Where required by the detailed specification, drawings shall be certified by a Professional Engineer currently registered in the State of New York.

D. Each separate catalog, brochure, or single page submitted shall have the identification required hereinbefore.
   1. Catalogs or brochures submitted containing multiple items for approval need the identification only on the exterior. In such instances the identification shall include page and catalog item numbers.

E. Annotate on each shop drawing and submittal information that is relevant to the work of other or where potential conflicts in the installed work may occur. "Bubble" in green ink the area of potential conflict so as to alert the reviewer.

F. In the event that one or more of the multiple items are not approved in the Submittal, the entire Submittal will be returned and shall be resubmitted until all items are approved.

G. Each Shop Drawing, working drawing, sample, and catalog data submitted by the Contractor shall have affixed to it the following Certification Statement, signed by the Contractor:

> "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."

   1. Make specific notations on the Shop Drawing of all deviations from the Contract Documents.

H. Shop Drawings will be returned, stamped with the following classifications:

Classification	Required Corrections
Approved	No notations or comments on the submittal. Equipment and/or material may be released for manufacture.

Approved as Noted	Confirmation of the notations and comments IS NOT required. Equipment and/or material may be released for manufacture; however, all notations and comments must be incorporated into the final product.
Approved as Noted/ Confirm	Confirmation of the notations and comments IS required. The Contractor may, at their own risk, release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 14 calendar days of the date of the Engineer's transmittal requiring the confirmation.
Approved as Noted/ Resubmit	Extensive notations and comments. Resubmit and address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 14 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
Not Approved	Submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.
Submitted for the Record	Submitted information for record purposes

I. The review and approval of Shop Drawings, samples, or catalog data by the Engineer shall not relieve the Contractor from responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.

J. No portion of the work requiring a Shop Drawing, working drawing, sample, or catalog data shall be started, nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased, or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The Owner and Ewill not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

K. Project work, materials, fabrication, and installation shall conform with approved Shop Drawings, working drawings, applicable samples, and catalog data.

1.03 WORKING DRAWINGS FOR CHANGES, SUBSTITUTIONS, OR CONTRACTOR DESIGN ITEMS

A. Prepare working drawings and design calculations for all proposed design changes and substitutions. Working drawings and calculations as submitted shall be certified by a Professional Engineer registered in the State of New York, and shall convey or be accompanied by calculations or other sufficient information to completely explain the proposed method of construction, including but not limited to type of machinery and method proposed. Design calculations shall be submitted with the working drawings.

B. The review and approval of these working drawings by the Engineer will not relieve the Contractor in any way from responsibility with regard to the fulfillment of the terms of the Contract. All risks of error are assumed by the Contractor, and the Engineer shall have no responsibility therefor.

C. All of the applicable requirements of paragraph of 1.02, "Shop Drawings" apply to this item.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes requirements of a general nature applicable to Sanitary Sewer Projects. The specific requirements included in this Section are as follows:

Title	Paragraph
Work Schedule and Work Hours	1.02
Contractor's Responsibility	1.03
Permits and Licenses	1.04
Compliance with Laws	1.05
Accidents	1.06
Temporary Services	1.07
Protection of Utilities and Utility Conflicts	1.08
Protection of Water Supplies	1.09
Protection of Nassau County Horizontal Control Monuments and Observation Wells	1.10
Test Pits	1.11
Preservation of Wetland and Hazardous Waste Disposal	1.12
Interpretation of Quantities	1.13
Sprinkler Systems	1.14
Ground Water and Flood Flows	1.15
Size Limitation for Construction Equipment	1.16

1.02 WORK SCHEDULE AND WORK HOURS

A. Work under the Contract shall not be prosecuted on Saturdays, Sundays or on official holidays, except in time of emergency, and then only with the written approval of the Engineer, who shall be the sole judge as to the exigency of the emergency.

B. The workday for the Owner and their staff begins at 7:00 A.M. and ends at 3:30 P.M. If the Contractor wishes to prosecute any portion of the work beyond the Owner’s hours, they shall first obtain permission from the Owner, notifying them each time in advance, giving them ample time to procure an Engineer and/or inspector for the work.

C. Should the Contractor deem it necessary to work on Saturdays, Sundays, or holidays or longer than eight (8) hours per day in order to comply with their construction schedule, the Contractor shall request permission of the Engineer to do so. If, in the opinion of the Engineer, the need is bona fide, they will direct the Contractor to work such hours as may be necessary.

D. Expeditiously complete the work at each location within the time indicated on the Construction schedule. Any deviation from the schedule must be approved by the Engineer.

E. The Contractor will not be allowed to commence more than two (2) work areas at any one time and shall not commence work on a third (unless the Engineer approves additions to the schedule) until such time as one of the two (2) in progress is one-hundred (100) percent completed.

F. The Contractor will not be allowed to start any work, or progress any which has been started, without proper supervisory personnel (e.g. Foreman or Superintendent) on the job site.

G. Prior to starting a work, the Contractor or the Contractor's representative shall visually look over the job site with the Engineer or Owner Inspector, reviewing the proposed work, including required equipment, materials, staffing, and traffic maintenance protection.

1.03 CONTRACTOR'S RESPONSIBILITY

A. Do all the work and provide all plant, labor, materials, equipment, and other facilities, except as herein otherwise provided, that may be necessary and proper for performing and completing the work. The Contractor shall be responsible for the entire work until completed and accepted by the Owner.

B. This said work shall be performed in accordance with the intent and meaning of the Contract Document. Unless expressly provided, the work shall be performed in accordance with the best modern practice, with materials and handiwork of the highest quality, all as determined by, and entirely the satisfaction of, the Engineer.

C. Unless otherwise expressly provided, the means and the methods of construction shall be such as the Contractor may choose, which does not relieve the Contractor of their obligations to accomplish the result intended by the Contract.

D. Lands by Contractor: Any land and access thereto not furnished by the Owner that the Contractor deems necessary for the Contract Work, for temporary construction facilities including field offices, access and egress or for storage of materials shall be provided by the Contractor at no cost to the Owner. Obtain permits and written approvals from the appropriate jurisdictional agency and property owner for use of premises not furnished by the Owner as described above, and of all offsite areas which include offsite borrow pits and waste areas. Such permits and approvals shall specify treatment of said areas during and at the completion of construction. Copies of all permits and approvals shall be furnished to the Engineer.

1.04 PERMITS AND LICENSE

A. Comply with all local, State, and Federal laws, rules and regulation applicable to this Contract and to the work to be done hereunder. Obtain at own expense all permits and/or licenses necessary for the prosecution of the work other than those permits obtained by the Owner. It is the responsibility of the Contractor to determine and obtain the permits needed for this work.

B. Procure and use all necessary forms required by Local, State, and Federal Agencies. Any cost involved shall be incurred by the Contractor.

C. Where permits are issued by New York State for work performed on State Highways, all work performed on or adjacent to State Highways will be supplemented by the requirements of the Specifications of the New York State Department of Transportation, including materials, methods, and handiwork.

D. Any stipulation or requirement of agreements or permits to enter upon or cross lands under jurisdiction of Federal, State, Municipal, or any other authority, whether incorporated or not in this document, is binding on the Contractor.

E. The County will acquire all permits necessary to perform the work on land owned by the Long Island State Park and Recreation Commission and the Long Island Railroad.

1.05 COMPLIANCE WITH LAWS

1. Keep informed of all current Federal, State, Local Laws and Ordinances.
2. The work shall be performed by the Contractor, in all respects, in conformity with all such laws, rules, regulations, requirements and ordinances of the Federal, Sate 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, immediately notify the Engineer in writing of such conflict and thereafter follow the written instructions of the Engineer in respect thereto; or should Drawings or Specifications demand more than the law requires, the Drawings and Specifications shall be followed, nevertheless.

1.06 ACCIDENTS

A. Accidents resulting in death or serious injury or which result in substantial property damage shall be reported immediately to the Owner's designated representative. Make an initial notification either by telephone or facsimile with a formal written report to follow immediately.

B. Promptly report in writing to the Engineer all accidents whatsoever arising out of, or in connection with the performance of the work, giving full detail and statements of witnesses.

1.07 TEMPORARY SERVICES

A. Water
   1. Provide at own expense the necessary water supply and running water for construction and testing as their own expense. Arrange for water use with the local water company.

B. Light, Power, and Telephone
   1. Provide at own expense all temporary light, power, gas, and telephone required for the proper performance and inspection of the work.

C. Sanitary Facilities
   1. Prohibit and prevent the committing of nuisances on the site of the work or on adjoining property and discharge any employee who violates this rule. Ample washroom, toilet facilities, and a potable water supply for use of all employees shall be provided by the Contractor in conformance with the applicable regulations of the New York State Department of Labor, Board of Standards and Appeals. Field offices shall be connected to suitable sewage disposal facilities.

1.08 PROTECTON OF UTILITIES AND UTILITY CONFLICTS

A. During the life of this Contract, the owners and operators of utilities may make changes in their facilities. The Contractor will be required to determine the exact locations and elevations of all pertinent structures, utilities, and facilities, before construction work and new installations are started, so that there will be no interference with the work. Conflict between existing structures, utilities, and facilities and new work shall be ascertained by the Contractor and called to the attention of the Engineer. Take these conditions into consideration in preparing the bid. The Contractor shall not claim damages and shall not be entitled to payment because of any omission or faulty location on the Plans or any pipes, ducts, utilities, or other underground structures.

B. It is understood and agreed that the Contractor has considered in their bid all the permanent and temporary utility facilities in their present or relocated positions, and that no additional compensation will be allowed for any delays, inconveniences, or damage sustained by them due to any interference from the utility facilities or from the operation of moving them.

C. Protect all utilities encountered and repair any damage to structures, utilities, and facilities caused by operations. If the nature of the damage is such as to endanger the satisfactory functioning of the utilities and the necessary repairs are not immediately made by the Contractor, the work may be done by the respective owning companies and the cost thereof charged against the Contractor.

D. Give the utility corporations involved reasonable notice, but not less than seventy-two (72) hours, in advance of operations which may or will affect their facilities.

E. Cooperate with the municipally owned and public utility corporations whose facilities (aerial, surface, or subsurface) are within the limits of or along the outside of the trench width, to make it possible for them to maintain uninterrupted service. Conduct operations in such a way as to delay or interfere as little as practicable with the work of the utility corporations.

F. Do all work and pay all costs of protecting, supporting, and maintaining all surface, subsurface, or overhead structures, and all other property, including pipes, conduits, ducts, tubes, chambers, and appurtenances, public or private, in the vicinity of the work (except such which by law, franchise, permit, contract, consent, or agreement the Owner thereof is required to protect, support, maintain, relocate, or restore) repairing the same if damaged, and restoring to their original condition all areas disturbed. The Contractor shall not claim or be entitled to any damages for delay or otherwise by reason of such required work, and thereby assumes all risks in connection therewith.

G. In general, it is the intention of the Owner not to order utilities moved; however, where direct conflict is encountered, the Engineer will direct the private utility corporations to shift or remove

those utility structures that interfere with the work. Do not remove any structure or part of a structure owned by any utility corporation without the approval of the Engineer.

H. It is not considered a conflict if the horizontal distance from the outside face of the sewer to the nearest face of a utility is as follows:

Sewer Size	Distance to Utility
6" - 24"	36"
>= 30"	48"

I. Utilities crossing the sewer trench at an angle greater than 45 degrees without direct interference with the proposed construction are not considered conflicts.

J. The Contractor shall see to it that utility valve boxes and manholes are readily accessible at all times. Do not store materials over them should it become necessary to cover boxes or manholes with soil. Devise a method for finding them quickly and assist the utility company to uncover them. Further, the boxes and manholes shall be uncovered during non-working hours.

K. Provide bypass pumping of sewage to maintain flow at all times while performing work on an existing sewer system.

L. Special attention shall be given to maintaining uninterrupted sewage flow and to the prevention of foreign materials from entering the sewer system. To achieve this purpose, the Contractor shall erect and install a plywood deck having a minimum thickness of 3/8 inch in the base of each manhole being altered, conforming to its shape prior to performing any other work thereon. Alternative methods of preventing debris from entering the system may be submitted for review and approval. This protective device shall remain in place until the work on the manhole has been completed, at which time it will be cleaned and removed together with any accumulated debris.

1.09 PROTECTON OF WATER SUPPLIES

A. Water Supply Interconnections
   1. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any sewage or polluted water into the potable supply.

B. Relation to Water Works Structures
   1. Sewers shall be kept remote from public water supply wells or other water supply sources and structures.
   2. All sewers including house connections within a radius of one hundred (100) feet of a water supply well will be constructed of pressure pipe.

C. Relation to Water Mains
   1. Horizontal Separation: Whenever possible, sewers should be at least ten (10) feet, horizontally, form any existing or proposed water main. Should local conditions prevent a lateral separation of ten (10) feet, a sewer may be laid closer than ten (10) feet to a water main:
      a. IF it is laid in a separate trench, OR IF
      b. It is laid in the same trench with the water mains located at one side on a bench of undisturbed earth, IF
      c. In either case the elevation of the top (crown) of the sewer is at least eighteen (18) inches below the bottom (invert) of the water main.

D. Vertical Separation
   1. Whenever sewers must cross under water mains, install the sewer at such an elevation that the top of the sewer is at least eighteen (18) inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirement, use watertight construction (pressure pipe) for the sewer will be used.

1.10 TEST PITS

A. Where the sewer is to be constructed in close proximity to existing pipes or other underground structures, the Engineer will notify the Contractor that test pits shall be dug prior to the start of the construction.

B. Where the structure involved is owned by a Utility Company, it will be the responsibility of the Contractor to inform them seventy-two (72) hours in advance of the work of digging the test pits.

C. The Contractor, when directed by the Engineer, shall dig test pits for determining the presence and depth of unsuitable material such as meadow bog, peat, etc.

1.11 PRESERVATION OF WETLANDS AND WATERWAYS AND HAZARDOUS WASTE DISPOSAL

A. Do not dump soil onto areas designated as wetland or waterways. Further, do not stockpile or store soil, materials, tools, or equipment on wetlands.

B. Burying of any materials within the limits of Nassau County will not be permitted.

C. Hazardous waste material encountered during the excavation shall be disposed of according to latest Environmental Agency guidelines.

1.12 INTERPRETATION OF QUANTITIES

A. The estimate of the quantities of the various items of work and materials as set forth in the Proposal form is approximate only and is given solely to be used as a uniform basis for the comparison of bids. The actual quantities required to complete the Contract work may be less or more than so estimated.

B. Payment to the Contractor will be made only for the actual quantities of work performed or materials to be furnished in accordance with the Contract.

C. No action for damages or for loss of profits shall accrue to the Contractor because of changes in quantities.

D. Unless specifically stated in detail in the Specifications, only the actual lengths, areas, sold contents, numbers, or weights, as required by terms of the Contract Documents shall be considered measuring the work.

E. In general, Contract Items which are measured and paid for by weight are to be determined from Inspector’s tickets furnished with weight certificates representing shipments of material furnished and placed in accordance with the directions of the Engineer.

F. Weight certificates shall indicate the name and address of the material supplier together with truck identification, Contract identification, date, and signature of a licensed weightmaster. Batches of material shall be weighed on an approved scale of the automatic recording type, and the gross and tare weights shown on the weight certificates shall be an automatic printout from the scale.

G. Steel reinforcement will be measured for payment in accordance with normal weight.

1.13 SPRINKLER SYSTEMS

A. If the Contractor in the course of their work removes or damages existing underground lawn sprinkler systems, whether in easement areas or in public or private property, they shall repair the damage to the sprinkler system or replace it, as ordered by the Engineer, at no cost to the Owner.

1.14 GROUNDWATER AND FLOOD FLOWS

A. Take all necessary precautions and furnish all labor, equipment, and materials required to handle all water, sewage, storm, seepage, surface, subsurface, and flood flows which may be encountered at any time during construction of the work, and assume all costs connected therewith. The manner of handling these flows shall be subject to approval of the Engineer.

1.15 SIZE LIMITATIONS FOR CONSTRUCTION EQUIPMENT

A. Limit the size and weight of Construction equipment in locations where operation of large and heavy equipment will result in extensive damage to trees, utilities and pavements. If the operation

of Contractor equipment results in damage to trees, pavements and utilities, the Contractor shall utilize smaller and lighter equipment at the request of the Engineer.

1.16 WORK IN EASTMENTS

A. Instruct employees and perform work in a manner to cause the least possible inconvenience to the occupants of adjacent homes and buildings, and having commenced the work, prosecute the work to completion in an expeditious manner without interruption so as to complete the work in the shortest time possible.

B. Construction of the sewer in easements shall be accomplished in trenches supported by tight sheeting if ordered by the Engineer, unless installation of the sewer is by jacking or boring.

C. Trees over four (4) inches in diameter shall be replaced with like species. Verify at the time of construction the species of trees over four (4) inches in diameter which will need to be replaced. Disturbed lawn areas shall be replaced by sodding with superior grade grass.

D. The lines of permanent and working easements shall be strictly observed.

1.17 WORK IN STATE AND COUNTY RIGHT-OF-WAYS

A. Requirements for maintenance of traffic in State and County roads are contained in Section 015526, "Traffic Control".

B. Submittals
   1. Secure all permits required by the State for sewer construction in or across State roads.
   2. Meet with the County and the New York State Department of Transportation and submit to the County for approval the following:
      a. Shop drawings of the jacking and receiving pits for all jacking operations showing the location of the pits from the curb, edge of pavement, or other road features.
      b. Construction procedures together with a detailed account of the proposed construction showing the phases of construction and a time schedule for all operations.
      c. The methods and materials to be used for restoring the State highways.

1.18 WORK IN RAILROAD RIGHT-OF-WAYS

A. Observe and comply with all the requirements of the MTA Long Island Railroad.

B. No work shall be done without proper Railroad Protective Forces present. Safeguard all Railroad property and equipment and be responsible for damage that occurs by the work.

C. Should the Railroad deem that the work creates a hazard to its equipment or property, the Railroad will supply qualified personnel to protect that property and equipment.

D. Execute all work within the requirements of the American Railway Engineering and Maintenance-of-Way Association (AREMA) Specification 5.2 for pipelines conveying non-flammable substances.

E. The Owner will secure the necessary permits from the Long Island Railroad for rehabilitating sewer lines within the railroad right-of-way.

F. Meet the insurance requirements of the Railroad and/or any other Agency having jurisdiction in connection with the work.

G. Submittals
   1. Construction drawings showing the proposed method and procedure of jacking or boring, material to be incorporated in the work and details of the jacking and receiving pits shall be submitted to the Owner and to the railroad for approval.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.01 WORK IN RAILROAD RIGHT-OF-WAYS

A. If during the course of construction the Contractor endangers Railroad facilities or property, immediately comply with orders issued by the Railroad Engineer to restore safe and proper

operation. Failure to do so will require the Railroad to do the work themselves, the cost of which will be borne directly by the Contractor.

B. Do not work any equipment nor store any material closer than ten (10) feet to a rail, power, telephone or telegraph line in railroad right-of-ways. Do note store materials on railroad property without prior approval, in writing, from the Chief Engineer of the railroad.

C. Notify the Chief Engineer of the railroad in writing not less than forty-eight (48) hours prior to the time the Contractor proposes to work on railroad property.

D. The Contractor shall be solely responsible for the protection of railroad property and structures during the course of construction. Damage to railroad property resulting from the Contractor's operations shall be immediately remedied to the satisfaction of the Railroad at no cost to the Owner.

E. Submit to the Engineer copies of all bills from the Railroad.

F. Submit to the Engineer proof of any payment to the Railroad for all Railroad bills.

3.02 WORK IN STATE AND COUNTY RIGHT-OF-WAYS

A. At no time shall signs listing various political officials be displayed on State or County right-of-ways.

B. Construction in Nassau County Right-of-Way
   1. The Contractor may be required to rehabilitate the sewers within County highways in stages in order to facilitate maintenance of traffic. Each stage of sewer construction, including pavement removal, manholes, house connections, backfilling, pulling of sheeting, and temporary paving, shall be completed prior to the start of the next stage. The Contractor will not be permitted to work on more than one stage at any one time and shall limit the length of each stage as indicated on the approved "Maintenance of Traffic" drawings.
   2. The Construction in stages outlined in the above paragraph also applies to the final pavement restoration.
   3. Upon completion of the final pavement restoration on a County roadway, notify the Engineer for restoration of all County roadway striping obliterated during the course of construction. The permanent restripping of County Roads will be done by the County of Nassau.

C. Construction in a New York State Right-of-Way
   1. The Contractor shall rehabilitate the sewers within State highways in stages. Each stage of sewer construction, including pavement removal, manholes, house connections, backfilling, pulling of sheeting and installation of pavement shall be completed prior to the start of the next stage. The Contractor will not be permitted to work on more than one stage at any one time and shall limit the length of each stage to the length shown on the plans.
   2. The Construction in stages outlined in the above paragraph also applies to the final pavement restoration.
   3. Upon completion of backfilling and proper compaction of the backfill in a State roadway, the Contractor shall construct a subbase course of select granular material conforming to "Granular Subbase Course" as described in Section 321200, "Roadway Pavement" Para. 3.11. Immediately thereafter, restore permanent pavement over sewer trenches.
   4. Existing traveled lanes or shoulders of a state roadway shall not be disturbed during the period of October, 16th through May, 14th without written approval of the New York State Department of Transportation and the Engineer. In the event the Contractor requests and is granted permission to construct sewers within a State roadway during winter periods and if in the opinion of the Engineer weather conditions are unsatisfactory for the placement of subbase and permanent paving materials, the Contractor shall as directed construct a temporary pavement consisting of a four (4) inch granular subbase and a three (3) inch minimum thickness of asphalt fine mix placed in two (2) one-and-one-half (1-1/2) inch lifts. The furnishing, placing, and disposal of the temporary granular subbase and temporary bituminous macadam pavement over sewer trench areas regardless of pavement classification shall be at no cost to the Owner.

5. Remove, replace, restore, and protect all pavements, curb signs, and other structures damaged during the construction as may be required by the Engineer.
6. All concrete sidewalks, concrete driveways, and aprons within a state owned right-of-way shall be constructed with steel fabric reinforcement.
7. Prevent the malfunctioning of the State drainage system, whether they be of the surface or underground type. Flooded areas, due to their operations within a State right-of-way, will not be permitted.
8. Comply with the New York State Department of Transportation Standard Specifications where sheeting for excavation, and compaction for backfill are performed within a State right-of-way.
9. All house connection pipe installed within State roadway shall be extended to the right-of-way line.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. The abbreviations in this section, together with others in general use, are applicable to these standard Specifications and to the plans or other Contract Documents.

1.02 COMMON USAGE

Abbreviation	Word or Words
Aband	Abandon, Abandoned
ABS	Acrylonitrile Butadiene Styrene
AC	Asphalt Cement
ACP	Asbestos Cement Pipe
ACPP	Asbestos Cement Pressure Pipe
Alt	Alternate
Amer Std	American Standard
AWG	American Wire Gage (nonferrous wire)
Bdry	Boundary
BM	Bench Mark
BOC	Bottom of Curb
B/W	Back of Wall
°C	Degree on the Celsius Temperature Scale
CB	Catch Basin
Cb	Curb
CBR	California Bearing Ratio
c-c	Center to Center
CF	Cellar Floor
C & G	Curb and Gutter
CIP	Cast Iron Pipe
CIPP	Cast-in-Place Pipe
CLF	Chain Link Fence
CO	Cleanout (Sewer)
Col	Column
Conc	Concrete
Const	Construct, Construction
Conn	Connection
Coord	Coordinate
CP	Cesspool
Db	Decibels
DI or DIP	Ductile Iron, Ductile Iron Pipe
DW	Dry Well
Dwg	Drawing
Dwy	Driveway
Dwy Apr	Driveway Apron
DL	Dead Load
E	Electric
ECR	End of Curb Return
EE	Entrance Elevation

EF	Each Face
EG	Edge of Gutter
El	Elevation
Eng	Engineer, Engineering
EP	Edge of Pavement
Esmt	Easement
Exist	Existing
Exc	Excavation
Exp Jt	Expansion Joint
°F	Degree on the Fahrenheit Temperature Scale
Fab	Fabricate
F & C	Frame and Cover
Fdn	Foundation
Fed Spec	Federal Specification
FDS	Front Door Sill Elevation
FF	First Floor Elevation
FG	Finished Grade
FH	Fire Hydrant
F & I	Furnish & Install
FL	Flow Line
FM	Force Main
FS	Finished Surface
Ftg	Footing
F/W	Face of Wall
G	Gas
Ga	Gauge
Galv	Galvanized
GIP	Galvanized Iron Pipe
GL	Ground Line or Grade Line
GM	Gas Meter
GP	Guy Pole
Gr	Grade
Grtg	Grating
GSP	Galvanized Steel Pipe
HC	House Connection
Hdwl	Headwell
Hor	Horizontal
Hp	Horsepower
HPG	High Pressure Gas
Hyd	Hydraulic
ID	Inside Diameter
Insp	Inspector
Inv	Invert
IP	Iron Pipe
Jt	Joint

L	Length
Lab	Laboratory
LL	Live Load
Long	Longitudinal
LP	Lamp Post
Maint	Maintenance
Max, Min	Maximum, Minimum
Meas	Measure
MH	Manhole
Mil Spec	Military Specifications
Misc	Miscellaneous
Mon	Monument
Mult	Multiple
No. or #	Number
Obs	Obsolete
Oc	On Center
OD	Outside Diameter
OE	Outer Edge
Opp	Opposite
Orig	Original
P	Pole
PB	Pull Box
PC	Point of Curvature
PCC	Portland Cement Concrete or Point of Compound Curvature
PE	Polyethylene or Professional Engineer
PI	Point of Intersection
PL	Property Line
POC	Point of Curve
POT	Point on Tangent
PP	Power Pole
PT	Point of Tangency
PVC	Polyvinyl Chloride
Pvmt	Pavement
Pvt R-o-W	Private Right-of-Way
Q	Rate of Flow in Cubic Feet per Second
Quad	Quadrangle, Quadrant
R	Radius
RC	Reinforced Concrete
RCP	Reinforced Concrete Pipe
Ref	Reference
Reinf	Reinforced or Reinforcement
RR	Railroad
R-o-W	Right-of-Way
SCCP	Steel Cylinder Concrete Pipe
SD	Storm Drain

SDR	Standard Thermoplastic Pipe Dimension Ratio (Ratio of Pipe O.D. to Minimum Wall Thickness)
SI	International System of Units (Metric)
Spec	Specifications
SP	Soil Pipe
SS	Sanitary Sewer
Sta	Station
Std	Standard
Str	Straight
Str Gr	Straight Grade
Struc	Structural/Structure
S/W	Sidewalk
T	Telephone Conduit
Tan	Tangent
TMH	Telephone Manhole
T/C or TOC	Top of Curb
Tel or Tele	Telephone
Topo	Topography
TS	Traffic Signal or Transition Structure
TSC	Traffic Signal Conduit
TSS	Traffic Signal Standard
T/W or TOW	Top of Wall
Typ	Typical
Var	Varies, Variable
VB	Valve Box
VCP	Vitrified Clay Pipe
Vert	Vertical
Vol	Volume
W	Water
WI	Wrought Iron
WM	Water Meter
X-Conn	Cross Connection
X-Sec	Cross Section

1.03 UNITS OF MEASUREMENT

Abbreviation	Unit of Measurement
MBF	1000 Board Feet Measurement
CF or Ft3	Cubic Feet
CY or Yd3	Cubic Yards
Ea	Each
Gal	Gallons
Lbs or #	Pounds
LF	Linear Feet
LS	Lump Sum
Psi	Pounds per Square Inch
Oz	Ounces

SF or Ft2	Square Feet
SG	Specific Gravity
SY or Yd2	Square Yards

1.04 INSTITUTIONS, STANDARDS, AND CODES

Abbreviation	Word or Words
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AGA	American Gas Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALS	American Lumber Standards
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
B&S	Brown and Sharpe Wire Gauge
CIPRA	Cast Iron Pipe Research Association
CRSI	Concrete Reinforcing Steel Institute
CSPA	Clay Sewer Pipe Association
EPA	Environmental Protection Agency (Federal)
FCC	Federal Communication Commission
Fed. Spec.	Federal Specifications or Federal Standards
LIPA	Long Island Power Authority
LIRR	Long Island Railroad
LISPRC	Long Island State Park and Recreation Commission
NAPCA	National Association of Pipe Coating Applicators
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards

NCPI	National Clay Pipe Institute
NCSS-HB	Nassau County Dept. of Public Works Standard Specifications for the Construction of Highways and Bridges
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electric Safety Code
NFC	National Fire Code
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NHLA	National Hardware Lumber Association
NLMA	National Lumber Manufacturer's Association
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
OSHA	Occupational Safety & Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PSEG-LI	Public Service Enterprise Group Long Island
ULI or UL	Underwriter Laboratories Incorporated
USACOE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USSG	United States Standard Gauge
USSWG	United States Steel Wire Gauge

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 – GENERAL

1.01 GLOSSARY OF TERMS

A. Unless otherwise stated, the words “directed”, “required”, “permitted”, “ordered”, “instructed”, “designated”, “considered”, “necessary”, “prescribed”, “approved”, “acceptable”, “satisfactory”, “in the judgment of”, or works of like import, refer to actions, expressions, and prerogatives of the Commissioner and/or the Engineer.

B. Where the words “furnish”, “provide”, “supply”, “replace”, or “install” are used, whether singly or in combination, they shall mean to furnish and install, unless specifically stated otherwise.

C. Easement means a grant of right of use of the property of an owner for a certain purpose at the will of the grantee.

D. Structure means structural entity including but not limited to building, manhole, ductbank, tank, foundation, road, pavement, pipe conductor, substation, pumping station, etc.

E. Or Equal means where a product or system is specified in the Contract Documents by one, two or more trade names followed by the phrase “or equal”, the “or equal” will be determined by the Engineer.

F. Approval means written approval from the Engineer.

1.02 DEFINITIONS

A. Wherever used in the Contract Documents, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof:

1. Act of God
   a. An act occasioned exclusively by violence of nature without the interference of any Human agency. It means a natural necessity proceeding from physical causes alone without the intervention of man. It is an act, event, happening, or occurrence, and disaster and effect due to natural causes and inevitable accident, or disaster; a natural and inevitable necessity which implies entire exclusion of all human agency which operates without interference or aid from man, and which results from natural causes and is in no sense attributable to human agency. It is an accident which could not have been occasioned by human agency but proceeded from physical causes alone. 1Black Henry C., Black’s Law Dictionary, Pg. 43, Revised 4th edition, west Publishing Co., 1968.
2. Addenda
   a. Written or graphic instruments issued in writing prior to the receipt of bids which modify or interpret the CONTRACT DOCUMENTS, DRAWINGS and SPECIFICATIONS by additions, deletions, clarifications or corrections.
3. Agreement
   a. The language or instrument embodying the Contract.
4. Beneficial Occupancy
   a. Shall mean the Commissioner’s action to take over, use, occupy or operate part of the completed or uncompleted work, when such action is deemed to be in the Owner's best interest.
5. Bid
   a. The offer or proposal of the BIDDER submitted on the prescribed form setting forth the prices for the WORK to be performed.
6. Bidder
   a. An individual, firm, or corporation formally submitting a complete bid for the work contemplated by acting directly or through a duly authorized representative.
7. Bonds
   a. Bid Bonds, Performance Bonds, Labor and Material Payment Bonds, Maintenance Bonds, and other instruments of security furnished by the Contractor and the Contractor's surety in accordance with the Contract Documents.
8. Change Order

a. A written order to the Contractor signed by the County Executive authorizing an addition, deletion or revision in the work within the general scope of the Contract Documents or authorizing an adjustment in the Contract Price.

9. Commissioner and/or Commissioner of Public Works
   a. The Commissioner of the Department of Public Works of the County of Nassau.
10. Contract
   a. The written agreement covering performance of work in accordance with the Contract Documents.
11. Contract Documents
   a. The Contract, including Contract Specifications, Notice of Award, Notice to Proceed, Change Orders, Drawings, Standard Specifications, Addenda, Standard Details, and State and Federal Contract Provisions.
12. Contract Specifications
   a. The set of documents issued by the Owner for a specific project which includes the Notice to Bidders, Instructions to Bidders, Proposal, Agreement, General Conditions, Special Conditions, Special Requirements, Special Technical Specifications and other forms and attachments.
13. Contract Time
   a. The number of consecutive calendar days stated in the Contract Documents for the completion of the work.
14. Contractor
   a. Shall mean the party with whom the Owner has executed the agreement, whether corporation, firm or individual, or any combination thereof, and its, their or his successors, personal representatives, executors, administrators and assigns, and any person, firm or corporation who or which shall at any time be substituted in the lace thereof.
15. Contract Unit Price
   a. The Contractor’s bid for a single unit of an item of work in the Proposal.
16. Contract Work
   a. Shall mean everything expressed or implied required to be furnished and done by the Contractor by any one or more of the parts of the Contract Documents referred to, except extra work as hereinafter defined; it being understood that, in case of any inconsistence in or between any part or parts of the Contract Documents, the Engineer shall determine which shall prevail.
17. County
   a. The word “County” or pronoun used in place thereof shall mean the County of Nassau, State of New York as represented by the County Executive or the County Executive's duly designated representative.
18. County Executive
   a. The County Executive of the County of Nassau, New York State.
19. County Testing Facility
   a. See definition for “Laboratory”. The term is used interchangeably with the word “Laboratory”.
20. Day
   a. A calendar day of 24 hours lasting from midnight one day up to midnight the next day.
21. Days
   a. Shall mean consecutive calendar days unless indicated otherwise in the Contract Documents.
22. Department
   a. The Department of Public Works of the County of Nassau.
23. Drawings
   a. The parts of the Contract Documents which show graphically the characteristics and scope of the work to be performed. It shall mean only those drawings listed in the Specifications, or in any Addendum or Addenda. The term is used interchangeably with

the word “Plans” and includes Standard Details and all other drawings issued for the Contract.

24. Engineer
    a. Shall mean the Engineer duly designated by the Commissioner to act as such, with the powers and duties as defined in the Contract Documents for the Engineer.
25. Employee
    a. Any person working on the project mentioned in the Contract Documents and who is under the direction or control or receives compensation from the Contractor or Subcontractor.
26. Equipment
    a. All machinery, implements, tools and apparatus necessary for the proper construction and acceptable completion of the work, together with the necessary supplies for upkeep and maintenance.
27. Extra Work
    a. Extra work shall mean work other than that required either expressed or implied by the Contract Documents in the present form. It may include work in areas of future work, or in areas within the Contract limits or adjacent thereto.
28. Field Order
    a. A written order issued by the Engineer to the Contractor during construction affecting a change in the work not involving an adjustment in the contract price or an extension of the contract time.
29. Final Acceptance
    a. Final Acceptance shall mean acceptance of the work by the County Executive, as evidenced by their signature upon the final certificate of completion. Such acceptance shall be deemed to have taken place only if and when such signature is affixed to such certificate.
30. Final Estimate
    a. Certification or estimate of the Engineer submitted to the Commissioner upon completion of the Contract, stating from actual measurements the whole amount of work done by the Contractor and also the value of such work under and according to the terms of the Contract.
31. General Conditions
    a. Contractual legal provisions of the Contract.
32. General Requirements
    a. General administrative and work related provisions of the Project.
33. House Connection
    a. A sewer within a public street, easement or right-of-way, proposed to connect any building, parcel, lot, or part of a lot with a main line sewer.
34. Inspector
    a. Inspector shall mean an authorized representative of the Department assigned to make any and all necessary inspections of the work performed and materials furnished by the Contractor.
35. Instruction to Bidders
    a. Outline of the Conditions for preparing the Bid including Bidder’s responsibility, Bid Security, Qualification of Bidders, Rejection of Bids, etc.
36. Interceptor
    a. All sanitary sewers designated as such on the drawings.
37. Item
    a. Any part of the work as stated in the detailed Specifications, which is necessary to complete the Contract.
38. Laboratory
    a. Laboratory shall mean the testing laboratory of the Department, or any official laboratory of the State of New York, or a laboratory especially designated by the Commissioner for testing the materials to be used under this Contract.

39. Lateral Sewer
    a. All sanitary sewers not designated as interceptors on the drawing.
40. Lump Sum
    a. The sum bid for any lump sum item shall represent payment in full for all of the various classes of work, including materials, equipment and labor, and incidentals necessary or required to complete, in conformity with the Contract Documents, the entire work shown, indicated or specified under such lump sum item.
41. Material
    a. Any approved material acceptable to the Commissioner of Public Works and conforming to the requirements of the Specifications.
42. Notice of Award
    a. The written communication issued by the County Executive to the successful bidder awarding him the Contract.
43. Notice to Proceed
    a. Written communication issued by the Commissioner to the Contractor authorizing him to proceed with the work and establishing the dates of commencement and completion of the work.
44. Owner
    a. Shall mean the County of Nassau, State of New York.
45. Partial or Monthly Payments
    a. Payments to the Contractor for work satisfactorily performed, as specified in the Contract Agreement.
46. Person
    a. Any individual, firm, association, partnership, corporation, trust, joint venture, or other legal entity.
47. Plans
    a. See definition for “Drawings.”
48. Project
    a. Shall mean the entire work to which the Contract relates.
49. Proposal
    a. The offer of the bidder for the work, when executed and submitted on the prescribed form.
50. Punch List
    a. Shall mean a written itemization of Contractor work items necessary before acceptance by the County. The itemization shall include, but not be limited to uncompleted work, defective work and missing work.
51. Record Plans
    a. All drawings which are prepared by the Contractor to indicate the as-built condition of the project.
52. Reference Specifications
    a. Those bulletins, standards, rules, methods of analysis or test codes, and Specifications of other agencies, engineering societies, or industrial associations referred to in the Contract Documents. These refer to the latest edition, including amendments in the project or permits, unless specifically referred to by edition, volume, or date.
53. Sanitary Sewer
    a. A conduit for the transport of wastewater.
54. Service of Notices
    a. The Contractor designates the business address in their Bid as the place where all notices, directions or other communications to the Contractor may be delivered, or to which they may be mailed. Actual delivery of any such notices, directions or communication to the aforesaid place, or depositing it in a postpaid wrapper addressed thereto in any post office box regularly maintained by the United States Post Office Department, shall be conclusively deemed to be sufficient service thereof upon the Contractor as of the date of such delivery or deposit. Such address may be changed at

any time by written notification from the Contractor and delivered to and receipted for in writing by the Commissioner. Nothing herein contained shall, however, be deemed to preclude or render inoperative the service of any notice, direction or other communication upon the Contractor personally, or, if the Contractor be a corporation,upon any officer or director thereof.

55. Shop Drawings
    a. All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a subcontractor, manufacturer, supplier, or distributor, which illustrate how specific portions of the work shall be fabricated or installed.
56. Site
    a. The specific area adjacent to and the area upon which construction work is to be performed. Generally, such area may be considered as defined by the right-of-way or property made available to the Contractor for construction operations.
57. Special Conditions
    a. Legal provisions which are unique to a Specific Contract, supplementing, modifying, adding or deleting items covered in the General Conditions.
58. Special Technical Specifications
    a. Technical requirements which are unique to a Specific Contract supplementing, modifying, adding or deleting items covered in the various sections of Divisions 02 through 48 of the Standard Specifications and addition of new section if required.
59. Special Requirements
    a. Administrative and Technical requirements which are unique to a Specific Contract supplementing, modifying, adding or deleting items covered in Division 1, “General Requirements” of the Standard Specifications.
60. Specifications
    a. They shall include the Contract Specifications.
61. Standard Details
    a. Nassau County drawings showing details of standard products, methods and material for the construction of sanitary sewers.
62. Standard Specifications
    a. The part of the Contract Documents consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and handiworkand General Requirements.
63. State
    a. State of New York
64. Subcontractor
    a. Subcontractor shall mean any person, firm or corporation, other than employees of the Contractor, who or which contracts with the Contractor to furnish, or actually furnishes labor or labor and materials, or labor and equipment, or labor, material and equipment at the site.
65. Substantial Completion
    a. That date as certified by the Engineer when the construction of the Project or a specified part thereof is sufficiently completed in accordance with the Contract Documents.
66. Supervision
    a. Supervision where used to indicate supervision by the Engineer, shall mean the performance of obligations, and the exercise of rights, specifically imposed upon and granted to the County in becoming a party to the Contract. Except as specifically stated herein, supervision by the County shall not mean active and direct superintendence of details of the work.
67. Supplier
    a. Any person or organization who supplies materials or equipment for the work (including that fabricated to a special design) but who does not perform labor at the site.
68. Surety

a. Surety shall mean any person, firm or corporation that has executed the Contractor's construction bonds securing the performance of this contract.

69. Technical Specifications
    a. Division 02 through Division 48 of the Standard Specifications.
70. Tests
    a. Methods adopted by the Commissioner to ascertain the quality, character and acceptability of handiwork, materials and processes utilized in performing the contract.
71. Utility
    a. Tracks, overhead or underground wires, pipe lines, conduits, ducts, or structures, privately or publicly owned, operated, or maintained in or across a public right-of-way or private easement.
72. Work
    a. The work shall mean everything, expressed or implied, required to be furnished and performed by the Contractor under the contract and shall include both contract work and extra work.
73. Work Days
    a. Calendar days, exclusive Sundays, Federally and New York State recognized legal holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for the major part of the day on the principal item or items of work which would normally be in progress at that time.
74. Written Notice
    a. Any notice to any party of the Agreement relative to any part of this Agreement in writing and considered delivered and the service thereof completed when posted by mail to the said party at the address specified in their bid or delivered in person to said party or their authorized agent.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. When a reference standard is specified, comply with requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards.

B. The latest provisions of applicable standards shall apply to the work, unless otherwise specified.

C. When required, furnish evidence satisfactory to the Engineer that materials and methods are in accordance with such standards where so specified.

D. In the event any questions arise as to the application of these standards or codes, copies shall be supplied to the Engineer by the Contractor.

1.02 INSTITUTIONS, STANDARDS AND CODES

Abbreviation	Word or Words
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AGA	American Gas Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALS	American Lumber Standards
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASA	American Standards Association
ASCE	American Society of Civil Engineering
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
B & S	Brown and Sharpe Wire Gauge
CIPRA	Cast Iron Pipe Research Association
CRSI	Concrete Reinforcing Steel Institute
CSPA	Clay Sewer Pipe Association
DIPRA	Ductile Iron Pipe Research Association
FCC	Federal Communication Commission
FED. SPEC.	Federal Specifications or Federal Standards

LIPA	Long Island Power Authority
LIRR	Long Island Railroad
LISPRC	Long Island State Park and Recreation Commission
NAPCA	National Association of Pipe Coating Applicators
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NCSS-HB	Nassau County Department of Public Works Standard Specifications for the Construction of Highways and Bridges (Parts 2 & 3 Only)
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electric Safety Code
NFC	National Fire Code
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NHLA	National Hardware Lumber Association
NLMA	National Lumber Manufacturer's Association
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
OSHA	Occupational Safety & Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PSEG-LI	Public Service Enterprise Group Long Island
UL	Underwriter Laboratories Incorporated
USACOE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency (EPA)
USSG	United States Standard Gauge
USSWG	United States Steel Wire Gauge

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section explains the format of the specifications.

1.02 SPECIFICATION FORMAT

A. The Specifications are generally arranged according to the Construction Specifications Institute (CSI) format. Most of the technical requirements are specified in the technical specifications of the document, which are grouped into forty-eight (48) major divisions. Most of the legal and administrative requirements are included in Division 01, General Conditions, Information For Bidders, and the Contract (agreement).

B. Technical sections are arranged in numerical order, however section numbers may not be consecutive from section to section.

C. Page numbering is subordinate to each section.

D. Most sections are generally broken down into three (3) parts:

1.	PART 1 - GENERAL
2.	PART 2 - PRODUCTS
3.	PART 3 - EXECUTION

E. Not all these parts may be used and in some cases, the title of some of the parts may be different than listed above. Paragraph numbers are subordinate to each part.

F. The format described here is flexible in nature.
   1. There is some overlapping of specified information between various portions of the Specifications.
   2. In all cases, the entire requirements of the Contract Documents for the project shall apply.

G. Explanations:
   1. Many technical sections begin with a paragraph titled "SUMMARY", "DESCRIPTION", or similar wording.
      a. In these paragraphs, a brief listing of the specified products may appear or a brief description of the work generally specified in that section is presented.
      b. These descriptions or listings are not all inclusive, but merely are provided as an aid in locating subject matter.
      c. In some cases special cost related items of work are called to the attention of the Contractor in these opening paragraphs.
   2. "RELATED SECTIONS" or "RELATED WORK" or similar wording list or reference related work specified elsewhere in the Contract Documents. Such listing is not all inclusive, rather, they are merely an aid to the Contractor in locating some of the other Specification Sections wherein work is specified which has a particularly close interrelationship with the work specified in that section.
      a. It shall be understood that all of the Work, and all of the Specifications and other portions of the Contract Documents, are interrelated, and that the total of all requirements set forth in all of the Contract Documents shall be met.
      b. Advise equipment suppliers and manufacturers of the requirements for making submittals and delivering products, as specified in Division 01 sections, even if said sections are not referenced therein that section.
   3. "REGULATORY REQUIREMENTS" or "REFERENCES" or similar wording paragraphs describe standards, laws, guidelines, regulations, and standards related to handiwork and installation of the products specified which shall be followed by the Contractor in completing the work specified therein that section as if it was written there in that section. All such requirements and references shall be latest issue in effect at the time of the bid opening.
   4. When a "GUARANTEE" or "WARRANTY" paragraph appears in the section it is calling attention to a guarantee which extends beyond the period of the Contractor's Guarantee

called for in the administrative portion of the Contract Documents or it states special requirements specific to the equipment, systems or products specified in that section.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 014223

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for monitoring the quality of the constructed project.

B. This section also includes services of an independent testing laboratory for quality assurance testing.

C. The services of the testing laboratory will be paid for out of the cash allowance included by the Contractor in the price as bid in accordance with the requirements contained herein and in Section 012100 - Allowances.

1.02 REFERENCES

A. ASTM C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

B. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

C. ASTM D4561 - Practice for Quality Control Systems for an Inspection and Testing Agency for Bituminous Paving Materials.

1.03 QUALITY ASSURANCE - CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and handiwork, to produce work of specified quality.

B. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or handiwork that is more precise.

C. Perform work by persons qualified to produce handiwork of specified quality.

D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

E. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

1.04 QUALITY ASSURANCE - TESTING LABORATORY

A. In order to establish compliance with the Contract Documents, materials shall be tested, examined and evaluated before they are incorporated into the work. During and after installations, additional tests, examinations, and evaluations shall be made to determine continued compliance throughout the course of the work.

B. Testing laboratory shall be a reputable, experienced firm that is capable of performing all of the required testing and authorized to operate in the state in which the project is located.

C. Perform all sampling and testing in accordance with specified procedures and use the materials, instruments, apparatus, and equipment required by the codes, regulations and standards. Where specific testing requirements or procedures are not described, perform the testing in accordance with all pertinent codes and regulations and with recognized standards for testing.

D. In the event that samples and test specimens are not properly taken, handled, stored or delivered or if other requirements of this Section are not complied with, Engineer reserves the right to delegate any or all of this work to others, or to take whatever action deemed necessary to ensure that sampling and testing are properly accomplished, for which all costs shall be borne by Contractor.

E. Engineer reserves the right to disapprove the use of a specific testing laboratory, even after prior approval, if the laboratory fails to meet or comply with the requirements of this Section. If this should occur, immediately discharge the testing laboratory and retain the services of a different laboratory acceptable to Engineer.

F. The testing laboratory shall meet the following criteria:
   1. Be capable of performing all of the required tests.

2. Be regularly engaged in performing the types of services required.
3. Have adequate facilities, materials, equipment, and personnel to perform the services.
4. Have an adequately trained, experienced and qualified staff.
5. Have at least one registered professional engineer licensed in the state in which the project is located who shall be capable of performing field tests, supervising laboratory testing and interpreting test results. The professional engineer shall be thoroughly knowledgeable in materials, soils, asphalt paving and concrete.
6. Shall be able to be on the Project site within two hours after being notified.
7. Comply with the requirements of ASTM C1077, ASTM D3740, ASTM D4561, and ASTM E548.
8. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

G. Comply with the requirements of ASTM C1077 and ASTM D3740.

H. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy standard traceable to either National Bureau of Standards or accepted values of natural physical constants

1.05 REFERENCE STANDARDS

A. Conform to reference standards by date that the project was bid.

B. Obtain copies of standards when required by Contract Documents.

C. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.06 SUBMITTALS

A. Within fifteen (15) calendar days from the date of the Notice to Proceed, submit documentation from three (3) testing laboratories that clearly indicates experience, location, qualifications of staff, and descriptions of any limitations or restrictions of the firm.
   1. Include a price schedule for standard tests and a billing rate schedule for technician classifications.
   2. Based upon this information, the Engineer will select one firm to be the primary testing laboratory and one firm to act as a standby.

B. Certified copies of each test report shall be mailed directly to the Engineer. The Contractor shall arrange with the laboratory to secure copies.

C. Each report shall be in writing and shall include the testing method used, the test results, the specified results, the exact location of where the test specimens were taken, the date taken, Project identification, Contractor’s name and other pertinent information required for a complete and meaningful test report.

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

E. Mail reports directly to Engineer within 24 hours after the sample is taken, except in those instances when tests cannot be immediately performed because of required curing, incubation periods, or lengthy testing procedures.

F. The laboratory shall verbally communicate test results when requested by the Engineer. This does not eliminate nor replace the requirements for a written report.

1.07 SCHEDULING - LABORATORY SERVICES

A. Except where otherwise specified, the Engineer will determine the number of samples to be taken, the date and time samples will be taken and tests made, the number and type of tests to be performed, who will collect the samples, how they will be handled and stored and when laboratory personnel are required on site.

B. Engineer will notify Contractor of their decision to take samples and/or have tests made and provide him with the pertinent information. Contractor is responsible for notifying the testing laboratory and for having the testing performed, on schedule.

C. In addition to the above, make arrangements for the sampling and testing of materials proposed to be incorporated into the work. This shall not be paid for out of the cash allowance.

D. Notify Engineer at least 72 hours in advance of the times at which scheduled samples or tests will be conducted.

E. If samples and/or tests cannot be taken or performed when required, delay the work until such time that they can be accomplished. Where possible, any work that has been installed but has not been sampled or tested as required, shall be tested by other means. Upon Engineer's request, uncover any work, which has been buried or covered, and perform special tests designated by Engineer. If the work cannot be tested by other means, Engineer may declare the work unacceptable. All costs associated with noncompliance and for special testing shall be borne by the Contractor and not be paid for out of the cash allowance.

F. Should the testing laboratory be scheduled to take or collect samples or to perform tests, and finds that it is unable to do so as a result of delays in construction, inclement weather, or any other reason, reschedule the tasks for a date acceptable to Engineer. Costs associated with times testing laboratory is unable to perform scheduled services shall be borne by the Contractor and will not be paid for under the allowance.

G. Plan all work and operations to allow for the taking and collection of samples and allow adequate time for the performance of tests. Delay the progress of questionable work until the receipt of the certified test reports.

1.08 TESTING REQUIREMENTS

A. Compaction Testing - Soil:
   1. Testing agency will test compaction of soils in place according to ASTM D 1556, Density and Unit Weight of Soil In Place by the Sand Cone Method or ASTM D 6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
   2. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.
   3. Perform tests and analysis of fill material in accordance with ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. Rammer and 12-inch Drop.

B. Compaction Testing - Asphaltic Concrete Pavement:
   1. Perform asphaltic concrete compaction testing in accordance with ASTM D2950 - Standard Test Method of Density of Bituminous Concrete in Place by Nuclear Methods.
   2. Calibrate nuclear density measurement equipment based on theoretical maximum specific gravity of asphaltic concrete pavement material.
   3. Perform test to determine theoretical maximum specific gravity in accordance with ASTM D2041 Theoretical Maximum Specific Gravity of Bituminous Pavement Mixtures. Perform test on mix at plant prior to delivery. Collect sample at plant in accordance with ASTM D979 - Standard Practice for Sampling Asphalt Mixtures and perform test in approved laboratory if plant does not have necessary equipment.

C. Concrete Testing:
   1. Collect samples in accordance with ASTM C172, Practice for Sampling Freshly Mixed Concrete.
   2. Make test cylinders in accordance with ASTM C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   3. Test concrete cylinders in accordance with ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   4. Test slump and air entrainment.

D. Asphalt Testing:
   1. Collect samples at point of delivery in accordance with ASTM D979, Standard Practice for Sampling Bituminous Paving Mixtures.
   2. Perform extraction test in accordance with ASTM D2172, Standard Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.
   3. Perform gradation test in accordance with ASTM C136, Method for Sieve Analysis of Fine and Coarse Aggregates.

1.09 TESTING SCHEDULE

A. Compaction Testing of Soil:
   1. Tests will be performed at the following locations and frequencies:
      a. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1500 square feet or less of paved area or building slab, but in no case fewer than three tests, or as directed by the Engineer.
      b. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests, or as directed by the Engineer.
      c. Trench Backfill: At each compacted backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests, or as directed by the Engineer.
      d. Concrete flatwork: Refer to Section 033000 - Concrete and Section 321313 - Cement Pavement Repairs.

B. Concrete Testing: Make six (6) concrete test cylinders for each 50 c.y. or fraction thereof.
   1. Test two (2) cylinders at 7 days.
   2. Test two (2) cylinders at 28 days.
   3. The remaining cylinders shall be tested at a time to be determined by the Engineer. This requirement shall be subject to change as required by the Engineer.

C. Asphalt Testing: Refer to Section 321200 - Roadway Pavement.

D. Compaction Testing of Pavement:

1.10 FIELD OBSERVATION OF CONTRACTOR'S WORK

A. The Engineer will provide periodic observation of the Contractor's work.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions. Verify that the existing substrate is capable of structural support or attachment of new Work being applied or attached. Examine and verify specific conditions described in individual specification sections. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance. Seal cracks or openings of substrate prior to applying next material or substance.

B. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 FIELD QUALITY CONTROL

A. Allow representatives of the testing laboratory access to the work at all time. Provide all equipment, labor, materials, and facilities required by the laboratory to properly perform its functions. Cooperate with and assist laboratory personnel during the performance of their work.

B. Test specimens and samples shall be taken by the person(s) designated in other Sections, or as directed by Engineer. Conduct field sampling and testing in the presence of Engineer. Provide all materials, equipment, facilities and labor for securing samples and test specimens and for performing all field-testing.

3.04 FIELD INSPECTOR SCOPE OF SERVICES

A. Concrete
   1. Concrete Plant Inspector
      a. Qualifications: The inspector shall be ACI Concrete Field Testing Technician, Grade I and have at least one year of batch plant experience.
      b. The duties will include the following:
         1) Perform inspection in accordance with NYSDOT Material Method MM 9.1, or as ordered by the Engineer.
         2) Verify that the concrete plant is currently approved by the NYSDOT and that the scales have been calibrated within the last 90 days.
         3) Verify that only NYSDOT Approved materials are incorporated into the mix.
         4) Observe the batching operation to insure that the specified types and amounts of materials conforming to the design mix are batched. Batch weights shall fall within the allowable tolerances.
         5) Insure that the concrete delivery trucks have current NYSDOT stickers, are in good operating conditions and are not loaded beyond their capacities.
         6) Verify that the resolution counter in the delivery trucks is operational and has been reset to zero.
         7) Prepare a delivery ticket for each batch of concrete with the following information:
            (a) Name of Batch Plant
            (b) Date
            (c) Truck Number
            (d) Project Designation
            (e) Class of Designation of Concrete
            (f) Amount of Concrete Batched
            (g) Time Batched (Time that sand and cement make contact)
            (h) C.Y. Batch Weights
         8) Sign the delivery ticket showing that the concrete batching has been inspected.
      c. When not witnessing the batching operation, conduct the following tests at least twice daily:
         1) Moisture content determination on fine and coarse aggregates (ASTM C566)
         2) Aggregate gradations, fine and coarse (ASTM C-136)
         3) Report all noted deficiencies immediately (verbally) to the designated authority.
         4) Provided a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
         5) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.
   2. Concrete Field Inspector
      a. Qualifications: The inspector shall be a certified ACI Concrete Field Testing Technician, Grade I and have at least one year of experience as a concrete field inspector.
      b. The duties will include the following:
         1) Perform inspection in accordance with NYSDOT Material Method MM 9.2, or as ordered by the Engineer.
         2) Verify the ambient air temperature is within specifications for concrete placement.
         3) Check plant inspection ticket for each concrete truck delivery for proper mixture and information.
         4) Verify that the NYSDOT sticker is current for each concrete delivery truck and that it is loaded within the truck mixing capacity.
         5) Check if the concrete has been mixed the proper number of revolutions.

c. Perform the following tests on one randomly selected delivery truck each day and each 50 cy/day, or as ordered by the Engineer, at a minimum.
   1) Sample the concrete (ASTM C-172)
   2) Perform slump tests (ASTM C-143)
   3) Check air content of concrete (ASTM C-173 or C-231)
   4) Check concrete temperature
   5) Cast six each 6” x 12” or 4” x 8” concrete test cylinders (ASTM C-31)
   6) Check unit weight of concrete for lightweight concrete (ASTM C-567)
   7) Monitor total mixing water (not to exceed specified amount)
   8) Assure that test cylinders are being field cured as required (with the structure or in a properly constructed curing box furnished by the Contractor)
   9) Check that maximum time for discharging of concrete has not been exceeded.
   10) Verify cold or hot weather curing procedures, if required (ACI305R & 306R)
   11) Report all noted deficiencies immediately (verbally) to the designated authority
   12) Provided a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
   13) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.

3. Concrete Construction Special Inspector
   a. Qualifications: The inspector shall be ACI Concrete Construction Special Inspector and have at least one year of experience.
   b. The duties will include the following:
      1) Inspect formwork erection and removal (ACI 347R & SP-4).
      2) Inspect reshoring (ACI 347R).
      3) Inspect reinforcing bars (grade, mill test certificates, bends, placement)(ACI 318 and CRSI “Placing Reinforcing Bars” and “Manual of Standard Practice”, shop drawings and contract plans).
      4) Check for correct anchor bolt size and placement in accordance with shop drawings and/or plans.
      5) Check that proper soil bearing capacity has been verified by a licensed P.E. before placing of foundation concrete.
      6) Inspect placement of concrete (including vibration)(ACI 304R & 309R).
      7) Inspect finishing operations (ACI 302.1R & 301)
      8) Inspect curing (ACI308).
      9) Verify hot and cold weather procedures, if required (ACI 305R & 306R)
      10) Report all noted deficiencies immediately (verbally) to designated authority.
      11) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
      12) At the conclusions of all testing provide to the Owner a Final Certification Letter stating that there are no unremediated deficiencies and all work conforms to the above requirements.
      13) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.

4. Precast Concrete Plant or Field Inspector (Local and Out-of-Town)
   a. Qualifications: The inspector shall be a ACI Concrete Construction Special Inspector, or a certified Precast/Prestressed Concrete Institute (PCI), Plant Quality Personnel Certification Level II, and have at least one year of experience as a precast concrete plant inspector.
   b. The duties will include the following:
      1) Perform inspection in accordance with NYSDOT Precast/Prestressed Concrete Construction Manual (PCCM), approved shop drawings and contract plan.
      2) Review contractor’s (supplier’s) quality control program.
      3) Review certifications and calibrations of scales, jacks, prestress strands, inserts, concrete mix designs, reinforcing steel, etc.

4) Monitor bed set up for cleanliness of forms, dimensions, skew distances, strand deflection, strand tensioning and elongation, reinforcing steel, plates, blockouts, inserts, and other pertinent items contained within the members.
5) Monitor concrete batching and observe placement. Monitor quality control sampling and testing performed by suppliers.
6) Obtain records of curing times and temperatures.
7) Witness compressive strength test of cylinders prior to detensioning, stripping & shipping, as required.
8) Witness detensioning process and sequence.
9) Check finished product for dimensions, camber, alignment, chamfers, blockouts, studes, inserts, cracks, surface texture, etc.
10) Inspect pieces at time of shipping for finish and patching, strand slippage, cracks and blocking and if found acceptable stamp or stencil date of acceptance.
11) Report all noted deficiencies immediately (verbally) to the designated authority.
12) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
13) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.

B. Structural Steel (Local and Out-of-Town)
1. Shop Inspector
a. Qualifications: The inspector shall be a Certified Welding Inspector (CWI) or Certified Associate Welding Inspector (CAWI) as per American Welding Society (AWS), with at least two years shop inspection experience.
b. The duties will include the following:
1) Monitor all fabrication, welding, bolting, cleaning, painting, etc. per specifications, applicable codes (AWS,AISC, etc.), approved shop drawings and contract plans.
2) Check mill test certificates.
3) Inspect painting.
4) Check welding certifications of welding personnel.
5) Check written welding procedures, equipment and supplies.
6) Inspect welding operations and inspect weldments.
7) Check for proper bolts and verify bolt documentation.
8) Report all noted deficiencies immediately (verbally) to the designated authority.
9) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
10) At the conclusion of all testing provide to the Owner a Final Certification Letter stating that there are no unremediated deficiencies and all work conforms to above requirements.
11) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.
2. Field Erection IFIELD ERECTION INSPECTOR
a. Qualifications: The inspector shall be a CWI or CAWI with at least two years or erection experience.
b. The duties will include the following:
1) Inspect members upon arrival for shipping damage.
2) Monitor erection and plumbness.
3) Inspect operation in accordance with approved shop drawings and contract plans.
4) Inspect painting (plant and field)
5) Check welding certifications of welding personnel.
6) Check written welding procedures, equipment and supplies.
7) Inspect welding operations and inspect weldments.
8) Check for proper bolts and verify bolt documentation.

9) Provide the following equipment for use by the inspector during structural steel bolting inspection:
   (a) Skidmore Bolt Testing Device
   (b) Calibrated Torque Wrench
10) Inspect proper bolting procedures and operations.
11) Report all noted deficiencies immediately (verbally) to the designated authority.
12) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
13) At the conclusion of all testing provide to the Owner a Final Certification Letter stating that there are no unremediated deficiencies and all work conforms to above requirements.
14) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.

3. Non-Destructive Testing (NDT) Technician
   a. Qualifications: Technician shall be certified in accordance with American Society of Non-Destructive Testing (ASNT) Level II or III. The organization performing the SDT must meet the requirements of ASTM E543.
   b. The duties will include the following:
      1) Perform all NDT in accordance with applicable standards.
      2) Report all noted deficiencies immediately (verbally) to the designated authority.
      3) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
      4) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.

C. Asphalt
   1. Asphalt Plant Inspector (Not Surperpave QA Technician)
      a. Qualifications: The technician shall be NYSDOT qualified or equal and have at least two years of plant inspection experience.
      b. The duties will include the following:
         1) Perform inspection in accordance with NYSDOT Materials Manual 5, or as ordered by the Engineer.
         2) Verify that the asphalt plant is currently approved by NYSDOT and that the scales have been calibrated within the last 90 days.
         3) Verify that only NYSDOT approved materials are incorporated in the mixes.
         4) Check to see that the correct aggregate sources and sizes are in the proper cold feed bins.
         5) Verify that the proper aggregate and asphalt batch weights, complying with the approved job mix formulas, are programmed into the batching computer.
         6) Check to see that the control panel is in the automatic mode and that the aggregate, mineral filler (if used) and asphalt interlocks are turned on.
         7) Observe the scales, automatic hatching controls and recorder when production begins and periodically thereafter to see if they are working properly.
         8) Check 100% of the batch weight recordation to verify that the weight tolerance interlocks are working and the correct tolerances are being used.
         9) Explain any system tolerance overrides.
         10) Test trucks at random to make sure mix is being shipped at the correct temperature.
         11) Sample asphalt, aggregate and mixes for analysis as required.
         12) Perform hot bin analysis or bumoff and check for gradation conformance, as required.
         13) Issue an inspection ticket to verify to the field that the asphalt batching has been inspected.
         14) Report all noted deficiencies immediately (verbally) to the designated authority.

15) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
16) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above

2. Asphalt Plant Inspector (Superpave QA Technician)
   a. Qualifications: The technician shall be New York Construction Materials Association certified as QC / QA Technician Hot Mix Asphalt, and have at least two years of field inspection experience.
   b. The duties will include the following:
      1) Perform all duties of sampling and testing of Superpave mixtures as a Quality Assurance (QA) technician as listed in the current edition of NY State Specifications, and Materials Procedure No. 401 "Quality Control and Quality Assurance Procedures for Hot Mix Asphalt (HMA) Production", or as ordered by the Engineer.
      2) When NYSDOT Series 50 or 60 compaction of Superpave mixtures is specified; perform tests on cores and loose material, as delivered, according to Materials Procedure MP 402-02 "Hot Mix Asphalt (HMA) Pavement Density Determination", Section IV: "Determination of Pavement Core % of Mixture Maximum Theoretical Density (%MMTD)" in an approved Laboratory.
      3) Report all noted deficiencies immediately (verbally) to the designated authority.
      4) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
      5) Price bid shall include the technicians time and all equipment necessary to perform all tests at the asphalt plant. Tests to determine %MMTD per test strip or per lot (4 pavement cores & 4 loose materials samples) shall be priced separately.
3. Asphalt Field Inspector
   a. Qualifications: The technician shall be New York Construction Materials Association certified as QC / QA Technician Hot Mix Asphalt, and have at least two years of field inspection experience.
   b. The duties will include the following:
      1) Verify that equipment meets specifications.
      2) Check incoming trucks for inspection tickets.
      3) Inspect trucks for proper mix temperature.
      4) Monitor laydown for proper mat placement and texture.
      5) Inspect thickness of mat and yield.
      6) Take samples as required.
      7) Test for compaction per NYSDOT MP 402-02 or ASTM 02950 using a nuclear density gauge in backscatter mode, or as ordered by the Engineer.
      8) Report all noted deficiencies immediately (verbally) to the designated authority.
      9) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
      10) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.

D. Soils
   1. Soil Technician
      a. Qualifications: Technicians shall be North East Transportation Training & Certification Program (NETTCP), Soil & Aggregate Inspector certified, or equal, and have at least two years experience.
      b. The duties will include the following:
         1) Inspect fill / backfill materials to verify they meet specifications.
         2) Inspect fill / backfill compaction operations and thickness of lifts.
         3) Perform tests per ASTM D-6938 using a nuclear density gauge in Direct Transmission mode only.

4) Perform field proctor tests, at least once per day, per type and source of fill / backfill material.
5) Provide a daily report to the Owner, within 48 hours, including all the above data including who was notified of any deficiencies.
6) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.

2. Soil Bearing Capacity Inspection for Foundations
   a. Qualifications: Licensed Professional Engineer with at least two years of geotechnical/foundation experience.
   b. The duties will include the following:
      1) Inspect all materials at the final foundation elevation for conformance to the design assumptions.
      2) Perform all appropriate tests and record all test results including, quality and quantity of fill/ backfill material placed and number and thickness of lifts.
      3) Report all noted deficiencies immediately (verbally) to designated authority.
      4) Provide a daily report to the Owner, within 48 hours, including all the above data. including who was notified of any deficiencies.
      5) Price bid shall include the technicians time and all equipment and tests necessary to perform the work as outlined above.

END OF SECTION 014500

PART 1 - GENERAL

1.01 SUMMARY

A. This Section covers requirements related to Testing and Inspection.

1.02 INSPECTION AND TESTING

A. All materials and equipment used in the construction of the Project shall be subject to adequate inspection and testing in accordance with generally accepted standards as required and defined in the Contract Documents.

B. During the progress of the work, and up to the date of final acceptance, always afford representatives of the Owner every reasonable safe and proper facility for inspecting work done or being done at the site, and also the manufacture or preparation of materials and equipment at the place of such manufacture or preparation. In addition, authorized Federal, State or Local agencies shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials and other relevant data and records. The inspection of any work shall not relieve the Contractor of obligations to perform proper and satisfactory work as herein specified.

C. All materials being used are subject to inspection or test at any time during their preparation and use.

D. Precast concrete components shall not be delivered to the job site until they have been inspected and bear the approved stamp of the Department of Public Works Laboratory. Any material may be tested by the Laboratory and no materials for which Laboratory tests are required shall be used by the Contractor until receipt of official notification of acceptance and then only so long as its quality remains equal to that of the accepted sample.

E. Tests specified to be made by the Owner will be paid for by the Owner, tests to be made by the manufacturer or Contractor shall be paid for by the Contractor.

F. The Owner shall have the right at all times to have its representatives inspect the materials, the processes of manufacture, the records of analysis and tests. The Owner's representatives shall have the right to witness all tests to be performed by the manufacturer and to select the test specimen.

G. Give notice in writing to the Owner in advance of his intention to commence the manufacture of pipes, manholes or materials especially manufactured or prepared for use in or as part of the permanent construction.

H. The notice shall be delivered to the Owner not less than ten (10) working days plus travel time prior to the commencement of production or testing.

I. Furnish the required samples without charge and provide every facility for the securing of samples furnish means and assist in the verification of all scales, measures, and other devices which operated. The samples furnished by the Contractor shall become the property of the Owner.

J. The Owner shall have the right to reject materials and hawhich are defective, or require their correction. Rejected work and materials shall be promptly taken down and removed from the site, which shall at all times be kept in a clean and neat condition.

K. Material which has been rejected as the result of Laboratory test will not be resampled or retested, except as provided for in the Specifications for any particular material, unless otherwise directed by the Owner.

L. The results obtained in the test of any material may be compared with the records of similar materials in actual service and when such service record is unsatisfactory, as determined by the Owner, the use of the material will not be allowed even though the tests are satisfactory.

M. Inspection, tests, or approvals by the Engineer or others will not relieve the Contractor from obligations to perform the work in accordance with the requirements of the Contract Documents.

N. Materials tested and passed at the place of manufacture will be properly stamped for identification before shipment to the site of the work. Any material at the site of the work found damaged in

shipment, or found not to fit properly or otherwise not meeting the Specifications, will be rejected, regardless of any former acceptance or approval.

O. Finished or unfinished work found not to be in accordance with the Contract shall be replaced as directed by the Engineer even though such work may have been previously approved and paid for.

P. If the Contract Documents, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction require any work to specifically be inspected, tested, or approved by someone other than the Owner Agencies, give the Engineer three working days' notice. Furnish to the Engineer the required Certificates of Inspection, testing, or approval.

Q. If any work is covered without the approval of the Engineer or contrary to requirements elsewhere in the Contract Documents, it must, if requested by the Engineer, be uncovered for observation and recovered at the Contractor's expense.

R. Should it be considered necessary or advisable by the Owner at any time before final acceptance of the entire work to make examinations of work already completed by removing or tearing out same, on request promptly furnish all necessary facilities, labor, and materials. If such work is found to be defective, the Contractor shall be responsible for all expenses of such examinations and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of same shall be considered an item of extra work to be paid for in accordance with the provisions for "Extra Work."

S. In general, weight shall be used in percentage determination of all material.

T. Certified test reports for all manufactured items shall be furnished as specified.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Asbestos and lead-based paint certification.

B. Moisture control.

1.02 RELATED SECTIONS

A. Section 014100 - Regulatory Requirements

B. Section 015719 - Dust Palliative

1.03 SUBMITTALS

A. Submit completed and notarized "Certificate of Asbestos and Lead-Based Paint" form.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

This space left intentionally blank.

Certificate of Asbestos and Lead-Based Paint (New Work)	
Client's Name:_____	
Project Location:_____	
Project Address:_____	
Project Name:_____	
Project Number:_____	
CERTIFICATION:	
This Contractor hereby certifies that no asbestos-containing material and lead-based paint, as defined by applicable federal and state regulations, has been furnished or installed at the referenced project:	
Contractor Name:_____	
Signature:_____	
Address:_____ _____	
Telephone:_____	Date Executed: _____
This Form Shall Be Notarized	

END OF SECTION 014536

PART 1 - SUMMARY

1.01 SECTION INCLUDES

A. The operations, equipment, and materials necessary to maintain wastewater flow at all times during the work.
   1. Conduct operations in such a manner as to ensure optimum health and safety.
   2. Provide uninterrupted flow conveyance around work locations. Furnish all materials, labor, equipment, spare parts, maintenance, control, power, and signal wiring, etc., to provide temporary systems to convey sanitary sewer flow around the work area and maintain wastewater flow in all public and private pipes while construction is in progress. The system shall prevent back up in sanitary sewage and allow for proper inspection, rehabilitation, testing, and drainage during pipe replacement, manhole installation, replacement, or rehabilitation, or related rehabilitation work.
      a. Maintain traffic on roadways and access to driveways and parking areas during operations of the temporary conveyance system.
         1) System shall be of sufficient capacity to handle existing flow plus additional flow that may occur during rainfall.
      b. Sewer surcharging will not be allowed.
      c. Maintain temporary conveyance system in operation until service can be completely restored.
   3. Design, installation, maintenance, and operation of the temporary conveyance pumping systems shall be the Contractor's responsibility. This Section outlines the minimum requirements that shall be adhered to by the Contractor and is intended to be a performance specification. The conveyance systems shall meet the requirements of all codes and regulatory agencies having jurisdiction. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey sewage to any land, street, storm drain or water course.
   4. The Contractor shall be responsible for design of the temporary conveyance systems, including all bulkheads, plugs, hoses, piping, pumps, valves, instruments, and appurtenances. As a component of system design, the Contractor shall be responsible for determining pump duty point and TDH based on final suction and discharge piping layout.
   5. Operating labor will be required on an “around the clock basis” for the pumping system.

B. Pump raw sewage back into the sanitary system.

C. Be responsible for the violation of any law, or the creation of a danger to public health, due to laxity in the diversion of flows.

D. Maintaining continuous wastewater conveyance is critical and shall be maintained at all times. If any spills of raw wastewater occur due to the failure of the Contractor to maintain the wastewater conveyance, the Contractor shall be responsible for any fines levied on the Owner by the NYSDEC or any other applicable agency.

E. Pumping systems shall have sufficient capacity to convey a peak flow of the line segment to be bypassed. All pipeline plugs, pumps, and temporary discharge piping and fittings shall be of adequate size to handle peak flow and ensure that the total flow in the wastewater system can be safely diverted around the section to be rehabilitated or repaired. Bypass pumping system will be required to be operated 24 hours a day.

F. The system shall safely convey the sewage past the work area without stopping or impeding wastewater system flows and in a manner that will protect public and private property from flooding and damage.

1.02 SYSTEM DESCRIPTION

A. Provide all pipeline plugs and pumps of adequate size to handle the system flow, and provide temporary discharge piping to ensure that the total flow can be safely diverted around installation of the rehabilitated section of sanitary sewer. Each temporary pump shall be capable of conveying the design operating flow rate.

1. The temporary sanitary wastewater conveyance system for improvements to the existing sanitary sewer shall meet the requirements of the schedule in Section 3.08.
2. The flow varies throughout the day.
3. The lowest flow typically occurs between the hours of 1:00 a.m. and 6:00 a.m.
4. Flow will be higher during precipitation.
5. Bypass pumping system shall be capable of conveying flow around the work area as necessary for satisfactory performances of work. Actual flows shall be measured by the Contractor before bypass pumping system submittal is submitted.

B. Temporary bypass pumping systems shall include the following:
1. Staging areas for pumps and ancillary equipment.
2. Flow stoppage system, including pipe and channel plugging method and types of plugs.
3. Number, size, material, location, and method of installation of all piping and valves.
4. Sections showing suction and discharge pipe depth, and embedment, if applicable.
5. Pump and pipe anchoring details.
6. Suction tube installation, bracing and support in the sewer.
7. Discharge pipe thrust and restraint block sizes and locations.
8. Temporary pipe supports, and anchoring required.
9. Plan indicating proposed location of bypass pumping line locations including provisions for access to bypass pumping locations, and proposed vehicle and pedestrian ramps. The plan must show any locations where bypass lines or equipment are located outside of public right-of-way, or existing utility easements. Drawings shall include standard scale and dimensions to existing referenced site features.
10. Downstream discharge plan.
11. Method of protecting discharge manholes or structures from erosion and damage.
12. Bypass pump dimensions, capacity, pump performance curves, quantity of pumps and power requirements.
13. Calculations for selection of bypass pumping pipe size including static lift, friction losses, and flow velocity.
14. Pump curves showing pump operating range plotted against the system head curve.
15. Pump diesel engine sizing, dimensions, emissions data, and location plan.
16. Standby power generator size and location.
17. Engine and pump noise enclosure details.
18. Engine fuel consumption curves.
19. Fuel storage tank details.
20. Qualifications of site pump operators.
21. Emergency contact telephone numbers.
22. Complete information on instruments, including calibration certificates.
23. Complete operating procedures, including mode of operation, sequence of starting and stopping the pumps, coordination with Owner.
24. Any required trenching.
25. Any required traffic control.
26. Noise and Hours of Operation: All bypass pumping activities shall comply with Local Noise Ordinances. Use sound attenuated enclosures on all pumps and engines to muffle pump noise at no additional compensation. "Quiet" pumping shall be accomplished by the use of a “quiet” brand of critically silenced pump(s). Sound attenuated pump enclosures shall be sheet metal lined with layers of polydamp acoustical sound deadening material to achieve a noise reduction to a maximum of 65 dBA at a distance of [30] feet ([914.4] cm) or as otherwise required by local ordinances. All exhaust pipes shall be muffled.

C. The system must overcome surcharge by tidal influence and groundwater.

D. Provide pump control elements such as floats to prevent surcharging of wastewater into the piping system and overflow from structures.

E. Pumps handling raw and partially treated wastewater shall be capable of passing a sphere of at least 3-inches in diameter.

F. Pump suction and discharge openings shall be at least 4-inches in diameter. Pump suctions and discharge openings of less than 4-inches may be considered for lower flows at the discretion of the Engineer.

G. All pumps shall be of a rugged design and capable of running dry without damage to the pump.

H. Maintain sanitary conditions to allow work to be performed. Protect equipment, suction piping, and discharge piping main from inclement weather, freezing conditions, and traffic.

I. Prevent leakage and spillage of wastewater.

J. Provide walkways over obstructions on sidewalks to maintain pedestrian traffic.

K. Provide ramps or below grade piping to maintain vehicular traffic.

L. Provide alarm system to indicate increase above normal operating liquid level in sewer.

M. Electrical system and components in sewers shall comply with the National Electric Code requirements for Class I, Group D, Division 1 locations.

N. Provide spare suction and discharge piping at the project site.

O. Adequate standby equipment shall be available and ready for immediate operation and use in the event of an emergency or breakdown. Standby pumps shall be provided with a flow redundancy of 100% of peak bypass system design flow. Include one stand-by pump of each size that will be installed on-line, ready for use in the event of primary pump failure isolated from the primary system by a valve and capable of becoming operational via automatic controls.

P. For temporary sanitary wastewater conveyance systems located in roadways, provide signs and traffic controls in accordance with the State Manual of Uniform Traffic Control Devices.

Q. Obtain confined space entry permit from Owner if confined space entry is needed for work under this section.

R. No construction shall begin until all provisions and requirements have been reviewed and approved by the Engineer.

1.03 SUBMITTALS

A. Provide a written plan of the proposed temporary sanitary wastewater conveyance system to the Engineer at least twenty-one (21) days prior to the need for the system.
   1. The written plan shall include number size and type of pumps, material, diameter and proposed route of piping and/or hoses, control system, back-up and spare equipment, and estimated duration of bypass operation.
   2. Provide a schematic diagram of the system.
   3. Provide a written emergency response plan that indicates the action to be taken by the Contractor should there be a failure of a component of the wastewater conveyance system.

B. Submit a schedule to complete the work. That includes the sequencing and coordination of sanitary sewer bypass pumping, new sanitary sewer installation, manhole replacement/installation, and dewatering during construction.

C. Submit measured sanitary sewer flow and sewage flow rates for each temporary conveyance system location.

D. Submit a list of 24-hour emergency telephone numbers that shall include the Contractor’s Project Manager, the Contractor’s Superintendent, and a responsible representative from the pump supplier.

E. Prepare a detailed description of the proposed pumping system.

F. Submit to the Engineer the qualifications of a subcontractor who can demonstrate that it specializes in the design and operation of temporary bypass pumping systems. Submit at least 5 references of projects of a similar size and complexity as this project performed by proposed

subcontractor within the past three years. References shall include Owner and Contractor contact information.

G. Upon acceptance by the Engineer, twenty-one (21) days prior to start of work, prepare and submit a comprehensive bypass pumping plan and written description for the Engineer's review. The plan shall be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, standby equipment and materials and all other incidental items necessary and/or required to insure proper operation of the bypass pumping system, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. All pumping equipment submitted shall include the manufacturer's performance curves. The size, type and routing of all suction and discharge pipes and the means of connecting the system shall also be included in addition to the following minimum requirements:
   1. Provide all necessary means to safely convey the normal flows past the work area. The system will not be permited to stop or impede the main or any sideline flows under and circumstances.
   2. Pumps and accessories shall be supplied by the pump manufacturer.
   3. Pumps shall be fitted with a fully automatic priming system incorporating an air compressor, air ejector assembly, and an air/water separation tank. No water shall be required in the pump to achieve a prime. The air ejector shall operate on the dsichare side of the compressor, eliminating the possiblility of water being drawn into the air source. The pump shall be capable of running totally dry for periods up to 24 hours.
   4. All pumps used shall be centrifugal, end suction, fully automatic self-priming units that do not require the use of foot-valves, vacuum pumps, or diaphragm pumps in the priming system. All pumps shall contain no moving parts or protective float gear. A demonstration of the pumps ability to repeatedly cycle from pump/snore/repriming/pump shall be required.
   5. Diesel engine driven pump units shall be mounted on a trailer that can be towed on the road at 50 MPH and wired for over the road usage, per applicable D.O.T. Standards.
   6. Prevent spillage of flows. All discharge piping shall be constructed of rigid pipe with positive type CH, leak proof connections. Discharge hose will only be allowed by specific permission of the Engineer.
   7. Provide start/stop controls for each pump.
   8. Provide hoisting equipment for each pump. Maintain accessories on the site.
   9. Material and equpment schedules listing material types and equipment capabilities.

H. No bypass pumping shall begin until all provisions and requirements have been reviewed and approved.

1.04 QUALITY ASSURANCE

A. Design, installation, maintenance, and operation of the temporary pumping system shall be the Contractor's responsibility.

B. Provide the services of a professional company that specializes in the design and operation of temporary bypass pumping systems.

C. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

D. The Contractor shall be responsible for damages upstream of pumps due to bypass pumping backups and/or overflows caused byinsufficent capacity or a failure of the approved system.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. All pumps used shall be submersible units or fully automatic self-priming units in good working order, with a working pressure gauge that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric, or diesel powered. Diesel engines shall be Tier 3 or newer. All pumps used must be constructed to allow dry running for long periods of time

to accommodate the cyclical nature of effluent flows. Pumps conveying raw and partially treated wastewater shall be capable of passing a sphere of at least 3-inches in diameter.

B. Provide solids handling ball type check valve with flexible rubber seat and quick release access feature with centrifugal pumps.

C. Provide the necessary stop/start controls for each pump. Provide a float switch system to automatically control the operation of the pumps in response to level changes in the sanitary sewer. In the event that a backup is imminent, immediately activate standby bypass pump(s) to decrease the water level at the bypass manhole. For bypassing sewers 30” and larger, automatic level transducers shall be utilized to maintain the proper surcharge levels in the sewer line.

D. Provide compact unit mounted on skid base or two-wheeled highway trailer. Either option shall include overnight running fuel tank.

E. Engines shall be equipped with critical silencers and be housed to minimize noise during operation. Sound attenuation shall comply with the applicable noise code regulations for the specific zone classification, or as specified by the Owner.

F. Engine driven pumps shall have adequate fuel storage capacity to operate continuously for 24 hours without refueling. Auxiliary fuel containers shall be provided to supplement integral fuel tanks as required. Fuel deliveries shall only be made during normal daytime working hours.

G. Furnish and install all suction and discharge piping. In order to prevent the accidental spillage of flows, all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Piping, joints, and accessories shall withstand at least twice the maximum system pressure or 50 psi (344.74 kPa), whichever is greater. All piping and fittings shall be steel with Victaulic couplings or flanged joints or fused high-density polyethylene pipe DR-11. Pump discharge piping may be individual or manifolded and valved so that pump can be conveyed to dedicated locations. Discharge hoses will only be allowed in short sections and by specific permission from the Engineer. Suction piping shall have bell ends. Suction piping shall be installed so that both barrels of the interceptor can feed bypass pumps. The piping shall be installed so that obstruction to the flow is minimal. Air relief valves shall be provided at high points in the piping. The maximum discharge pipe velocity at the exit shall be less than [11] feet ([335.28] cm)/second.

H. If connecting discharge piping to an existing force main, the bypass system must overcome the static and friction force main head pressure at the point of connection to the existing force main.

I. Spill containment around diesel pumps and storage tanks, including filling operation shall be provided in accordance with applicable regulations.

J. Electrical system and components in sewers shall comply with National Electric Code requirements for Class I, Group D, Division 1 locations.

K. Road Crossings: Fabricated of galvanized steel and engineered to provide minimal head-loss when used on pumping projects. Road crossing shall be manufactured to remain in compliance with federal bridge laws of 20,000 lbs. single axle. Entrance and exit ramps shall be sloped. Piping connections shall be flanged. Vehicle width clearance 12 feet (365.76 cm). Tie downs at each corner out of path of vehicle travel. Manufacturer: Rain for Rent or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Test temporary conveyance system to the satisfaction of the Engineer prior to usage.

B. Provide personnel to continuously attend the bypass system to assure continuous wastewater conveyance for entire time use of system is required and to ensure that the temporary pumping system is properly maintained.

C. Locate the bypass pipelines to minimize disturbance to existing utilities and obtain approval of the pipeline locations from the Owner. Locate bypass pumping and piping equipment on property and easements possessed by the Owner.

D. The pipes shall be adequately braced and supported to resist flow of water.

E. The discharge pipe shall extend into the receiving manhole so that there is neither splashing out of the manhole nor siphoning.

F. Provide plugs in the upstream manhole to prevent flow from the upstream sanitary sewer through the sewer in the work location. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device.

G. When the bypass pipeline crosses local streets and private driveways, place the bypass pipelines in trenches and cover with flowable fill and temporary asphalt or steel road plates or utilize approved Road Crossings.

H. Provide temporary power and lighting systems for 120V lighting to illuminate the site of the temporary pumping stations, and 120V to power instruments and control panels that are not powered or lit by existing site systems. Provide all labor and materials necessary to install temporary electric power.

I. During all bypass pumping operation, protect existing structures and equipment from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the existing structures and equipment caused by human or mechanical failure. Replace any section of structures damaged during the bypass operation.

J. Exercise caution and comply with OSHA requirements paying attention to conditions when working inside existing structures, in the presence of gases, combustible or oxygen-deficient atmospheres, and confined spaces. Obtain confined space entry permit from Owner for personnel working in manholes.

K. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Owner, remove all the piping, and restore all property and pavement to pre-construction condition.

3.02 PLUGGING AND BLOCKING

A. Insert a sewer line plug into the line at a manhole upstream of the sewer section in which work is to be performed.
   1. Design of the plug shall allow all or any portion of the sewage flow to be released in an emergency.
   2. Remove plug and restore normal flow following the specified rehabilitation work.

B. Flow Control Precautions:
   1. When flow in a sewer line is plugged, blocked, or conveyed through a temporary system, take sufficient precautions to protect sewer lines from damage due to surcharging.
   2. Take precautions to insure that sewage flow control operations do not cause flooding or damage to adjacent property.
   3. Repair any damage due to lack of flow control at no cost to the Owner.

C. When plugging or blocking is no longer needed for performance and acceptance of work, remove in a manner that permits the sewer flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream. When bypass pumping operations are complete, drain piping into the sewer prior to disassembly.

3.03 PUMPING AND BYPASSING

A. Supply necessary pumps, conduits, and other equipment to divert the flow of sewage around the location in which work is to be performed.

B. Furnish necessary labor, supervision, power source, and materials to set up and operate the pumping and bypass system.

C. Insure that the temporary pumping system is properly maintained, and a responsible operator shall be on hand at all times when pumps are operating.

D. Contractor shall be responsible for sewage spills and sewage back-ups into buildings plus costs and fines associated with the clean-up of sewage spills and sewage back-ups. Contractor shall be responsible for any and all damages to public or private property resulting from deficiencies in or failure of the bypass system.

3.04 SAFETY REQUIREMENTS

A. Be knowledgeable with Safe Working Requirements in confined spaces.

B. Exercise caution and comply with all local, state or provincial and federal safety requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, or in any confined space.

C. Perform testing of atmosphere prior to entering each manhole, and throughout the workday.

D. If dangerous, hazardous, or explosive gases are detected, remove these by forced ventilation to a level permitting entry in accordance with OSHA regulations.

3.05 SYSTEM STARTUP

A. Once the installation is completed, a trained representative from the pump supplier shall inspect the installation and verify in writing that the installation is complete in all aspects and ready to run as intended on a continuous basis.

B. The Temporary Bypass Pumping System shall be tested before bypass operations can be scheduled. Run each of the pumps for a minimum of 2 hours of continuous run time to prove the reliability of the entire installation. No more than two pumps per pump station may be tested simultaneously. Conduct tests during normal daytime working hours. Conduct tests only with the approval of the Owner. Once the reliability has been established to the satisfaction of the Engineer, the temporary bypass pumping operations can be scheduled.

C. Prior to bypass pumping operations, meet with the Owner and Engineer to develop step-by-step pumping operating strategy, communication protocol, and procedures for interaction between the Owner and Contractor.

3.06 FIELD QUALITY CONTROL

A. Place temporary pumping system in service for a minimum of 24 hours before any other work may begin.

B. The pumping systems operator shall be trained to turn on and off the pumps in response to the working water levels in the sewer and shall provide assistance to the Contractor. Operation of the bypass pumping system shall be coordinated with construction activities.

C. The pump supplier’s representative shall be available by cellular telephone at all times.

D. Subject the pump discharge piping for all systems to a pressure test of two-times the operating pressure for 4 hours using clean water prior to actual operation. No loss of pressure or visible leakage will be allowed. Provide blind flanges to allow capping of both ends of the piping during testing. Give the Owner and Engineer 24 hours’ notice prior to testing.

E. The bypass design operating pressure shall not exceed 10 percent below the maximum pressure rating of the HDPE pipe.

F. Inspect bypass pumping system every two hours to ensure that the system is working correctly.

G. During bypass pumping, do not allow sewer flow to be leaked, dumped, spilled, or discharged in or onto any area outside of the existing sewer system.

H. In the event of overflow, immediately stop the discharge and take action to clean and stabilize disturbed area at own expense and promptly notify the Owner.

I. Prevent back-up of sanitary sewer in existing sanitary sewer network to avoid local flooding and basement flooding.

J. Bypass pump watch logs shall be maintained onsite at all times recording every ½ hour:
   1. System Discharge Pressure
   2. Pump RPM
   3. Suction Manhole surcharge level
   4. Plug Pressure
   5. Fuel levels
   6. Flow

7. Discharge line condition (every two hours)

K. Extra Materials:
1. Spare parts for pumps and piping shall be kept on site.
2. HDPE pipe repair bands for each size HDPE pipe shall be kept on site.
3. Fuel (not including fuel in equipment) for the operation of the bypass pumps for a period of 24 hours shall be stored onsite.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the provisions to maintain vehicular and pedestrian traffic and protection for both the public and the Contractor's employees from all damage to person and property within the limits of and for the duration of the Contract and for providing watchperspn services.

1.02 SUBMITTALS

A. Notify the Engineer at least seventy-two (72) hours prior to the closing of any portion of a road as might be necessary to perform the work and shall adequately describe the detour to be followed.

B. For work within County and Town right-of-ways, submit traffic maintenance drawings to the County for approval. The maintenance of traffic drawings shall be submitted within thirty (30) days after the contract is awarded. These drawings shall be submitted even if maintenance of traffic drawings are included with the Contract Drawings. No work will be allowed to start on any County and own right-of-way prior to the Contractor receiving approved drawings.

C. Traffic maintenance details shown on the Contract Drawings for work in State right-of-ways are intended to outline a method of maintaining traffic conforming with State requirements. The Contractor shall submit traffic maintenance drawings where they intend to deviate from these details and will be required to submit a detailed account of the construction within State right-of-ways showing phases of construction, time schedule, shop drawings, etc., to the County for approval.

D. The maintenance of traffic drawings shall meet the following requirements:
   1. Drawings shall be prepared and signed by a licensed Professional Engineer.
   2. Drawings shall be presented on twenty-four (24) inch by thirty-six (36) inch sheets to a scale of 1 inch (25.4 mm) = 40 feet (1219.2 cm) or 1 inch = 50 feet (1524 cm).
   3. Drawings shall show all locations and type of barricades, safety devices, signs and temporary striping.
   4. Drawings shall conform to the New York State Manual of Uniform Traffic Control Devices.
   5. Drawings shall show in detail the methods, sequences, procedures and facilities that the Contractor proposes to use for the maintenance, protection and detouring of traffic.
   6. Approval of these traffic maintenance drawings is intended only as an outline of minimum requirements and the provision of these drawings does not in any way lessen the Contractor's responsibility to maintain vehicular and pedestrian traffic and to protect the public and own employees from all damage to person and property. Adjustments in the field may be required as the Owner or entity with jurisdiction for the roadway deems necessary.

E. Any change, modification or amendment to the original plan or schedule must also be approved in writing by the County.
   1. Submit for approval by the Owner, all persons or service contracts proposed to be utilized during non-working hours for providing watchperson patrol of the contract site.

PART 2 - PRODUCTS

2.01 GENERAL

A. Traffic Devices
   1. All temporary signs, delineators, barricades, lighting and other warning and guiding devices shall be as shown and specified on the Plans, the New York State Manual of Uniform Traffic Control Devices, the Traffic Maintenance Details including in the Contract Drawings and/or approved by the Engineer.
   2. Unless otherwise specified, all materials and equipment used will remain the property of the Contractor.

B. Safety Tape
   1. Minimum three (3) inch wide fluorescent orange plastic safety tape.

PART 3 - EXECUTION

3.01 PREPARATION

A. Obtain, supply and pay for all required electrical energy, services, permits and certificates.

3.02 PERFORMANCE

A. Traffic shall be maintained over a reasonably smooth traveled way, which shall be marked by signs, delineations and/or other methods so that a person who has no knowledge of conditions can safely and with a minimum of discomfort and inconvenience, travel the area under construction. Maintenance of Traffic shall be in conformance with the New York State Manual of Uniform Traffic Control Devices (referred to as "manual") current edition.

B. Adequate advance warning shall be provided whenever traffic is interfered with or lanes are closed. All signs, markings, signals, barricades, lighting devices and flagger operations shall conform to the "manual." All necessary traffic control devices shall be in place before the particular construction operations are started. In case of emergency construction where there is not sufficient time to prepare a traffic plan, the Contractor shall be responsible for following the guidelines set forth in the manual.

C. Access for emergency vehicles is of the utmost importance and provision shall be made by the Contractor to provide such access. Adequate provisions shall also be made for business and commercial establishments, schools and public buildings.

D. Generally maintain two (2) way traffic on streets where work is in progress.

E. For the duration of the Contract, the Contractor shall maintain within the contract limits the entire pavement, drainage and sewage facilities and other street elements unless otherwise specified. The traveled way shall be kept well drained, reasonably smooth, cleaned and hard at all times. Potholes, bumps, irregularities and depressions shall immediately be repaired. Foreign objects, sand, rocks, spillage of materials shall immediately be removed and the area cleaned to the satisfaction of the Engineer. Spillage outside the contract limits is the Contractor's responsibility to pay the cost for work necessary to clean the areas affected. Remove snow on those streets where roads are not passable for snow plows because of Construction.

F. Traffic delays shall be kept to a minimum. A period of five (5) minutes shall be considered the maximum time allowed for stopping traffic.

G. Detour signs, barricades and other facilities shall be furnished and erected as called for on the approved Plan and/or as directed by the Engineer. The route of any detour shall be clearly marked at beginning and end with direction arrows at intermediate points along its entire length.

H. Supply and utilize safety tape around the boundary of the daily work zone and/or additionally where so ordered by the Engineer. The safety tape shall be substantially secured to suitable posts spaced no more than fifteen (15) feet apart.

I. Provide one (1) weeks notice to all interested agencies when detours or construction will interfere with the normal traffic flow. These agencies include, but are not limited to:
   1. Nassau County and Local Police
   2. Local Fire Departments
   3. School districts
   4. New York State Department of Transportation (for State roads)
   5. Nassau County Unit of Traffic Engineering (for County roads)
   6. Local Traffic Departments and Town Departments of Public Work
   7. MTA Long Island Bus

J. Do not store soil, materials, equipment or supplies that will interfere with sight distances, within thirty (30) feet of an intersection or areas where visibility is critical.

K. When travel must be diverted from the accustomed traveled way on to some other area, grade, repair, stabilize and provide ramps if necessary to provide for the smooth flow of traffic. Upon completion of construction, the area utilized shall be restored to its original condition.

L. Construct and maintain, where called for on the Plans or as directed by the Engineer, temporary bridges or bridging over excavations, obstructions and newly laid pavements to provide access for pedestrian and vehicular traffic and access to fire hydrants. During construction, the take particular care to allow for the ingress and egress of emergency vehicles from firehouses, police stations, hospitals, etc. Adequate provisions shall also be made for business and commercial establishments, schools, and for public buildings. Plating and/or bridging is required at all intersections and crossings.

M. Street signs, route markers and other signs that fall under public jurisdiction, i.e., Bus Stop, Stop Signs, Parking Signs, etc., shall be protected and maintained or if approved by the Engineer removed, stored, cleaned and replaced. The Engineer may also order that these signs be temporarily relocated and then reinstalled in their original location. If in the course of construction, it becomes necessary to temporarily move a Bus Stop on a State Roadway, the temporary site must be approved by the Regional Office of the New York State Department of Transportation.

N. Provide protection from damage to persons or properties.

O. All signs, lights, barricades and other materials installed to direct or warn the traveling public shall be maintained, repaired and replaced by the Contractor. Vandalism or theft shall not preclude the Contractor from meeting the specified requirements. Special attention shall be given to Traffic Maintenance during non-working hours, weekends, holidays and other periods or temporary shutdown of work.

P. Materials, equipment and handiwork for lighted barricades shall be in compliance with the National Electric Code and only licensed electricians may perform the work.

Q. Signs or markers lost, damaged or removed without the Engineer's approval shall be replaced at no cost to the Owner. Signs not to be replaced shall be cleaned and delivered to the Engineer.
   1. Temporary reflectorized pavement markings shall be placed where existing markings are obliterated by Construction, wherever determined that the roadway would be without traffic markings for two (2) weeks or more, or as otherwise directed by the Engineer. The temporary markings shall provide the same number of through travel lanes as previously existed.

R. Sheeting
   1. Sheeting around excavations shall project four (4) feet above the existing grade to form a tight barricade or the excavation shall be protected with a temporary fence as specified in Section 321316, “Earth Excavation”.

3.03 FLAGGERS

A. Competent flaggers shall be provided by the Contractor when required, ordered by the Engineer or as directed by the Plans or Specifications. These flagmen shall have no function other than the direction of traffic. They shall wear safety vests and shall direct traffic with a red flag as required by the New York State Manual of Uniform Traffic Control Devices.

B. Watchperson Service
   1. Provide watchperson service for the continuous patrol of the Contract site during non-working hours or whenever his operations are closed down. Watchperson service shall be provided from the commencement to the completion of actual construction.
   2. The Watchperson shall be responsible for making sure that all temporary fences, signs, barricades, flares and markers are up and in good condition.
   3. Watchperson shall maintain daily logs of their patrols. Copies of these logs shall be submitted weekly to the Owner.
   4. In the event that any unusual or emergency condition arises, the watchperson shall immediately notify the Contractor, the Engineer and the appropriate regulatory or emergency agency for assistance.
   5. The Contractor may apply to the Owner for suspension of the watchperson service following completion of the active construction but prior to the completion of the project (when punch list items remain).

C. Traffic Signal Maintenance

1. The maintenance of the traffic signals shall be in accordance with the latest Nassau County Traffic Signal Specifications, available from the Unit of Traffic Engineering, Department of Public Works, Traffic Signal Operations. Traffic signals on State highways shall be maintained in accordance with the latest Standard Specifications of the New York State Department of Transportation, Office of Engineering.

D. Protect traffic signal equipment and cables from any damage or malfunctioning.
   1. All County traffic signals and electronically operated traffic control devices within the Contract area limits will continued to be maintained by the County during Construction, except when a traffic signal or electronically operated traffic control device is physically damaged by Construction or requires physical work under this Contract. Such conditions as the removal or shoring of the signal support poles, detector removals, or any malfunction or change to the operation of the signals caused by the construction, shall oblige the Contractor to immediately have the signals repaired to enable their continued operation. The signals shall then be maintained by the Contractor for the duration of the Contract at no cost to the County until the issuance of the "Completion Certificate" by the County.
   2. The Unit of Traffic Engineering - Department of Public Works, Traffic Signal Operations shall be immediately notified of any damage, malfunction, or for a final inspection of the traffic signal equipment within the Contract limits. In the event of any disruption to New York State Traffic Control signals, the Traffic Department of the New York State Department of Transportation shall be notified.
   3. Maintain a telephone number within the County of Nassau, for twenty-four (24) hours per day for emergency traffic signal trouble calls. Informing the local Police Precinct and the Nassau County Department of Public Works, Unit of Traffic Engineering, Traffic Signal Operations of emergency traffic signal troubles.

3.04 MAINTENANCE OF TRAFFIC IN COUNTY RIGHT- OF - WAYS

A. Limit work schedule to specific times and seasonal periods as specified or as ordered by the Engineer. To insure the orderly flow of travel on roadways where peak traffic is influenced by commuter traffic and in locations ordered by the Engineer, proceed with the sewer construction no earlier than 7:00 A.M. each morning and shall cease no later than 3:30 P.M. each afternoon. All equipment and stockpiled material shall then be removed from the site and the road opened to traffic for its full width prior to 4:00 P.M., unless otherwise directed by the Engineer.
   1. Unless otherwise shown on the Plans or ordered by the Engineer, protect and maintain a minimum of one (1) lane of traffic in each direction at all times.

3.05 MAINTENANCE OF TRAFFIC IN NEW YORK STATE RIGHT-OF-WAYS

A. Adhere to all rules and regulations of the New York State Department of Transportation.

B. During non-woking hours and night time periods restore State highways to their full width unless the specific conditions require the use of long-term detours. At locations where long-term detours are allowed to be used during non-working hours and/or night time closure, provide suitable approved barricades. All barricades used for the maintenance of traffic in State roads shall be continuously lighted during night time. The use of blinkers or flashers will not be permitted for continuous lighting.

C. The Traffic Department shall be notified any time traffic patterns on State roads are altered by sewer construction in local streets.

D. The Contractor may be required to limit work schedule to specific times and seasonal periods in accordance with the approval of the New York State Department of Transportation, Traffic Department.

3.06 PAVEMENT STRIPING

A. The Contractor is responsible for all temporary striping in Town, State and County roadways where the existing striping has been obliterated by construction or has to be changed for construction. In Town and County roads, temporary striping shall be placed immediately after completion of the temporary and/or base pavement. In State roads, temporary striping shall be

placed if the wearing course is not installed within one (1) week after placing the base pavement. The pattern of the temporary striping shall be the same as the pattern prior to construction.

B. The Contractor shall be responsible for all permanent restriping in Town and State roads to the previously existing pattern using the same type of materials which existed prior to construction.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the provisions for furnishing all materials, labor, equipment, tools, and necessary incidentals required for dust control during construction and until the completion of all work.

1.02 QUALITY ASSURANCE

A. Calcium chloride will be accepted on the basis of the following information being plainly marked on each container; manufacturer, the approximate net weight and the percentage of calcium chloride guaranteed by the manufacturer. The Owner reserves the right to sample and test this material subsequient to delivery at the project site.

PART 2 - PRODUCTS

2.01 CALCIUM CHLORIDE

A. The material shall meet the requirements of ASTM D98. The calcium chloride shall be in the form of flakes, pellets or other granular material so that it will feed readily through the common forms of spreaders.

PART 3 - EXECUTION

3.01 APPLICATION

A. Calcium Chloride
   1. Apply calcium chloride on unpaved trench areas for dust control when directed by the Engineer.
   2. Apply with a drop spreader. For small areas, it may be distributed by hand.
   3. The rate of application for calcium chloride shall be one (1) pound per square yard.
   4. Should dust continue to be a nuisance, the Engineer may order the Contractor to increase the rate of application.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes requirements of a general nature related to Material, Services, and Facilities.

1.02 MATERIAL, SERVICES, AND FACILITIES

A. It is understood that except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the work within the specified time.

B. Unless otherwise stated in the Proposal, on the plans, or in the Specifications, it will be understood that only articles or materials manufactured or produced in the United States will be used on the work.

C. After receipt of the Notice of Award, furnish the Owner within ten (10) days the names and addresses of all companies proposed to purchase materials or manufactured products which are to be incorporated into the work. Designate the location of plant or plants to be used for the mixing or batching of materials. The source of supply of each of the materials specified shall be approved by the Commissioner before delivery is started.

D. In those instances where the Commissioner deems it necessary to have physical inspections made of materials, products, sources of supply, or of mixing, batching, or manufacturing processes, give the Owner not less than ten (10) working days notice plus travel time prior to all out-of-County inspections.

E. Only materials conforming to the requirements of these Specifications and approved by the Commissioner shall be used in the work. No material which, after approval, has in any way become unfit for use, shall be used in the work. Acceptance at any time of any material shall not be a bar to its future rejection if subsequently found to be defective or inferior in quality or uniformity in the materials specified. Any material may be rejected if, in the opinion of the Commissioner, service records indicate that it is unsound or otherwise unsatisfactory.

F. Require the manufacturer or supplier to submit with each delivery of material a sworn statement certifying that the products furnished meet all the requirements of the Specifications, that all the required tests were performed, and that the product meets or exceeds all specified test requirements. Transmit these certified statements to the Engineer within twenty- four (24) hours of delivery of materials.

G. Materials, supplies, or equipment to be incorporated into the work shall not be purchased by the Contractor or the Subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.
   1. Manufactured articles, materials, and equipment shall be stored, applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer, and as approved by the Engineer.

H. Store materials and equipment to insure the preservation of their quality and fitness for the work. Stored materials and equipment to be incorporated in the work shall be located so as to facilitate prompt inspection.

I. Locate aggregate stock piles at points approved by the Engineer and so arranged that fine and coarse aggregates or coarse aggregates separated by specification requirements, do not become mixed.
   1. Provide either approved platforms or a prepared base satisfactory to the Engineer; or at least six (6) inches of the base of the stock pile material shall be left undisturbed until the completion of pavement and structures.

J. Materials from different sources of supply shall not be stored in the same stock pile unless approved by the Engineer.

K. Place perishable materials in waterproof buildings or otherwise protected from the elements.

L. Stored materials, even though approved before storage, may be subject to further inspection prior to their use in the work and shall meet the requirements of the Specifications at the time it is proposed to use them.

M. Pipe stored adjacent to the trench or on the contract site shall be stored according to the following requirements: (1) Pipe that is stockpiled shall be properly checked and strapped to the satisfaction of the Engineer in such a position until ready for use; (2) when pipe is stored singularly adjacent to or in the vicinity of the trench, each length of pipe shall be checked for defects prior to its installation.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes cleanup during construction as required to prevent accidents to personnel, the general public, and to Owner employees, and final cleanup.

1.02 CLEANUP DURING CONSTRUCTION

A. During Construction of the work, always keep the site of the work and adjacent premises free from material, debris, and rubbish in order to prevent a hazard or an objectionable nuisance.

B. Remove from the site all surplus materials and equipment when no further need therefor exists.

1.03 MOBILE BROOM

A. Have available throughout the duration of the contract a mechanical mobile street sweeper of the type approved by the Commissioner and in operating condition at all times. An experienced operator shall be made available as required. Whenever the Engineer directs, and without prior notice, the Contractor shall cause the broom to operate to clean the streets and other areas at or adjacent to the site of the work.

1.04 OWNER'S RIGHT TO CLEAN

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

1.05 FINAL CLEANUP

A. Final cleanup shall be performed at the conclusion of the work. Promptly take away all equipment, tools, temporary structures, and materials belonging to him. Remove and dispose of all dirt, rubbish or any other foreign substance.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes lists for documents to submits before substantial completion and with the final application for payment.

1.02 SUBMITTALS

A. Submit the following documents to the Engineer before Substantial Completion:
   1. Post Construction CCTV as specified in Section 330130.11.
   2. Project Record Documents as specified in Section 017839.
   3. Operations and Maintenance Manuals prepared in accordance with Section 013233 and be updated as a result of start-up activities.
   4. Manufacturer's Start-up Reports (MSR's) for all equipment and systems where manufacturer field time is specified.
      a. Each MSR shall be signed by the field technician(s) who attended the start-up.
      b. If the manufacturer is taking exception to the installation or if the warranty is voided, provide a statement to that effect and provide reasons and justification to explain the company's position.
   5. One binder containing original counterparts of all warranties, guarantees, bonds, or affidavits as specified in the Technical Specification Sections. These documents shall contain the original signatures and be placed in a plastic sheet protector, one document per protector.
   6. Spare parts checklist itemizing all spare parts furnished under the Contract summarized by Section.
   7. Electrical Underwriter's Certificate where the contract includes electrical construction.

B. Submit the following items to the Engineer with the final application for payment:
   1. Final Application for Payment and continuation (G702 and G703)
   2. Contractor's Certified Payrolls
   3. OSHA cards for all workers
   4. Contractor's Affidavit of Payment of Debts and Claims (G706)
   5. Contractor's Affidavit of Release of Liens (G706A)
   6. Final list of Subcontractors (G705)
   7. Subcontractor's Affidavit of Payment of Debts and Claims (G706) - (for each subcontractor used)
   8. Subcontractor's Affidavit of Release of Liens (G706A) - (for each subcontractor used)
   9. Consent of Surety to Final Payment (G707)
   10. 2 year Maintenance Bond - 100% of contract uncluding change orders
   11. Contractors letter guaranteeing handiwork 2 years
   12. Product data, Maintenance manuals and Warranty Information
   13. Record Documents
   14. Asbestos Affidavit and waste manifests

C. All documents shall be complete, signed, dated, and notarized (where applicable) and be subject to the Engineer's acknowledgment of receipt or approval.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 017800

PART 1 - GENERAL

1.01 SUMMARY

A. Maintain and provide the Engineer with Project record documents.

1.02 MAINTENANCE OF DOCUMENTS

A. General
   1. Maintain in the Contractor's field office in a clean, dry and legible condition complete sets of the following: Contract Drawings, Specifications, Addenda, approved Shop Drawings, Samples, Change Orders, Modifications to Contract, Test Records, Field Orders, and all other documents pertinent to the Contractor's work.
   2. Provide files and racks for proper storage and easy access. File in accordance with filing format of Construction Specification Institute (CSI) unless otherwise approved by Engineer. As an alternative to paper format, the Contractor may have documents available in PDF format.
   3. Make documents available at all times for inspection by the Engineer and Owner representative.
   4. Record documents shall not be used for any other purpose and shall not be removed from the office without the Engineer's approval.

1.03 RECORDING UPDATED INFORMATION

A. General
   1. Label each document "PROJECT RECORD" in two (2) inch high printed letters.
   2. Keep record documents current.

B. Contract Drawings: Legibly mark to reflect actually installed Construction including:
   1. Depths of various elements of foundation in relation to datum.
   2. Horizontal and Vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
   3. Type of material
   4. Field changes of dimensions and details.

C. Changes made by:
   1. Change Order or Field Order
   2. Details not on original Contract Drawings.
   3. Details of delegated design.

D. Specifications and Addenda: Legibly mark up each Section to record:
   1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
   2. Changes made by Change Order or Field Order.
   3. Matters not originally specified.

E. Shop Drawing:
   1. Maintain as Record Documents and legibly annotate drawings to record changes made after review.

1.04 RECORD PLANS

A. Post-rehabilitation CCTV and GIS file databases shall be submitted as Record Documents for all work of the Contract.

B. Submit monthly Post-rehabilitation CCTV and a GIS file geodatabase that reflect that month's construction activity and progress. The GIS file geodatabase shall be cumulative and include all rehabilitation to date. This submittal shall accompany the monthly requisition for payment. The submittal's accuracy and adequacy must be approved as a prerequisite to processing said requisition. Substantial completion payment or final payment to the Contractor will not be processed until the Record Documents are approved by the Owner.
   1. All Record Documents shall have the following data as applicable contained thereon:

a. The notation "Record Document" in prominent lettering.
b. Description of material.
c. Explanatory notes quantifying the information contained in the Record Documents.
d. Contractor's name, address, and phone number.

2. The naming convention for the GIS file geodatabase shall be as follows:
   a. RecordFile_[Lateral Sewer Contract Number]_[Hamlet]_[Date Submitted]
3. The GIS file geodatabase shall contain objects, such as lines and points, that represent each rehabilitation action taken to date and shall be geospatially accurate.
   a. Sewer rehabilitation shall
   b. Lining rehabilitation shall be represented by lines. Each line object shall span the length of the lining rehabilitation but no more than one manhole-to-manhole run.
   c. Point repairs shall be represented by lines that span the total length of the point repair.
   d. Manhole rehabilitation shall be represented by point objects.
4. Each layer within the GIS file geodatabase shall contain the following information as fields:
   a. Lateral Sewer Contract Number
   b. Street Name
   c. Hamlet
   d. Rehabilitation Action Taken, one of the following:
      1) Point Repair
      2) Point Repair with Lining
      3) Lining
      4) Short Lining
      5) Manhole Floors or Invert
      6) Manhole Lining, No Chimney Seal
      7) Manhole Lining, With Chimney Seal
   e. Date of Rehabilitation
   f. For lining rehabilitation, include the following:
      1) Upstream Manhole ID
      2) Downstream Manhole ID
      3) Original Pipe Diameter
      4) New Pipe Diameter
      5) Length of lining
   g. For point repairs, include the following:
      1) Upstream Manhole ID
      2) Downstream Manhole ID
      3) Pipe Diameter
      4) Number of point repairs
      5) Length of point repairs
      6) Depth of point repair
      7) Dewatering Required (Yes or No)
   h. For manhole rehabilitation, include the following:
      1) Manhole ID
      2) Bench/Invert Reconstruction (Bench, Invert, Bench/Invert, or None)
      3) Internal Surface Area Restored, if any (SF)
      4) Internal Chimney Surface Area Restored, if any (SF)

C. Utilize the services of a licensed surveyor to conduct surveys necessary for recording information necessary for the preparation of Record Documents.

D. The Contractor shall be responsible for all costs associated with reproducing Record Documents if they are lost, damaged, or otherwise marred at any time prior to final Owner acceptance of the entire set of Record Documents.

E. Submit Record Documents within one month of the completion of the installation of all sewer pipe and appurtenances. The sets will be reviewed by the Owner for acceptance. If corrections are

required, the Contractor will be so informed and shall resubmit the corrected Record Documents within two weeks. The process will be repeated until full approval is obtained from the Owner.

F. The cost for preparation of Record Documents resulting from an approved change order is considered included in the overhead of said change order.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. The Owner will provide GIS-based maps that include general locations for the principal component parts of the work. These maps do not indicate exact locations of the underground components of the collection system and it is the responsibility of the Contractor to confirm exact locations.

1.02 CONSTRUCTION SURVEYS BY THE CONTRACTOR

A. Provide all surveys, mark-outs, and stake-outs of working or construction lines or grades as needed for the setting of forms, string lines, sewer and manhole inverts, grade control and other controls which may be required to construct the work in the Contract.

B. Preserve and maintain in proper position all hubs, stakes, grade stakes and lines installed by the Owner until authorized to remove the same. If the Contractor fails to protect the aforementioned items, reset all disturbed items at own expense.

C. Any work done without lines and grades or without instructions having been given by the Engineer, will not be estimated or paid for. Any work done may be ordered removed and replaced at no cost to the Owner.

D. Furnish, at own expense, all stakes, templates and such temporary structures as may be necessary for marking and maintaining points and lines for the work.

E. Unless otherwise approved by the Engineer, utilize a Laser-Transit control for the installation of all sewer pipes eight (8) inch diameter and larger. The laser beam shall be used coaxially through the center of the pipe being laid. The laser beam projector is to be rigidly mounted to its support platforms, with a two-point suspension or equivalent, assuming that all ground and equipment vibrations be kept to an absolute minimum. Any other equipment necessary to control atmospheric conditions in the pipe to keep line and grade to acceptable standards of accuracy shall be furnished by the Contractor.

F. A transit shall be used for line and grade of house connection pipes. Line and grade shall be held constant for the entire house connection run.

G. Keep a transit and leveling instrument on the site at all times. A skilled survey party shall be employed or obtained whenever necessary for layout and checking of work in progress. The survey party shall check the initial setting of the laser equipment and thereafter at the half-way points between manholes and shall check all pertinent elevations of manholes immediately after their installation. Copies of all survey notes shall be transmitted to the Engineer on a weekly basis.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Retain an independent utility locator service company with a minimum of five (5) years of experience to field locate, mark, and stakeout existing underground utilities and service connections. The company shall be equipped with the latest state-of-the-art equipment.

B. If required, determine the exact location of utilities by hand excavated test pits or through vacuum methods. Support and protect all utilities to remain in place.

C. Field locate, mark, and stakeout underground utilities prior to excavation.

D. Use different colored markers for each separate utility run. Immediately take digital photographs to document the mapped utilities and provide digital photograph files to the Engineer.

E. Contractor shall be responsible for the location of all utilities within areas of excavation, and all costs associated with the repair of utilities hit/damaged during construction.

1.02 TEST HOLES

A. Test holes shall be performed by air vacuum excavation key-hole technology or other non-destructive techniques on existing utilities. One call notification and permit applications shall be made prior to test hole excavation as necessary.

B. The test holes shall be staked at the site by contractor personnel utilizing a tape or survey instrument as deemed necessary. Test hole openings shall be a minimum 8” x 8” and typically not larger than 12” x 12”. Excavate to expose the utility in a careful manner with the utmost concern for the safety of personnel, the public and surrounding property. Complete a field test hole form for each excavation that indicates at a minimum parameters required by the ASCE/CI Standard 38-02, which includes: depth to the utility, outside diameter, height of conduits or encasement, utility material, pavement type/ thickness and general soil type.

C. Place permanent marker over a reference point on the utility flush with grade. Typically this reference point is the centerline of pipes or the edge of concrete structures. A minimum of three (3) ties shall be taken to the permanent marker. The depth to the reference point on the utility shall also be measured plumb to the permanent marker.

D. Backfill excavation utilizing excavated materials or a self-compacting aggregate. Pavement restoration shall be made in accordance with temporary pavement requirement on the Contract Drawings.

E. Locate test hole permanent markers using conventional or GPS survey equipment. The test hole markers shall be directly located to provide horizontal and vertical coordinates for the locations relative to the project coordinate system.

F. Do not backfill test holes until directed by the Engineer. Take photographs of exposed piping and keep on file for the duration of the project. All photographs shall be taken using a digital camera at a minimum resolution of 5 megapixels. All photographs shall be landscape frame position and in JPEG format. All Annotate on each photo the location of the photograph, the name of the exposed line, and the date it was taken. The digital file shall be provided to the Engineer. Trenching for new buried pipelines shall not be started until the locations of existing pipes and utilities are verified.

1.03 SUBMITTALS

A. Submit detailed experience and qualifications description of underground utility locator service. Experience and qualifications package should include a description of the types of utility locator equipment and services that can be provided.

B. At conclusion of project, provide two (2) sets of paper and one (1) copy of electronic plans documenting all utilities located and identified. All documentation shall be referenced to existing data (horizontal and vertical) previously established.

1.04 COORDINATION AND SCHEDULING

A. General Location: Within areas of excavations all utilities shall be field located and their locations marked at least one (1) day prior to the performance of the required excavation.

B. The performance of hand excavated test pits or vacuum excavations to determine the utilities exact location shall be performed just prior to performing the work to minimize the time that excavated areas will be exposed to erosive conditions.

C. Coordinate work with the Engineer to minimize utility disruptions and facility operations. The Engineer shall be notified at least three (3) working days prior to performing the work, and should be provided a schedule for the works progression

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

END OF SECTION

SECTION 026400 - Removal And Replacement Of Curbs, Curbs And Gutters, Sidewalks, Driveways, And Driveway Aprons

PART 1 - GENERAL

1.01 SUMMARY

A. This section covers the provisions for the removal and replacement of Portland cement concrete and bituminous concrete curbs, curbs and gutters, sidewalks, driveways and driveway aprons.

B. All curbs, curbs and gutters, sidewalks, driveways and driveway aprons which are damaged or destroyed by the Contractor outside the line of work shall be removed and replaced by the Contractor at no expense to the Owner.

C. Coordinate with municipalities not mentioned in this section for all products and installation requirements of all curbs, curb and gutter, sidewalk, driveway and driveway aprons owned by the municipality.

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT CONCRETE

A. Concrete for curbs, curbs and gutters, sidewalks, driveways, and driveway aprons shall be 4000 psi (27579.04 kPa) concrete conforming the requirements of Section 033000, "Concrete".

2.02 STEEL REINFORCEMENT

A. Concrete Curbs shall be reinforced as shown on the Nassau County Standard Sheets for the Construction of Highways and Bridges.

B. Commercial driveways and driveway aprons shall be reinforced as shown on the Nassau County Standard Sheets for the Construction of Highways and Bridges.

C. Sidewalks, Driveways, and Driveway Aprons in State Roads shall be reinforced as shown on the Plans.

D. All steel reinforcement shall conform to the requirements of Section 032100, "Steel Reinforcement".

2.03 EXPANSION JOINTS

A. Expansion joints in Portland cement concrete curbs, curb and gutters, sidewalks, driveways, driveway aprons, and against existing concrete shall be made with a pre-molded bituminous joint filler conforming to the requirements of ASTM designation D1751.

2.04 STONE CURB

A. "Stone" curb shall include Cobblestone, Belgian Block, or equal as approved by the Engineer.

2.05 BITUMINOUS CONCRETE

A. Bituminous concrete plant mix to be utilized to replace asphalt curbs, gutters, sidewalks, driveways and driveway aprons shall conform to the requirements for Type 1A plant mix as specified in Table IV, Section 321200, "Roadway Pavement".

PART 3 - EXECUTION

3.01 PREPARATION

A. Breaking, Removal, and Disposal
   1. All curb, curb and gutter, sidewalk, driveway and driveway aprons removal shall be made within the lines established by the Engineer in the field.
   2. In general, removal and replacement shall be to the nearest construction joint. The Engineer shall determine where saw cutting is necessary. The minimum depth of the saw cut shall be one-and one-half (1-1/2) inches. Saw cutting shall be required when the line of removal is not an existing construction joint, so that the surface contact between the new and existing concrete will be a straight line.
   3. In removing any section of stone curb, salvage the existing stone and reuse the stone in the replacement thereof. Should any additional stone be required, provide a stone of shape, color and material similar to that removed.

4. All removed material, not authorized by the Engineer to be used in other parts of the work, shall be properly disposed of.

B. Preparation of Subgrade
1. All excavation shall be made to the required depth and the subgrade or base to be placed shall be thoroughly compacted to a firm, even surface. All excavation and compaction shall conform to the requirements of Section 312316, "Earth Excavation" and Section 312333, "Backfill".
2. Where temporary pavement has been installed, remove the temporary pavement and underlying material, and prepare the subgrade to receive the new sidewalk, curb, curb and gutter, driveway and/or driveway apron.
3. Thouroughly compact the subgrade. Any additional fill required to prepare the subgrade shall be placed, compacted and shaped to the proper elevation. The subgrade shall be finished to a width of six (6) inches on each side in excess of the width of the sidewalk, curb, curb and gutter, driveway and/or driveway apron.

C. Forms and Expansion Joints for Portland Cement Concrete
1. Set forms true to line and grade and held rigidly in position. The forms shall be of such construction and material that a smooth, even surface will result upon their removal. They shall be not less than two (2) inches in thickness and depth equal to depth of concrete. Wood forms shall be maintained in excellent condition at all times. Any warped, bent or otherwise damaged pieces shall immediately be removed from the site or discarded. Installation of forms shall conform to the requirements of Section 033000, "Concrete".
2. Expansion joints for curbs shall be three-quarters (3/4) inch thick, spaced fifty (50) feet apart on straight runs and flat curves, at the beginning and end of all sharp curves and adjacent to driveways, and shall be recessed back one-fourth (1/4) inch from the front and top surfaces. Expansion joints for sidewalks shall be one-half (1/2) inch thick, spaced twenty (20) feet apart and recessed one-half (1/2) inch from the front and top surface.
3. Expansion joints shall be constructed where sidewalks, driveways or driveway aprons abut buildings, catch basins, curbs or other permanent structures.
4. The joint material shall be in one piece shaped to the cross section of the curb and sidewalk.

3.02 INSTALLATION

A. General
1. All mixing, placing, vibrating, finishing, curing, protection and any other information and procedures necessary for the completion of the work in this Section shall conform to the applicable requirements of Section 033000, "Concrete" and Section 321200, "Roadway Pavement" of these Specifications.
2. Construct all curbs, curbs and gutters, sidewalks, driveways and driveway aprons to match the existing structures or conform to the requirements and dimensions shown on the Nassau County Standard Sheets for the Construction of Highways and Bridges.

B. Replacement of Portland Cement Concrete Sidewalks, Driveways, Driveway Aprons and Gutters
1. Remove any temporary pavement and sufficient underlying material and fine grade the subgrade.
2. Before any concrete may be placed, check each section of the subgrade by testing with a template of wood or metal. If the subgrade is dry, it shall be sprinkled with as much water as will be rapidly absorbed so as to permit a uniform moist and compact subgrade. After proper mixing, the concrete shall be placed and thoroughly compacted and tamped. It shall then be struck off one-half (1/2) a template, leaving the top of the concrete flush with the top of the forms. The concrete shall be of the driest consistency possible to work with a sawing motion of the strike-off board or straight edge. After striking off to the established grade, compact with a wood float. The surface shall be tested with a ten (10) foot straight edge and all irregularities of over one-eighth (1/8) inch shall be immediately eliminated.
3. The final finish shall be delayed sufficiently so as to allow the concrete to set to such an extent that an excess of fine material will not be worked to the top in the finishing operations. No dry cement or mixture of dry cement and sand shall be sprinkled on the surface. The

concrete surfaces shall be wood floated to a true and even plane and steel troweled. The surface shall then be slightly roughened by using a soft broom, by dragging burlap across the surface or other acceptable means.

4. Mark the sidewalk off in blocks of the same length as the width of the sidewalk or to match adjacent concrete sidewalks.
5. Finish the edges of the transverse joints with an approved edging tool of one-quarter (1/4) inch radius. The edging tool shall also be used on all extreme outside edges. Such edging tool shall leave a smooth, finished edge of not over two (2) inches wide.
6. The thickness of new sidewalks shall be at least equal to the thickness of the existing sidewalks but not less than four (4) inches. The thickness of new driveways or aprons shall be at least equal to the thickness of the existing driveways or aprons but not less than six (6) inches. Driveway aprons include the entire driveway area from curb to back of walk. Sidewalks crossing driveways shall be considered driveway aprons.

C. Replacement of Portland Cement Concrete Curbs
   1. Remove any temporary pavement and sufficient underlying material and fine grade the subgrade.
   2. Place concrete on a moist subgrade within the forms and well spaded or worked so as to completely fill the forms and force the mortar and fine particles to the outer surfaces. The top of the curb shall be finished off to an even surface and the outer corner rounded as shown on the Nassau County Standard Sheets for the Construction of Highways and Bridges or to match the existing curb as directed by the Engineer.
   3. Immediately upon removal of the forms, the curb shall be rubbed down to a smooth, uniform surface.

D. Replacement of Bituminous Concrete Curbs, Sidewalks, Driveways and Driveway Aprons
   1. Remove any temporary pavement and sufficient underlying material and fine grade the subgrade.
   2. Existing bituminous concrete curbs, sidewalks, driveways and driveway aprons shall be removed and replaced within the limits directed by the Engineer.
   3. In general, replacement shall be made to match the original construction whenever practical.

E. Replacement of Unclassified Curb
   1. Restore unclassified curbs such as railroad ties, pipe, metal band, concrete block and/or brick (whether they be of mortared or unmortared construction, etc.) where specifically ordered by, and to the complete satisfaction of the Engineer.
   2. Brick, stone, pebbles, masonry, slate, patio blocks, railroad ties and wood edging set loosely in the soil along walks, driveways, and in planting areas, in any decorative manner shall be replaced to match the existing. Original materials shall be used at the direction of the Engineer.

F. Temporary Pavement Over Sewer Trenches in Sidewalk Areas.
   1. Where sewer pipe trenches are excavated through sidewalks, a temporary pavement shall be constructed in the sidewalk area and conform to Section 321200, "Roadway Pavement".

END OF SECTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The purpose of this section is to outline the scope of work and work procedures required for the removal of asbestos cement pipe that is anticipated to be encountered during the water main replacement on Greenvale Circle & related intersections.

B. Determination of limits of asbestos cement pipe was based upon Water Department records. The contractor shall verify in field via test holes the limits of asbestos cement pipe prior to commencement of the water main replacement.

C. Federal (EPA and OSHA) and New York State Department of Labor (NYS DOL) regulations (ICR 56.11), Project Drawings and Project Documents.

D. The Contractor shall be aware of all conditions of the Project and is responsible for field verifying quantities and locations of all ACM to be removed prior to submission of any bid. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work. The quantities presented in this Specification are approximate and should not be used solely as the basis for any bid. In the event that suspect materials not included in this Specification are encountered while the work is in progress, such material shall be tested for asbestos content or assumed positive for asbestos content, and removed in accordance with the procedures herein. Any discovery of new ACM shall not delay the progress of the Work. Payment for any additional work shall be considered on a case-by-case basis by the Engineer.

E. Any special job conditions, including any site specific variances are to be obtained by the Contractor, and any fees associated with procuring these variances shall be included in the Contractor’s bid.

F. The Contractor's industrial hygiene practices during asbestos abatement will be monitored by the Owner’s representative; however the Contractor shall be responsible for monitoring his own construction safety work practices for compliance with the OSHA regulations.

1.02 SPECIAL JOB CONDITIONS

A. Any special job conditions, including any site specific variances, are to be obtained by the Contractor, and any fees associated with procuring these variances shall be included in the Contractor’s bid.

1.03 CODES, 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 Federal and New York State regulations. Where more stringent requirements are specified, adhere to the more stringent requirements.

C. State Licenses: The Contractor must maintain current licenses pursuant to the New York State Department of Labor (NYSDOL) and New York State Department of Environmental Conservation (NYSDEC) for all Work related to this Project.

1.04 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 Department of Health (NYSDOH) Training Requirements

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

1.05 DELIVERY AND STORAGE

A. Deliver non-contaminated 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/damage away from wet/damp surfaces and under cover.
2. Protect materials from unintended contamination.

C. Remove damaged or deteriorated materials from the job site. Materials contaminated with asbestos shall be disposed of as asbestos debris as herein specified.

PART 2 - PRODUCTS

2.01 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.

2.02 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. If the asbestos waste has the potential to damage or puncture the disposal bags, burlap sacks shall be utilized as a liner inside the polyethylene disposal bags to prevent puncture or damage to the disposal bags. In addition, 30 or 55 gallon capacity fiber or metal drums capable of being sealed air and water tight may also be used. 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 with the names of the waste generator and the location at which the waste was generated in accordance with 40 CFR Part 61 NESHAPS.

D. Labeled ACM waste containers or bags shall not be used for non-ACM waste. Any material placed in labeled containers or bags, whether turned inside out or not shall be disposed of as ACM waste.

2.03 HEPA VACUUM EQUIPMENT

A. All dry vacuuming performed under this contract shall be performed with High Efficiency Particulate Absolute (HEPA) filter equipped industrial vacuums conforming to ANSI Z9.2.

B. Provide tools and specialized equipment including scraping nozzles with integral vacuum hoods connected to a HEPA vacuum with flexible hose.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform all asbestos removal Work using wet removal procedures. Dry removal procedures are not permitted.

3.02 WORK AREA PREPARATION

A. Work Area preparation shall be performed in accordance with NYSDOL regulations.

B. Remove all items attached to or in contact with ACM. HEPA vacuum and wet wipe with amended water all removed items prior to their removal from the Work Area and before the start of asbestos removal operations.

3.03 REMOVAL OF ASBESTOS CONTAINING MATERIALS

A. Asbestos-containing materials shall be removed in accordance with NYSDOL and the Contract Documents.

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 HEPA equipped filtered local exhaust ventilation.

E. Power or pressure washers will not be allowed to be used for asbestos removal or clean-up procedures.

3.04 ACM WASTE CONTAINERIZING, DECONTAMINATION AND LOAD OUT PROCEDURES

A. Packaging of ACM shall conform to OSHA Standard 29 CFR 1926.1101, DOT 49 CFR 171, 172, and 173, and EPA Standard 40 CFR Part 61 and the requirements as herein specified.

B. 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 area pending removal. The carts shall be wet cleaned and/or HEPA vacuumed at least once each day.

3.05 WORK AREA CLEANING PROCEDURES

A. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, decontamination procedures shall be followed as specified in Title 15 or ICR 56, unless otherwise stated in the variance(s) utilized by the Contractor.

B. Following each decontamination procedure the PM shall inspect the Work Area for effectiveness of the cleanings. If necessary, additional cleaning shall be performed by the Contractor as directed by the PM.

3.06 ASBESTOS WASTE

A. Applicable Regulations: All asbestos waste shall be stored, transported and disposed of in accordance with the following regulations as applicable:
   1. NYS DEC 6 NYRCC part 360 and 364
   2. US EPA NESHAPS 40 CFR 61
   3. US EPA Asbestos Waste Management Guidance EPA/530 SW85

END OF SECTION 028000

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the provision for furnishing and installing steel bars and welded steel wire fabric (mesh) to be embedded in concrete.

1.02 QUALITY ASSURANCE

A. Unless otherwise noted, submit to the Engineer a certificate of conformance with ASTM A615 including the grades specified.

B. Test certificates of the chemical and physical properties, covering each shipment, shall be submitted for approval unless otherwise specified.

1.03 SUBMITTALS

A. Submit detailed shop drawings and schedules of reinforcing bars.

1.04 DELIVERY AND STORAGE

A. Reinforcing steel, as delivered to the work, shall be in bundles strongly tied and each group identified with a metal tag giving the number corresponding to the bar schedule. All bars shall be properly stored, at least twelve (12) inches off the ground, kept clean, and protected from the weather as directed by the Engineer.

PART 2 - PRODUCTS

2.01 REINFORCING BARS

A. All reinforcing bars shall be free from defects, kinks and bends that cannot be readily straightened in the field.
   1. All bars shall be supplied in lengths which will allow them to be conveniently placed in the work and provide sufficient lap at joints. Dowels of proper length, size and shape shall be provided for tying walls, beams, floors and the like together.
   2. Reinforcement bars shall be new billet steel. New billet steel bars shall be rolled from open hearth steel billets (not rerolled material), and shall meet the requirements of ASTM Des. A615, Grade 60 or Grade 40.

2.02 WELDED STEEL WIRE FABRIC (MESH)

A. Welded steel wire fabric shall meet the requirements of ASTMA1064. Cold drawn steel wire shall meet the requirements of ASTM A1064.

2.03 ACCESSORIES

A. Reinforcing accessories shall conform to the requirements of the Concrete Reinforcing Steel Institute "Manual of Standard Practice."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Bending and Placing
   1. Bars shall be cut to the required length and accurately bent by approved methods.
   2. Before being placed in position, thoroughly clean all reinforcement of all loose mill scale, rust, dirt, coatings, or other material that might reduce the bond.
   3. Stirrups and ties shall have a minimum inside radius of bend of two-and- one-half (2-1/2) bar diameters. All other bars shall have a minimum inside radius of bend of three (3) bar diameters, except that No. 8 bars and larger shall have a minimum inside radius of bend of four (4) bar diameters.
   4. Place bars in the positions and with the spacing shown or required. Securely fasten in position at intersections to prevent displacement during the placing of concrete. Fasten bars with annealed wire of not less than eighteen (18) gauge or other approved devices. Provide spacing chairs to support and hold reinforcing bars in position in accordance with CRSI "Manual of Standard Practice".

5. Place reinforcement mesh in the positions shown, specified, or required to fit the work. Suitable spacing chairs or supports where required.
6. The concrete covering shall be as shown, specified, or ordered.
7. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

B. Concrete Protection for Reinforcing Bars

1. The concrete cover measured from the surface of the bar shall be not less than the following except as otherwise shown, specified, or directed:

Slabs	
1"	In general top and bottom.
1"	At top, under earth fill
1.5"	At surfaces trowelled as floor finish.
2"	On bottom for slabs over water or sewage
3"	On bottom for slabs resting on earth.
Footings	
2.5"	At top of footings, bottom of footings bearing on concrete working base.
3"	Above piles.
3"	At bottom, sides, and ends of footings and sides of pile caps.
Walls	Add 0.5 inchs for wall surfaces contacting water or sewage.
1.5"	in walls less than twelve (12) inches thick.
2"	in walls twelve (12) inches or more in thickness
Beams and Girders	Add 0.5 inch for Beams and Girders contacting water or sewage.
1.5"	minimum for stirrup steel.
2"	minimum to main longitudinal steel.
Columns	Add 0.5 inch for column surfaces contacting water or sewage.
2"	in general, to main vertical reinforcement.

C. Splices

1. Splices in tension reinforcement shall be lapped thirty (30) diameters. Splices in compression reinforcement shall be lapped twenty-four (24) diameters. All bar splices shall be staggered where possible.
2. Welded wire mesh shall have a minimum lap of eight (8) inches.
3. Welding of reinforcing steel will not be permitted unless authorized by the Engineer.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes provisions for installing and supplying cast-in-place and precast Portland cement concrete for structures, pavement, curbs, sidewalks, drainage structures, pipe cradle, pipe encasement and incidental construction.

B. The work shall consist of providing normal weight Portland cement concrete.

C. Concrete classes are specified by the required twenty-eight (28) day compressive strength. The classes of concrete are as follows:
   1. 4000 psi (27579.04 kPa) Concrete: Is intended for reinforced concrete structures designed for strength or impermeability, manholes, manhole invert fill, catch basins, finished concrete pavement, concrete curbs, concrete sidewalks, concrete driveways, concrete drainage structures and concrete driveway aprons.
   2. 3300 psi (22752.71 kPa) Concrete: Is intended for concrete base pavement, pipe cradles, etc.
   3. 2000 psi (13789.52 kPa) Concrete: Is intended for miscellaneous concrete fill.

1.02 QUALITY ASSURANCE

A. Cast in Place Concrete
   1. Testing will be performed by the laboratory except where otherwise indicated herein.

B. Precast Concrete
   1. Inspection and Testing
      a. The Owner reserves the right at all times to have its representative inspect the materials, the processes of manufacture, the records of analysis and tests, and to select the test specimens at the place of manufacture of the precast concrete sections. The supplier shall furnish materials to be tested and labor as required.
      b. Manufacturer shall provide ample space between rows of stockpiled sections to facilitate adequate inspection.
      c. Concrete compressive strength shall be determined from compressive tests made on concrete cylinders in accordance with appropriate ASTM requirements.
      d. Results of all tests conducted by the manufacturer shall be furnished upon request to the Owner. The Owner reserves the right to require core samples of finished products.
      e. All concrete cylinders shall be cured under the same environmental conditions as the corresponding structures.
      f. Notify the Owner at least seven (7) calendar days prior to the pouring of any concrete.

1.03 SUBMITTALS

A. General
   1. Submit to the Owner the design of the concrete mix for approval. No concrete shall be placed without an approved mix design.
   2. Submit to the Owner product data and manufacturer certificates for all forms and form ties, expansion joint filler, waterstops, and lifting devices.
   3. Submit to the Owner product data and manufacturer certificates for all curing materials including, but not limited to:
      a. Waterproof Paper Blankets
      b. Polyethylene Coated Burlap Blankets
      c. Quilted Covers
   4. Submit to the Owner a detailed description of the method proposed for providing curing temperatures during cold weather along with a list of jobs where the proposed method has been used successfully.
   5. Submit to the Owner product data and manufacturer certificates for all joint sealing materials.

B. Certified Test Reports

1. Submit certified test reports to the Owner for review which shall be approved by the Owner before delivery of materials for the items listed below:
    a. Cement
    b. Aggregate
    c. Admixtures
    d. Waterstop
    e. Materials for curing concrete
    f. Joint sealing materials
    g. Expansion Joint fillers

C. Delivery Tickets for Concrete
1. Submit certified delivery tickets for concrete showing the following information:
    a. Batch number
    b. Mix by compressive strength with maximum aggregate size.
    c. Types and amounts of admixtures included.
    d. Air content
    e. Required slump
    f. Time of loading
    g. Amount of water put in at batch plant
    h. Date of delivery
    i. Revolution count of drum (where appropriate)

D. Samples
1. Submit samples of materials to the Owner for testing in accordance with ASTM requirements.

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT

A. Types of Cement
1. This specification covers six (6) types of Portland cement as follows:
    a. Type 1 - For use in general concrete construction where low heat of hydration is not required and where no sulfate action is anticipated.
    b. Type 2 - For use in general concrete construction.
    c. Type 3 - For use when high early strength is required.
    d. Type 4 - For use where low heat of hydration is required (mass- concrete).
    e. Type 5 - For use when high sulfate resistance is required.
    f. Type 6 - For use in white concrete or white mortar.
2. Types of cement to be used will be as specified in this Section.
    a. Portland Cement Types 1, 2, 3, and 5 shall conform to the chemical and physical requirements of those respective types as contained in ASTM C150. Portland Cement Type 6 shall conform to the chemical and physical requirements of ASTM C150 Type I except that the color shall be white. For all types, any cement possessing an alkali content in excess of 0.70% may be either accepted, rejected, or have use limitations imposed as directed by the Laboratory. In addition, the requirement for False set as stipulated under ASTM C150, Table 2a, "Optional Physical Requirements" shall apply for all types. The gypsum shall be added to the clinker by means of an approved automatic mechanical device. At the option of the manufacturer, additions of those commercial products known as "grinding aids" will be permitted as provided for by ASTM C150.

B. Storage
1. The cement shall be stored at its source of supply in approved weather-tight silos. Facilities shall be provided for maintaining such silos under Department seal control when and as directed by the Laboratory. All silos shall be completely empty and clean before cement is deposited therein.
2. Cement remaining in bulk storage at the mill and/or distribution terminal for a period greater than one (1) year after completion of tests shall be resampled and retested before shipment.

However, cement which has been in bulk storage at mills and/or distribution terminals more than two (2) years from the time of original manufacture shall not be used. No cement stored by the Contractor over the winter shall be used until retested by the Laboratory. Bagged cement shall not be stored at mill or terminal locations for a period longer than six months.

C. Shipment
   1. All shipment of cement shall be made in accordance with procedural directives issued by the Laboratory. Conveyances for bulk cement shipment shall be of a type approved by the Department. The compartments of all such conveyances shall be completely empty and clean before any cement is loaded therein. Cement may be shipped in paper bags which conform to industry standards and which have the brand name, type of cement, and the name of the manufacturer plainly marked thereon.
   2. A bag shall contain ninety-four (94) pounds net. One (1) bag of cement shall be considered as containing one (1) cubic foot.
   3. The temperature of cement at the time of shipment shall not exceed one-hundred-seventy (170) degrees Fahrenheit.

D. Inspection and Testing
   1. All inspection and testing shall be in accordance with procedural directives issued by the Laboratory. When required by the Laboratory, cement shall be sampled by means of an automatic sampling device constructed so as to obtain continuous samples across the full stream of cement and deliver such samples into a sealed container approved by the Laboratory. Tests for chemical and physical properties shall be in accordance with test methods stipulated by ASTM C150.

E. Basis of Acceptance
   1. Portland cement will be considered for acceptance at mill or terminal locations in accordance with procedural directives issued by the Laboratory.

2.02 FINE AGGREGATES

A. General
   1. All samples of fine aggregates will be secured and sent to the Laboratory by a representative of the Department.
   2. All approved operating sources will be sampled when:
      a. The latest test for a source is two (2) years old.
      b. A change in the character of processed fine aggregate occurs.
      c. The location of the source of raw material is shifted or a change in the character of raw material occurs.
      d. Considered necessary by the Department.
   3. Non-approved or rejected operating sources equipped with adequate and proper processing facilities will be sampled and tested upon recommendation by the Engineer and approval by the Commissioner. Approval of such sources will be conditioned on the results obtained by periodic sampling and testing as prescribed by the Department.
   4. Proposed new sources of material will also be sampled upon approval by the Commissioner. The results of tests on such samples shall be for information only and shall be interpreted as indicative of the potential fitness of the sources. Action in regard to acceptance or rejection of a source will be taken only after processing facilities have been established, inspected and approved.
   5. Materials meeting test requirements will be rejected if, in the judgment of the Commissioner, service records indicate that they are unsound or otherwise unsatisfactory.
   6. If undesirable material is furnished from acceptable sources of supply through faulty operation or any other cause whatsoever, the source of supply and any objectionable material therefrom will be rejected by the Engineer.
   7. All sources of fine aggregate shall be stripped of all inferior and objectionable material before operations are started and shall be kept stripped far enough from the working face to insure against undesirable material becoming mixed with output.

8. All natural sand shall be washed before using.

B. Fine Aggregate Details

1. Fine aggregate shall consist of sand, stone screenings except limestone screenings, iron ore tailings, artificial sand that is prepared from an accepted source of dolomite rock and contains not less than thirty (30) percent of magnesium carbonate, or a mixture of these, that shall conform to the gradation requirements shown below. The aggregate shall consist of grains or particles of hard durable rocks, the surfaces of which are not coated with any injurious materials. Any fine aggregate will be rejected if, in the judgement of the Commissioner, it contains sufficient deleterious or unsound material to be harmful.
2. Fine aggregate when dry shall conform to the following gradation requirements:

Fine Aggregate Gradation		
	Passing By	
Sieve Size	Percent Minimum	Weight Maximum
3/8 inch	100	-
No. 4	90	100
No. 8	75	100
No. 16	55	85
No. 30	25	60
No. 50	10	30
No. 100	1	10
No. 200 (Wet)	0	3

3. Fine aggregate shall meet the testing requirements indicated in the table below unless accepted by the Engineer on the basis of service records, petrographic examination, geological studies and/or quarry reports.

Fine Aggregate Testing Requirements	
Test Method	**Portland Cement Concrete**
Magnesium Sulfate Max. percent loss by weight at 5 cycles	30
Organic Impurities AASHTO T-21	-
Organic Plate, Lighter Than	3
Gardner Color, Lighter Than	11

a. If fine aggregate is found unsatisfactory when examined for organic impurities, it will be rejected unless it passes the mortar strength tests for tension and compression prescribed by the Laboratory. Fine aggregates so tested shall achieve a tensile or compressive strength at least one-hundred (100) percent of that developed by the Standard Ottawa Sand Mortar.

C. Test Methods

1. The details of all tests and test methods for fine aggregates may be obtained by the Contractor from the Department by request.

D. Basis of Acceptance

1. Acceptance of the source is determined on the basis of tests performed by the Laboratory on samples representing the sources, review of Geologic Source Reports and Plant Flow Information, petrographic examination and other geologic studies, and performance histories where applicable. The material is incorporated into the work on the basis that it is from an approved source conforming to procedural directives of the Department and the aggregate shall meet the gradation requirement at the point of use.

2.03 COARSE AGGREGATES

A. General

1. All samples of coarse aggregates are to be secured and sent to the Laboratory by a representative of the Department.
2. All approved operating sources will be samples when:
   a. The latest test for a source is two (2) years old.
   b. A change in the character of processed coarse aggregate occurs.
   c. The location of the source of raw material is shifted or a change in the character of raw material occurs.
   d. Considered necessary by the Department.
3. Non-approved or rejected operation sources equipped with adequate and proper processing facilities will be sampled upon approval by the Commissioner. Approval of such sources will be conditioned on the results obtained by periodic sampling and testing as prescribed by the Department.
4. Proposed new sources of material will be sampled upon approval by the Commissioner. The results of tests on such samples shall be for information only and shall be interpreted as indicative of the potential fitness of the sources. Action in regard to acceptance or rejection of a source will be taken only after processing facilities have been established, inspected and approved.
5. Materials meeting test requirements may be rejected if, in the judgment of the Commissioner, service records indicate that they are unsound or otherwise unsatisfactory.
6. If undesirable material is furnished from acceptable sources of supply through faulty operation or any other cause whatsoever, the source of supply and any objectionable material therefrom will be rejected by the Engineer.
7. All sources of coarse aggregates shall be thoroughly stripped of all inferior and objectionable material before operations are started and shall be kept stripped far enough from the working face to insure against undesirable material becoming mixed with the output.
8. Throughout these Specifications where the term "Broken Stone" or "Broken Slag" is used, it is to be interpreted as being synonymous with the term "Crushed Stone" or "Crushed Slag" respectively.

B. Coarse Aggregate Details
1. Coarse aggregates shall consist of well graded, uniformly mixed broken stone, crushed gravel, screened gravel, or broken slag, and shall meet the requirements given for these materials. Run of bank gravel will not be permitted for coarse aggregate.
2. If deliveries of coarse aggregate show segregation of sizes, material shall be mixed to the specified gradation before using.
3. Coarse aggregates shall contain not more than thirty (30) percent of particles that are flat or elongated to the degree of 3:1 and shall contain not more than then ten (10) percent of particles that are flat or elongated to the degree of 5:1. The sizes to be used for this determination shall be as directed by the Laboratory in accordance with the intended usage of the aggregate.
4. The amount of deleterious substances contained in any primary size of crushed stone or crushed coarse aggregates shall not exceed the following:

Material	% By Weight
Material Passing the No. 200 Sieve	0.7
Shale or Other Lightweight Materials	1.0*
Coal or Lignite	1.0
Clay Balls or Lumps	0.2
Other Deleterious Substances	1.0

   a. *This requirement may be waived if service records and/or abrasion and soundness tests indicate to the Department that the aggregate is satisfactory.
5. Coarse aggregates containing more than these specified amounts of deleterious substances shall be washed or otherwise processed until the Specifications are satisfied.

C. Gradation of Coarse Aggregates

1. Coarse aggregates shall conform to the gradation requirements of ASTM C33.
2. All crushing plants installed on the work shall be fitted with tailing chutes so that no stone will reach the bins other than that which passes through the proper screens.
3. All coarse aggregates shall be of the required sizes when placed in the work, breaking up stone, gravel or slag by hammers or otherwise will not be permitted.

D. Crushed Stone
1. Crushed stone shall consist of clean, durable, sharp angled fragments of rock, including iron ore tailings, of uniform quality throughout.
2. Gravel hardheads retained on a four (4) inch scalping screen and then crushed will be acceptable as crushed stone provided such crushed hardheads meet the gradation and the other requirements for the type of stone specified.
3. Crushed stone used as coarse aggregate for Portland cement concrete items shall be obtained from sources conforming to the regulations of the Department as to sampling, testing methods and procedures, and quarry reports.
4. Crushed stone as coarse aggregate shall meet the test requirements specified in the following table unless accepted by the Engineer on the basis of service records, petrographic examination, geological studies and/or quarry reports.
5. Crushed Stone Tests

Los Angeles Abrasion Test, ASTM Designation C131 Percent Loss Max., by Weight	35
Magnesium Sulphate Soundness Test, ASTM Designation C88 Percent Loss at 10 Cycles, Max. by Weight	18
*Freezing and Thawing Test Percent Loss at 25 Cycles Max., by Weight	10

a. *This test required only on aggregate used in Portland cement concrete where surfaces are exposed.

E. Crushed Gravel
1. Crushed gravel shall consist of clean, sound, tough, hard gravel, free from coatings and shall be thoroughly washed. The gravel shall contain at least seventy-five (75) percent of fractured particles in each number size and shall meet the gradation requirements for crushed stone. A satisfactory fractured particle shall have at least one (1) fractured face and the total area of face fracture shall exceed twenty-five (25) percent of the maximum cross sectional area of the particles.
2. Gravel shall meet the test requirements of the following table unless accepted by the Engineer on the basis of service records, petrographic examination, geological studies, and/or quarry reports.
3. Gravel Tests

Los Angeles Abrasion Test, ASTM Designation C131 Percent Loss Max., by Weight	35
Magnesium Sulphate Soundness Test, ASTM Designation C88 Percent Loss at 10 Cycles, Max. by Weight	18
*Freezing and Thawing Test Percent Loss at 25 Cycles Max., by Weight	10

a. *This test required only on aggregate used in Portland cement concrete where surfaces are exposed.

F. Screened Gravel
1. Screened gravel shall consist of clean, sound, tough, hard stone free from coatings and shall be thoroughly washed. Screened gravel may consist of all uncrushed particles or of crushed particles up to seventy-five (75) percent of the total in each size number.
2. Screened gravel shall meet the test requirements specified above under "Crushed Gravel."
3. In making the abrasion test and the soundness test, uncrushed particles shall be used.

G. Crushed Slag
1. Crushed slag shall be air-cooled blast furnace slag, hard and durable, composed of angular fragments uniform in density and quality, free from injurious amounts of sulphur, and free from thin, elongated or glassy pieces, dirt and other objectionable matter. Crushed slag shall contain not more than three (3) percent metallic ore by weight. The dry rodded weight of crushed slag shall weigh not less than seventy (70) pounds per cubic foot.
2. All slag shall be obtained from approved sources.
3. Crushed slag shall meet the requirements of the following tests:
4. Crushed Slag Tests

Los Angeles Abrasion Test, ASTM Designation C131	40% Max. Loss
Magnesium Sulphate Soundness Test, ASTM Designation C88	6% Max. Loss @ 10 Cycles

H. Test Methods
1. The details of all tests and test methods for coarse aggregates may be obtained by the Contractor from the Engineer, by request.

I. Basis of Acceptance
1. Acceptance of the source is determined on the basis of tests performed by the laboratory on samples representing the source, review of Quarry Reports, Geologic Source Reports, and Plant Flow Information, petrographic examination, and other geologic studies, and performance history where applicable. The material is incorporated into the work on the basis that it is from an approved source conforming to procedural requirements of the Department and that the aggregate shall meet gradation at the point of use.

2.04 WATER

A. General
1. Mixing water and water for curing concrete shall be free from oil, acid, alkali vegetable matter, organic matter or other deleterious substances.
2. Tests shall be in accordance with AASHTO Des. T-26.

2.05 CONCRETE ADMIXTURES

A. Air Entrainment
1. When air entraining admixture is required, it shall be added to the mix in sufficient quantity and in such a manner as to produce the desired air content uniformly throughout the concrete. Air entraining admixture shall conform to ASTM C260.
2. The following table shall be used as a guide for concrete air content.
3. Concrete Air Content for Various Sizes of Coarse Aggregate

Nominal Maximum Size of Coarse Aggregate	**Total Air Content (percent by Volume)**		
	Minimum	Suggested	Maximum
3/8"	6	8	10
1/2"	5	7	9
3/4"	4	6	8
1"	3.5	5	6.5
1 1/2"	3	4.5	6
2"	2.5	4.0	5.5
3"	1.5	3.0	4.5

B. Retardation
1. Where a retarding admixture is required, admixture shall be added to the concrete mix at the batching plant or as approved by the Engineer. The quantity to be used shall be in accordance with the manufacturer's recommendations, such that it will produce the desired retardation. When the temperature is below sixty (60) degrees Fahrenheit, the quantity of retarding admixture shall be determined with special care. Consideration shall be given to

all factors affecting the rate of hydration. In determining the quantity of retarding admixture under various conditions, the Contractor shall follow the manufacturer's recommendations.

C. Accelerating Admixture
   1. Where accelerating admixture is required, it shall be added to the concrete mix at the batching plant unless specified otherwise or directed by the Engineer.
   2. The quantity to be used shall be in accordance with the manufacturer's recommendations. All of the approved manufacturer's direction shall be carefully followed. Accelerating admixture shall meet all the requirements of ASTM C494 Type "C". Accelerating admixture should not be used where aluminum items are imbedded in the concrete or where sulfate resistance is needed.

D. Water Reduction
   1. Retarding and water reducing admixtures, when required, shall conform to the requirements of ASTM C494.

2.06 FORM MATERIALS

A. General
   1. Formwork shall conform with the requirements and recommendations of ACI 347. Materials shall be suitable for the use intended and adequate to support loads within tolerances recommended in ACI 347.

B. Wood Forms
   1. Formwork for exposed concrete surfaces shall be made of smooth faced undamaged plywood to provide continuous, straight, smooth as-cast surfaces.
   2. Formwork for concrete concealed from view or covered with cement plaster shall be rough sawn boards of sound grade as approved by the Engineer to provide a mechanical bond for subsequent application of plaster.

C. Metal Forms
   1. The metal used for forms shall be of such thickness that they will remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms that do not present a smooth surface or line up properly, shall not be used. Special care shall be exercised to keep metal forms free from rust, grease, and other foreign matter that would tend to discolor the concrete.

D. Forms Coatings
   1. The form surface in contact with concrete shall be coated with a form coating compound that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
   2. Coating materials shall be approved by the Engineer prior to placing of concrete.

E. Form Ties
   1. Metal form ties shall be factory-fabricated, adjustable-length, removable or snap off type.
   2. Form ties shall be Type 304 Stainless Steel material with plastic cones.
   3. Form ties shall be bars or rods of a design which will leave no metal closer than two (2) inches from the outer concrete surface. Form ties shall not leave a hole larger than one (1) inch diameter in the concrete surface.
   4. All form ties shall be subject to acceptance by the Engineer.

2.07 CURING MATERIALS

A. Quilted Covers
   1. Quilted covers shall consist of a filling material of cotton "bat" or "bats" covered with unsized cloth, and tufted or stitched to maintain the shape and stability of the unit under job conditions of handling.
   2. Cotton cloth covering shall weigh not less than 6.3 ounces per square yard and shall have an average of not less than thirty-two (32) threads in warp and not less than twenty-eight (28) threads in filling, having a minimum average breaking strength (grab method) of sixty

(60) pounds in the warp and of sixty (60) pounds in the filling. The weight of the cotton cloth covering shall not fall below the specified weight by more than five (5) percent. The raw material used in the manufacture of the cotton cloth shall be raw cotton, cotton comber waste, cotton card strip waste, or combination thereof. The other physical characteristics of the cloth shall be equal to those in such material for industrial purposes.

3. Burlap or jute covering for cotton mats shall weigh not less than 6.7 ounces per square yard and shall have not less than eight (8) threads per inch of warp and not less than eight (8) threads per inch of filling. It shall be the grade known commercially as "firsts" and shall be free from avoidable imperfections in manufacture and from defects or blemishes affecting the serviceability. A tolerance in weight of minimum five (5) percent will be permitted.
4. The filling material for the mats shall be a cotton bat or bats, made of raw cotton, cotton waste, cotton linters, or combinations thereof, and shall weigh not less than twelve (12) ounces per square yard. The batting used shall not be lower in quality than a batting made of U.S. Standard Grade No. 3 Linters.
5. The cotton thread for tufting shall be not less than 4-cord number 12's and at least equivalent in size and strength to standard 3-cord number 30 cotton thread.
6. Mats shall have a filler five (5) feet nine (9) inches in width and shall have a flap six (6) inches or more in width, consisting of an extension of two (2) thicknesses of the covering material, extending along one longitudinal edge of the mat. The length of the mats shall be two (2) feet six (6) inches greater than the width of pavement slab to be cured.
7. The length or width of the mats shall not be less than that specified by more than two (2) percent.
8. The cotton filling material in the form of a bat or bats shall be held in place between the coverings by sewing or tufting all around the periphery of the mat within one (1) inch of each of the four edges of the filler, and by sewing or quilting longitudinally at intervals not greater than four (4) inches, or by tufting at intervals both longitudinally and transversely not greater than three (3) inches. The sewing or tufting shall be sufficiently loose to permit substantially all of the surface of the mat to come in contact with a flat surface when in use, but not so loose as to permit the filling material to shift. The flap shall be constructed by sewing the upper and lower covering together longitudinally within one (1) inch of the outer edge of the flap. Along the edge of the mat opposite the flap, the filling material shall be within one (1) inch of the edges of the covering material, and the covering material shall be sewn together so as to enclose the filling material. The ends of the mats shall be finished by running an additional seam (i.e., a seam in addition to the seam holding the filling material in place) across the mats. This seam shall not be closer to the seam holding the filling material in place than one-fourth (1/4) inch and not closer to the end of /either covering than one-half (1/2) inch unless the ends of the mat are finished with an overlying or whip stitch, or in a manner which will not leave a raw edge. All longitudinal sewing or quilting shall average at least three (3) stitches per inch and shall have not less than five (5) stitches in any two (2) inches. All other sewing shall average six (6) stitches per inch and shall have not less than nine (9) stitches in any two (2) inches.
9. This material will be accepted on the basis of certification by the manufacturer. Each shipment shall be accompanied by the manufacturer's certificate attesting to the fact that the shipment meets the Specifications.

B. Polyethylene Coated Burlap Blankets
   1. The blankets shall conform to the material requirements of AASHTO M171 (ASTM C171) for White Burlap-Polyethylene Sheet.
   2. Polyethylene coated burlap blankets shall be manufactured of new burlap, AB mill quality, weighing not less than nine (9) ounces per square yard and with a white, opaque, polyethylene film four (4) mils thick impregnated or extruded into one side.
   3. Each shipment shall be accompanied by the Manufacturer's Certificate attesting to the fact that the shipment meets the specified standards. Upon request, the manufacturer of the covers shall supply a record of the results of the prescribed tests as made on the samples.

C. Polyethylene Curing Covers (White Opaque)

1. Polyethylene curing covers shall consist of single sheets manufactured from virgin resin, containing no scrap or additives, with a thickness of not less than four (4) mils 0.004 inches (0.1 mm). The covers shall conform to the material requirements of AASHTO M171 (ASTM C171) for Polyethylene Film: White Opaque.
2. Polyethylene curing covers shall be sufficiently tough and durable to permit their use under the conditions encountered in the course of highway work, without tearing or otherwise becoming unfit. They shall be free of visible defects and shall have a uniform appearance. Rolls shall be wound on serviceable handling members extending beyond the edges of the roll, forming handles to facilitate applying the covers over the concrete.
3. Each shipment shall be accompanied by the manufacturer's certificate attesting to the fact that the shipment meets the specified standards. Upon request, the manufacturer of the covers shall supply a record of the results of the prescribed tests made on the samples.

D. Insulated Concrete Curing Blankets
1. Insulated concrete blankets for curing shall conform to the requirements of ASTM C518-21.
2. The words "KEEP OUT" and the name of the manufacturer shall be stenciled on each blanket at the time of fabrication.
3. Insulated concrete curing blankets shall have a sufficient R value for the surrounding weather and temperature conditions.
4. Insulated concrete curing blankets shall be made of polyethelyne or abraision-resistant vinyl and shall be sufficently tough and durable to permit their use under the conditions encountered in the course of highway work, without tearing or otherwise becoming unfit. The blanket shall have a moisture barrier and shall have a closed-cell foam core. The blankets shall have heavy-duty, double-stitch hems, grommets for tying down, and overlap flaps with Velcro.
5. Each shipment of blankets shall be accompanied by the manufacturer's certificate attesting to the fact that the shipment meets the specified standards. Upon request, the manufacturer of the blankets shall supply a record of the results of the prescribed tests as made on a sample.

E. Waterproof Paper Blankets
1. Waterproof Paper blankets for curing shall conform to the material requirements of AASHTO M171 (ASTM C171).
2. The words "KEEP OUT" and the name of the manufacturer shall be stenciled on each blanket at the time of fabrication.
3. Each shipment of blankets shall be accompanied by the manufacturer's certificate attesting to the fact that the shipment meets the specified standards. Upon request, the manufacturer of the blankets shall supply a record of the results of the prescribed tests as made on a sample.

2.08 JOINT SEALING MATERIALS

A. Joint Sealer
1. The sealing compound shall be furnished in two (2) components, a base compound and a curing agent. The base compound shall consist of an elastomeric polymer modifier with plasticizers, activators, and inert fillers. The curing agent shall consists of a blend of accelerators and extenders. The sealing compound shall be capable of being homogeneously mixed on the job to a consistency appropriate for pressure extrusion. When mixed and applied in the field in accordance with the manufacturer's instructions, the mixture shall completely fill the joints without the formation of air holes (entrapped air) and discontinuity. Within twenty-four (24) hours of application, the material shall form a tackfree, rubber-like compound which shall seal the pavement joints against infiltration of water, motor fuels, and other foreign matter throughout repeated cycles of pavement expansion and contraction. The rate of curing shall permit traffic on the pavement within one (1) hour of application without wheel pickup.
2. Before the material is used, submit manufacturer that the material has been tested in accordance with Interim Federal Specifications SS-S-00200 (Army-C.E.) and meets the following requirements:

a. Penetration: 0.3 to 1.5 centimeters after being conditioned at laboratory atmospheric conditions for twenty four (24) hours.
b. Flow: None at two-hundred (200) degrees Fahrenheit (+/-2 degrees Fahrenheit (-16.67 degrees Celsius).)
c. Bond: None of the specimens shall develop a crack, separation, or other opening in the sealing compound or between the sealing compound and the concrete block after three (3) cycles of extension and compression both non-immersed and water immersed. There shall be no surface hardening or loss of rubber-like characteristics when subjected to the water immersed bond test.
d. Resilience: The recovery shall be more than seventy (70) percent.

3. Samples shall be furnished if requested by the Engineer.

B. Preformed Elastic Joint Sealer
   1. The preformed elastic joint sealer shall be of polychloroprene which shall bond to concrete with a lubricant-adhesive in conformance with these Specifications.
   2. The joint filler shall conform to the following ASTM requirements:

	Test Procedure ASTM Designation	**Transverse or Longitudinal Requirement**	**Alternate for Longitudinal**
Tensile Strength, PSI, Min.	D412	2000	2000
Elongation at Break, % Min	D412	250	250
Hardness, Type A Durometer - Recovery under 50% Deflection	D2240	50	60
After 70 hours at .	-	75% min.	85% min.
After 22 hours at - 20 degrees Fahrenheit (-6.67 degrees Celsius).	-	75% min.	83% min.
Oven Aging 70 Hours, @ 212 degrees Fahrenheit (100 degrees Celsius).	D573	-	-
Tensile Strength % Change, Max	-	-20	-20
Elongation, % Change, Max.	-	-20	-20
Hardness, Points Change, Max.	-	+10	+10
Oil-Swell, ASTM Oil No. 3, 70 Hours, @ 212 degrees F.	D471	45%	45%

   3. All test sections used in the above procedures shall be cut or buffed from elastic joint seal specimens. Each lot of the joint filler shall be identified with the manufacturer's name or trade mark and shall be accompanied by the manufacturer's affidavit attesting conformance with this specification.
   4. Samples shall be furnished if requested by the Engineer.

C. Lubricant-Adhesive
   1. The lubricant-adhesive shall be a one (1) component polychloroprene compound containing only soluble phenolic resins blended together with anti-oxidants and acid acceptors in an aromatic hydrocarbon solvent mixture and shall have the following properties:

Average Net Weight per Gallon:	7.84 lbs plus or minus 5%
Solids Content:	22-26% by Weight.
Brookfield Viscosity at 77 degrees Fahrenheit (25 degrees Celsius)., No. 2 Spindle @ 10 RPM.	7,000-7,500 CPS
Film Strength, ASTM D412:	2,300 Minimum Tensile Strength; 750% Minimum Elongation before Breaking

2. Test specimens composed of two (2) pieces of 0.064 gauge 6061 Aluminum alloy bonded together with the adhesive on a joint one (1) inch wide with one-half (1/2) inch lap and aged fourteen (14) days shall show the following minimum strengths when tested by the laboratory:

Dynamic Strength	1,300 psi (8963.19 kPa)
Static Strength, 1 Minute	700 psi (4826.33 kPa)

3. The adhesive shall be stored at a temperature of fifty (50) degrees Fahrenheit to eighty (80) degrees F. Any adhesive not used within two-hundred-seventy (270) days of its manufacture will be unacceptable.
4. Each lot of the adhesive shall be delivered in containers plainly marked with the manufacturer's name or trade mark and date of manufacture, and shall be accompanied by the manufacturer's affidavit attesting conformance with this specification.
5. Samples shall be furnished if requested by the Engineer.

2.09 EXPANSION JOINT FILLER

A. Filler not exposed to traffic or weather shall conform to requirements of ASTM D994.

B. Filler exposed to traffic and/or weather shall conform to requirements of ASTM D1751 or ASTM D1752.

C. Each piece shall be plainly marked with the manufacturer's name, and each lot delivered shall be accompanied by the manufacturer's affidavit attesting to the conformance with ASTM D994, ASTM D1751, or ASTM D1752.

D. Samples of any or all materials used in the manufacture of the joint filler shall be furnished if requested by the Engineer.

2.10 WATERSTOPS

A. Waterstops of approved polyvinyl chloride (PVC) or hydrophilic strips shall be provided as called for in the Project Specifications and Plans.

B. Waterstops shall be manufactured, formed and installed so as to provide for expansion and contraction movements at the joints and to prevent seepage of water.

C. Samples shall be furnished if requested by the Engineer.

2.11 CONCRETE MATERIALS FOR REPAIRS

A. Precast concrete units shall be repaired by a Portland cement based concrete mix of high strength and have fast setting characteristics. Compressive strength shall be a minimum of 2000 psi (13789.52 kPa) after one (1) day and 5000 psi (34473.80 kPa) after twenty-eight (28) days. The material shall be able to withstand twenty-five (25) cycles of freeze-thaw (10% NaCl) with a maximum loss of four (4) percent. There shall be a minimal amount of expansion or shrinkage such that no cracks are produced. The bonding shall be such that a special bonding agent is not necessary. The material shall exhibit no appreciable heat of hydration. The color of the repair after it cures shall be of substantially the same color as the item being repaired.

2.12 LIFTING DEVICES

A. All lifting devices shall have a capacity sufficient to support four (4) times the lifted load.

PART 3 - EXECUTION

3.01 PROPORTIONING

A. General
1. Proportions of ingredients except admixtures for all cast-in-place Portland cement mixtures shall be determined by the Contractor according to these Specifications unless otherwise indicated in the Contract Documents.
2. Aggregate and cement shall be proportioned by weight except when the amount of concrete required for any one contract is ten (10) cubic yards or less. Approximate proportions shall be as indicated in the following table:
   a. Proportions by

Minimum Strength @ 28 days	Approximate Volumetric Mix	Lbs. of Cement per Cu Yd. of Concrete
4000 psi (27579.04 kPa)	1 : 1-1/2 : 3	700
3300 psi (22752.71 kPa)	1 : 2 : 4	565
2000 psi (13789.52 kPa)	1 : 2-1/2 : 5	310

b. Proportions by Weight

Minimum Strength @ 28 days	Minimum Strength @ 7 days	Min. Lbs. of Cement per Cu. yd. of Concrete	Fine Aggr. percent by wt. of total Aggregate
4000 psi (27579.04 kPa)	2600 psi (17926.38 kPa)	700	31 to 39
3300 psi (22752.71 kPa)	2150 psi (14823.73 kPa)	565	31 to 39
2000 psi (13789.52 kPa)	1300 psi (8963.19 kPa)	310	31 to 39

3. The volumetric mixes and weight mixes shown on the above tables are for guidance only. The exact proportions shall be determined by the Contractor by means of laboratory tests before the work is started.
4. Portland cement shall be Type II unless otherwise specified and shall conform to the requirements of Portland cement in this Section.
5. Coarse aggregate shall be sieve size No. 57 for all thin closely reinforced concrete work such as floors and roofs less than seven (7) inches thick, walls less than nine (9) inches thick, all beams, girders, struts and columns. For all concrete work aggregate size No. 467 shall be used unless otherwise specified. Coarse aggregate shall conform to the requirements of coarse aggregate in this Section.
6. The same source of aggregates shall be used for all faces of concrete structure exposed to view.
7. Admixture shall be added to the concrete mix if required by the Engineer and shall be considered as part of the solid volume of concrete. Air Entrainment admixtures shall be added within the limits specified in this Section. The air content shall be determined by means of a test performed in accordance with the Department's written instructions.

B. Slump
1. Water shall be added in amounts that are required to obtain the slump specified. Slump shall be determined in accordance with the Standard Method of Slump Test for Consistency of Portland Cement ASTM C143.

2. Concrete shall be placed at a slump as shown in the following table:
   a. SLUMP TABLE

Type of Placement	Maximum Slump (inches)
Concrete Pavement	2-1/2
Culvert Headwalls	3
Sidewalk	4
High Early Strength Pavement Slabs or Structural Sections	3
Tremie Concrete	4
Cradle and Pipe Encasement	6*
Manholes	4

   1) *6" slump requires one additional bag of cement per cubic yard of concrete.
3. The specified slump shall be uniformly maintained throughout the placement.
4. Concrete that exceeds the Maximum Slump shown in the above table shall be rejected for use in the work.
5. The Contractor shall be responsible for the production of concrete having the slump specified.

C. Tests
1. The Engineer will make test specimens of all concrete at intervals during the progress of the work in accordance with the "Standard Method of Making and Storing Specimens of Concrete in the Field" of the ASTM C31.
2. Concrete strength will be considered satisfactory if each set of cylinders tested meets the following requirements for the twenty-eight (28) days specified strength:
   a. The average strength of the concrete cylinders from the same set equals or exceeds the specified strength.
   b. No individual concrete cylinder tested falls below the specified strength by more than 10% or by five-hundred (500) psi, whichever is higher.
   c. Should the requirements as stated above not be met, it shall be sufficient reason to order the removal of the work which it represents and its replacement with satisfactory concrete, at no cost to the Owner.
3. Provide the Inspector with the necessary labor and facilities (laborer, wheel barrow, shovel, wash water, etc.) that the Owner's Inspector requires to make the cylinders for testing in the Laboratory.
4. Protect cylinders under the following curing conditions while in the field. Molds shall be placed on a rigid horizontal surface free from vibration and other disturbances. Cylinders shall be stored under conditions that maintain the temperature immediately adjacent to the specimens in the range of sixty (60) degrees Fahrenheit to eighty (80) degrees F. and prevent loss of moisture from the specimens. Specimens shall not be stored for the first twenty-four (24) hours in contact with wet sand or wet burlap or under any conditions that will allow the mold to absorb water. Molds can be covered with a layer of polyethylene sheeting and then wet burlap placed over them.
5. The number of cylinders to be made shall be in accordance with the following table:

Total Cubic Yards of Concrete (each class) Placed During One Day	Minimum No. of Cylinders
Up to 100	3 for each 50 yds. or fractional part
100 – 500	3 for each additional 100 yds or fractional part *
Over 500	3 for each additional 200 yds or fractional part *

*These are accumulative cylinders

6. Cylinders shall be picked up by the Laboratory twenty-four (24) hours after being made and transported to the Laboratory for compressive tests. If the cylinders are not picked up within twenty-four (24) hours (except Holidays and Weekends) notify the Engineer.
7. Except as otherwise specified, methods of test shall be as prescribed in the following requirements of the American Society for Testing Materials.

	ASTM
Making and Curing Concrete Compression Test Specimens in the Field	C31
Sampling Fresh Concrete	C172
Compressive Strength of Molded Concrete Cylinders	C39

8. A daily record will be made by the Owner's Inspector making the cylinders giving the following information:
   a. Number of yards of concrete placed
   b. Location of concrete placed
   c. Number of cylinders made
   d. Concrete plant inspection slips shall be delivered to the Owner's Inspector at the job site with each delivery. A duplicate copy of these records shall be submitted to the Laboratory once a month.
   e. All cylinders shall be properly identified with numbered tags. These numbers are to be placed on the cylinder sheets (or cards). Where cylinders are made by job inspectors, cylinders and sample cards (sheets) shall be made available to the Laboratory.
9. One cylinder of each set of three cylinders will be tested after seven (7) days and the remainder after twenty-eight (28) days. The strength requirements for the seven (7) and twenty-eight (28) day tests are listed in the following table:
10. Strength of Concrete *

**7 Day Test ** **	**28 Day test**
2600 psi (17926.38 kPa)	4000 psi (27579.04 kPa)
2150 psi (14823.73 kPa)	3300 psi (22752.71 kPa)
1300 psi (8963.19 kPa)	2000 psi (13789.52 kPa)

   a. *Based on tests of cylinders that have been moist cured in the laboratory.
   b. **The 7 day tests are only made as an indication of the 28 day strength

D. Proportioning Equipment
1. Provide or have available a modern and dependable batch plant within a reasonable distance from the work, as approved by the Engineer.
2. The weighing equipment shall be so arranged that the batch plant operator can conveniently observe all scales from the operating station.
3. The accuracy of the weighing equipment on all proportioning plants shall conform to the requirements of the National Bureau of Standards Handbook 44 for such equipment, subject to the provisions of the following paragraph:
   a. All plant scales shall be tested at the expense of the Contractor by competent scales technician as follows:
      1) Prior to use in work.
      2) At intervals of not more than thirty (30) calendar days thereafter.
      3) At any time ordered by the Engineer.
4. Subsequent to each adjustment by a scales technician, the scales shall be sealed by the Nassau County Department Sealer of Weights and Measures. Furnish for use in testing scales, one (1) standard fifty (50) pound weight for each five-hundred (500) pounds of major batch scale capacity. A cradle or platform, approved by the Engineer, shall be provided on

each scale for applying the test weights. If directed by the Engineer, provision shall be made for locking all scales against tampering.

5. The batching equipment for each constituent shall be capable of controlling the delivery of material so that the combined inaccuracies in feeding and measuring during full production operation of the plant will not exceed:

Material	Percent
Cement	1 (By weight)
Water	1 (By weight or volume)
Aggregate	2 (By weight)
Admixtures	3 (By weight or volume)

6. When bulk cement is used in proportioning concrete, the batching controls shall be so interlocked that:
   a. The batcher inlet gates cannot be opened while the discharge gates are open.
   b. The batcher discharge gates cannot be opened until the full batch weights are registered on the scales, while the weighing hopper is being filled, if batcweights are over or under the above specified delivery tolerances.
   c. A new batch cannot be weighed until the hopper is entirely empty of the previous batch and all scales have returned to zero ().
7. Batching and storage facilities for cement shall be reserved exclusively for cement that is being used on County work. Provisions shall be made for maintaining such batching and storage facilities under the County's seal control as directed by the Engineer.
8. Discharge chutes shall be so arranged that materials will not lodge therein, there will be no losses on discharge, and so that they are not suspended from any part of the weighing system.
9. If the Contractor elects a cumulative weighing system for aggregates rather that individual component weighing, it shall still be required that bulk cement be weighed in a separate hopper and be kept separate from the aggregates until the batch ingredients are released for discharge.
10. Cement weight hoppers and appurtenances shall be completely shielded against the escape of dust arising from the weighing operation. Cement storage bins or silos shall be sealed against the elements and this equipment shall be such as to exclude moisture from stored cement whether in bulk or in bags.
11. The batch plant shall install and maintain in operating condition an approved electrically actuated moisture meter that will indicate on a readily visible scale or chart the percentage of moisture in the fine aggregate as it is batched.
12. At the time of batching, all aggregates shall have been dried or drained sufficiently to result in a stable moisture content such that no visible separation of water from the aggregate will take place during transportation from the proportioning plant to the point of mixing. In no event shall the free moisture content of the fine aggregate at the time of batching exceed eight (8) percent of its saturated, surface-dry weight.
13. All scales and other plant control equipment shall be installed so as to insure protection against exposure to dust and the elements. If vibrators are installed on bins or batches, they shall be so arranged that no significant vibrations are transmitted to the scales or other plant control equipment during the time materials are being weighed.
14. All batching plants shall include mechanical dispensers approved by the Engineer for proportioning admixtures, if admixtures are required. All such dispensers and devices shall be capable of ready adjustment to permit varying the quantity of admixture to be batched.
15. The batch plant shall furnish and install satisfactory facilities for procuring representative samples of aggregates in each batching plant. Where a cumulative weighing system is employed, the samples shall be taken from the discharge gates of the bins feeding the weighing hopper. In individual component weighing systems, the samples shall be taken from the discharge gates of the individual batches.

3.02 BATCHING AND MIXING

A. General
   1. The types of mixers noted in the following three references are Department approved:
      a. "Concrete Plant Mixer Standards", Plant Mixer Manufacturers Division, Concrete Plant Manufacturers Bureau (Central mix plants).
      b. "Truck Mixer and Agitator Standards", Truck Mixer Manufacturers Bureau (Truck Mixers).
      c. "Concrete Mixer Standards", Associated General Contractors of America, Incorporated (Paver Mixers and Small Construction Mixers).
   2. If a mixer type or size is not included in the above references, the Contractor may request, upon recommendation by the Engineer and the approval by the Commissioner, a specific mixer type for use in the Contract.
   3. All batches of mortar or concrete shall be adjusted so as to come within the capacity of the mixer as hereinafter specified. When cement is delivered in bags for use in any item, the batch shall be so proportioned as to use only full bag batches, i.e., the use of a fraction of a bag of cement will not permitted.

B. Hand Mixing
   1. All concrete shall be used while fresh and before there is any evidence of initial set. Any concrete which has achieved its initial set will be rejected and not permitted to be used in the work.

C. Paving Mixers
   1. Concrete material shall be delivered to the mixer in batch boxes or trucks with compartments of sufficient tightness and capacity to carry individual batches so there will be no loss or overrun of concrete into the mixer. Truck bodies or batch boxes used to transport cement and concrete batches will be equipped with waterproof tarpaulins for protection against rain or wind.
   2. Batch trucks may be charged with a complete dry batch at a central plant provided the time interval between charging and actual mixing does not exceed ninety (90) minutes. However, without exception, when the cement has been in contact with the aggregate for more than ninety (90) minutes before being mixed the entire batch shall be rejected and not used in the work.
   3. Paving mixers shall be not smaller than the 27E and shall not be larger than the 34E single or dual compartment machines, unless otherwise approved by the Engineer.
   4. Batch sizes for paving mixers shall be as follows:
      a. For paving mixers operating on a maximum grade of six (6) percent maximum size of batch shall be the nominal capacity of the mixer plus ten (10) percent.
      b. For paving mixers operating on grades greater than six (6) percent maximum size batch shall be the nominal capacity of the mixer.
   5. For dual compartment paving mixers, the interval of mixing time (including transfer time) for each batch shall be not less than seventy-five (75) seconds after all materials are in the mixer drum. The drum shall revolve at the rate of not less than fourteen (14) nor more than twenty (20) revolutions per minute. The compartments shall be so interlocked that no charging of a compartment can occur until it has fully discharged the previous batch.
   6. For single compartment mixers, the interval of mixing time shall be not less than ninety (90) seconds after all the materials are in the mixer drum. The drum shall revolve at arate of not less than fourteen (14) nor more than twenty (20) revolutions per minute. No charging of the drum will be permitted until it has fully discharged the previous batch.
   7. Each paving mixer shall be equipped with timing devices that will automatically lock the discharge lever of each compartment during the full time of mixing and release it at the end of the mixing period for its compartment. During the progress of the work, should the timing devices become broken or otherwise out of order, the Contractor will be permitted to operate while they are being repaired provided each batch is mixed thirty (30) seconds longer and provided repairs are made promptly.

8. Each paving mixer shall also be equipped with an accurate, automatic water measuring device capable of introducing mixing water to the drum within an accuracy of one (1) percent and with an approved auxiliary water tank from which the measuring tank or tanks shall be filled. A bypass valve shall be installed on each outlet from the measuring tanks so that the quantity of water measured for each may be checked at any time. No mixing will be permitted when valves are leaking or are otherwise out of order.

D. Small Construction Mixers
1. In miscellaneous work involving less than one-half (1/2) cubic yard of concrete and where a small mixer is adaptable to the work, the Engineer may waive any or all the requirements for automatic timing, locking and water measuring devices. The mixing time for such mixes shall be not less than ninety (90) seconds after all the materials are in the mixer drum.

E. Truck Mixed Concrete
1. Truck Mixed Concrete is defined as concrete mixed completely in a truck mixer at the point of deposition following the addition of mixing water also at the point of deposition.
2. Approved spreader and/or placement devices will be required. Maintain a continuity of supply of concrete consistent with the operation and satisfactory to the Engineer. A detailed placement schedule shall be submitted to the Engineer and approval in writing obtained before concreting is begun.
3. During the use of Truck Mixed Concrete, make whatever changes in procedures or equipment that are ordered by the Engineer.
4. Each Truck Mixer shall be of the rotating drum type, shall conform to the requirements of the Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau, and shall be approved by the Engineer. Each unit will be subject to inspections during its use and if found unfit to function properly, it will be disapproved for further use until its proper operating conditions have been restored. When the blades inside the drum become loose, broken, bend, scalloped, worn down twenty (20) percent in any dimension or otherwise damaged, they shall be repaired or replaced.
5. A manufacturer's plate indicating the capacity of the unit for both mixing and agitating as well as the manufacturer's recommended drum speeds for each operation shall be permanently affixed to the unit and kept in readable condition.
6. Truck mixers shall neither mix nor agitate concrete batches of greater volume than the maximum capacities indicated on the manufacturer's rating plate.
7. Each unit shall mix or agitate at drum speeds within the tolerances indicated on the rating plate. These tolerances shall, however, not exceed the following limits:
   a. Mixing: four (4) rpm minimum to a maximum drum speed which will result in a peripheral velocity of the drum of 225 feet (6858 cm) per minute at its largest diameter.
   b. Agitating: two (2) rpm minimum to six (6) rpm maximum.
8. Each mixer shall be equipped with an approved drum revolution counter mounted so as to be readily visible by the Engineer.
9. Mixing shall be continued for a minimum of one-hundred (100) revolutions after all materials are in the drum or until uniform, well-mixed concrete is produced, whichever is longer.
10. If uniform, well-mixed concrete cannot be produced by mixing at the specified speed for fifteen (15) minutes maximum, the concrete will be rejected and shall not be used in the work.
11. Truck mixers shall be equipped with in line water flow meters capable of being reset to zero (0), of withstanding water temperatures up to two-hundred (200) degrees Fahrenheit, and having a manufacturer's certified flow rate capacity of seventy (70) gallons per minute. The batching delivery tolerance for the water flow meter shall be one (1) percent by weight or volume. The flow meters shall be equipped with air strainers capable of removing any trapped air in the system.
12. Truck mixers shall be equipped with air pressurized tanks having a capacity sufficient to meet the accelerator solution design needs of the mix. The air pressurized tank shall be capable of discharging the design quantity of accelerator solution into the truck mixer drum in less than one (1) minute. The tanks output hose leading into the truck mixer shall be

made of clear plastic. The air pressurized tank shall be equipped with properly working relief valves.

13. Suitable devices to insure against the introduction of water into the drum from the washing supply during the mixing and discharge period shall also be provided.
14. The sizes of batches for a mixer shall be such that complete discharge can be accomplished in twenty (20) minutes and therefore will depend upon the nature of pour to be made. Where placement of concrete is unusually difficult, slow, or in highly-reinforced, thin sections, reduce size of batch to insure proper placement within the permissible discharge period.
15. cannot be complied with, the cement must be charged into the drum at a location and in such manner as will insure conformance.
16. Approved Truck Mixers may be charged with a completely dry batch at the batching plant provided the period of time from batching to the addition of water at the site of pour does not exceed thirty (30) minutes. If the permissible maximum limit of a thirty (30) minute interval between adding cement and the introduction of water at the site of pour cannot be complied with, the cement must be charged into the drum at a location and in such a manner as to insure conformance.
17. During the charging with coarse or fine aggregates, the drum may be rocked or revolved to permit entry of the material.
18. During the charging with cement, the drum shall not be rocked or revolved but shall remain stationary.
19. Before charging the drum with aggregate for each batch, the wash water shall be discharged until less than two (2) gallons remain.
20. Mixing by Truck Mixers shall be done only at the site of pour where the mixing water shall be added. The mixer drum shall not be revolved between the time that the material is batched and mixing begins at the site of pour.
21. Discharging shall be through a completely open discharge gate providing unrestricted flow. The discharge area or gate shall remain fully open throughout the discharge period and the rate of discharge shall be controlled by speed of the drum. The concrete shall be discharged directly from the discharge opening into approved bottom-dump buckets, buggies, spreaders or hoppers, or into chutes attached to the mixer. The entire batch from a truck mixer shall be completely discharged within a maximum period of twenty (20) minutes immediately following completion of mixing and not more than ten (10) minutes shall elapse between placing of consecutive batches. The concrete will be rejected if there is any evidence of setting-up in the mixing or rotating container.
22. The rotating container or truck mixer shall be thoroughly cleaned after each batch.

F. Transit Mixed Concrete
   1. Transit Mixed Concrete is defined as concrete mixed completely in a truck mixer while in transit to the point of deposition. All other requirements specified for Truck Mixed Concrete that are applicable shall apply to Transit Mixed Concrete.

G. Shrink Mixed Concrete
   1. Shrink Mixed Concrete is defined as concrete mixed partially in a stationary mixer and then transferred into a truck mixer where the mixing is completed. The use of shrink mixed concrete will not be permitted.

H. Central Mixers
   1. Central Mixed Concrete is defined as concrete mixed completely in a stationary mixer and the mixed concrete transported to the point of deposition in approved agitating or non-agitating units.
   2. Central Mixed Concrete will not be permitted unless approved by the Commissioner. Approved spreader and/or placement devices will be required.
   3. Approval of any method of transportation will be based upon the ability of the Contractor to deliver a satisfactory uniform, non- segregated mix to the point of deposition and to place the concrete properly in the forms or pavement as required by the Specifications.
   4. Concrete for structural concrete items shall be transported in agitating units only unless the Engineer authorizes in writing the use of non-agitating units.

5. A detailed placement schedule shall be submitted to the Engineer and approval in writing obtained before concreting is begun.
6. Mixing units shall be of an approved type equipped with an acceptable timing device that will not permit a batch of concrete to be discharged until the specified mixing time has elapsed. Mixing units and control devices shall be maintained in good operating condition and will be disapproved if at any time they are found unfit to function properly. When the blades inside the drum have become loose, broken, bent, scalloped, worn down twenty (20) percent in any dimension or otherwise damaged, they shall be properly repaired or replaced.
7. Batch sizes for any given mixer shall be no larger than the "guaranteed capacity" for said mixer as defined in the aforementioned pamphlet "Concrete Mixer Standards."
8. The speed of drum and length of mixing time for Central Mixers shall be as directed by the Engineer. In no case, however, shall the mixing time after all materials are in the drum be less than ninety (90) seconds.
9. The charging of Central-Mixers shall be in an approved manner and consistent with the requirements of the Specifications.
10. The plant mixer shall discharge the entire batch in an unrestricted manner into a hopper or directly into a delivery unit. If discharge is into a hopper, the entire batch of concrete shall be immediately transferred into a delivery unit.
11. Agitating units shall rotate at a drum speed of two (2) to three (3) rpm unless otherwise approved by the Engineer.
12. Agitating units shall also conform to the requirements for Truck Mixers as they pertain to operating conditions and the condition of the drum.
13. Non-agitating units shall have bodies that consist of smooth, round cornered, watertight metal containers equipped with gates that will permit control of the discharge of the concrete.
14. Covers meeting the approval of the Engineer shall be provided for protection against the elements. Delivery by non-agitating units shall be over smooth haul roads free from holes, washboarding, or any other features that would result in the segregation of the mix.
15. A manufacturer's plate indicating the capacity of the delivery unit shall be permanently affixed to the unit and kept in readable condition.
16. Central Mixed Concrete shall be delivered to the site of the work in a thoroughly mixed and uniform mass and discharged with a satisfactory degree of uniformity.
17. Discharge shall be completed within a maximum period of thirty (30) minutes from the combining of cement and water in the mixer drum.
18. The concrete shall be discharged directly into approved bottomdump buckets, buggies, chutes, spreaders, or hoppers from the discharge opening.
19. Not more than ten (10) minutes shall elapse between placing of consecutive batches.
20. Each delivery unit shall be approved by the Engineer. Each unit will be subject to inspections during its use on the work and if found unfit to function properly, it will be disapproved for further use until its proper operating condition has been restored.
21. Both the agitating and nonagitating delivery units shall be completely emptied, and shall be clean and free from all concrete and/or wash water before receiving the next load of Central Mixed Concrete.
22. The concrete will be rejected if there is any evidence of setting-up in either type of unit.

3.03 STRUCTURAL CAST IN PLACE CONCRETE

A. General
   1. All the requirements under "Proportioning" paragraph 3.01 and "Batching and Mixing", paragraph 3.02 shall apply to all cast-in-place structural concrete with the additional requirements detailed within this article.

B. Handling and Placing Concrete
   1. The type and capacity of all equipment used for mixing, transporting, placing and finishing concrete will be subject to the approval of the Engineer.

2. All foreign matter of every kind shall be removed from the interior of forms before placing concrete. Temporary struts or braces within the forms shall be removed when concrete has reached an elevation rendering their further use unnecessary.
3. Concrete will be rejected which does not reach its final position in the forms within sixty (60) minutes after water is first added to the mix.
4. The method and manner of placing concrete shall be such as to avoid the possibility of segregation of the concrete materials or the displacement of the reinforcement. When troughs or chutes are used in placing concrete, their angle of inclination shall not exceed one (1) vertical to two (2) horizontal with respect to the horizontal. When pipes are used, they shall be kept full of concrete and have their lower ends buried in fresh concrete; such pipes shall be used in the same manner as a tremie. All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete. Open troughs or chutes shall be metal or metal-lined, and shall extend as nearly as possible to the point of deposit. When the discharge must be intermittent, a hopper or other device for regulating the discharge shall be provided.
5. Dropping the concrete a distance of more than five (5) feet or depositing a large quantity at any point and running or working it along the forms will not be permitted.
6. Special care shall be taken to fill each part of the forms by depositing concrete directly in or as near its final position as possible, to work the coarser aggregates back from the face and to force the concrete under and around the reinforcement without displacing it. After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing any strain on the ends of projecting reinforcement.
7. Concrete shall be compacted as specified in paragraph "3.03.C." below or by continuous working with a suitable tool in a manner acceptable to the Engineer. Slabs, girders, arch ribs and all thin section work shall be thoroughly worked with a steel splicing rod.
8. In order to secure a smooth, even surface on the exposed surfaces of concrete structures, fine stone forks or spades shall be used to work the coarser aggregate back into the mass and allow the mortar and fine particles to occupy the space adjacent to the forms. In addition, the concrete shall be thoroughly vibrated while it is being placed.
9. Concrete shall be placed in horizontal layers not more than twelve (12) inches thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has taken its initial set to prevent injury to the green concrete and to avoid cold joints between the batches. Each layer shall be compacted so as to avoid the formation of a joint with a preceding layer which has not taken initial set.
10. Work shall be continuous from the bottom to the top of any face except in a emergency and then only with the permission of the Engineer. If placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid visible joints, as far as possible, upon exposed faces, the top surface of the concrete adjacent to the forms shall be smooth and level whenever concreting is discontinued. Where a "feather edge" would be produced at a construction joint, an inset form shall be used to produce a blocked out portion in the preceding layer which will produce an edge thickness of not less than six (6) inches in the succeeding layer.
11. Immediately following the discontinuance of placing concrete, all accumulation of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the plastic concrete.
12. Construction joints shall be placed only where shown on the plans or permitted by the Engineer. All exposed edges of concrete and exposed joints shall be chamfered one (1) inch, unless otherwise shown or noted.
13. Concrete shall not be placed until all sleeves, castings, hangers, pipe, conduits, bolts, anchors and other embedded items have been placed and anchored by the Contractor.

C. Vibrating
1. Concrete shall be thoroughly compacted during and immediately after depositing by vibrating the concrete internally by means of mechanical vibrating equipment.

2. Internal mechanical vibrators shall be of a type approved by the Engineer. Vibrators shall be of sturdy construction, adequately powered, capable of transmitting vibration to the concrete in frequencies of not less than four thousand (4,00) impulses per minute and shall produce a vibration of sufficient intensity to cause flow or settlement of the concrete into place without a separation of the ingredients.
3. The vibratory element shall be inserted into the concrete at the point of deposit and in the areas of freshly placed concrete. The time of vibration shall be of sufficient duration to accomplish thorough consolidation, complete embedment of the reinforcement, the production of smooth surfaces free from honeycombing and air bubbles, and to work the concrete into all angles and corners of the forms. However, over-vibration shall be avoided and vibration shall continue in a spot only until the concrete has become uniformly plastic and shall not continue to the extent that pools of grout are formed. The optimum length of time of vibration depends upon the frequency of the vibration (impulses per minute), size of vibrators and the slump of the concrete, and shall be determined in the field. The internal vibrators shall be applied at points uniformly spaced not farther apart than the radius over which the vibration is visibly effective and shall be applied close enough to the forms to vibrate the surface concrete effectively.
4. The vibrator shall not be used to push or distribute the concrete laterally. The vibrating element shall be inserted in as nearly a vertical position as practicable in the concrete mass to a sufficient depth to vibrate the bottom of each layer effectively. The vibrator shall be withdrawn completely from the concrete before being advanced to the next point of application.
5. To secure even and dense surfaces free from aggregate pockets and honeycomb, vibration shall be supplemented by working or spading by hand in the corners and angles of forms and along form surfaces while the concrete is plastic.
6. A sufficient number of vibrators shall be employed so that at the required rate of placement, thorough consolidation is secured throughout the entire volume of each layer of concrete. Extra vibrators shall be on hand for emergency use and for use when other vibrators are being serviced.
7. The use of surface vibrators to supplement internal vibration will be permitted only when satisfactory surfaces cannot obtained by internal vibration alone. When permitted, surface vibrators shall be applied only long enough to embed the coarse aggregate and to bring enough mortar to the surface for satisfactory finishing.
8. The use of form vibrators will be permitted only when it is impossible to use internal or external vibrators. When permitted, form vibrators shall be attached to or held on the forms in such a manner as to transmit the vibration to the concrete effectively and so that the principal path of motion of the vibration is in a horizontal plane. Internal vibrators shall not be applied to the forms or to the reinforcing steel.

D. Depositing Structural Concrete Under Water
1. Concrete shall not be exposed to the action of water before setting nor be deposited in water except with the approval of the Engineer and under their direct supervision. When concrete is so deposited, it shall be mixed in the same proportions as indicated on the Plans or in the Specifications except that an additional bag of cement per cubic yard shall be used.
2. Concrete deposited under water shall be carefully placed in a compacted mass in its final position by means of a tremie, a closed bottom-dump bucket or other approved method and shall not be distributed after being deposited. The surface of the concrete shall be kept as nearly horizontal as practicable at all times. To insure thorough bonding, each layer of concrete shall be placed before the preceding layer has taken initial set. Special care shall be exercised to maintain still water at the point of deposit.
3. No concrete shall be placed in running water and all form work shall be constructed to retain concrete under water properly. The consistency of the concrete shall be carefully regulated and special care shall be exercised to prevent segregation of the materials. The method of depositing concrete shall be so regulated as to produce approximately horizontal surfaces.
4. When a tremie is used, it shall consist of a tube having a diameter of not less than then ten (10) inches, constructed in sections having flanged couplings fitted with gaskets. The

means of supporting the tremie shall be such as to permit the free movement of the discharge end over the entire top surface of the work and shall be such as to permit it to be rapidly lowered, when necessary, to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be raised slightly, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous and in no case shall it be interrupted until the work is complete.

5. When concrete is placed by means of a bottom dump bucket, it shall have a capacity of not less than one-half (1/2) cubic yard. The bucket shall be lowered gradually and carefully until it rests upon the concrete already placed. It shall then be raised very slowly during the discharge travel, the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixtures.
6. For parts of structures that will be under water, but which are to be poured in the dry, concrete seals shall be placed without interruption from start to finish. Dewatering of the structure may proceed when the concrete seal has sufficient strength to withstand all superimposed loads. All laitance or other unsatisfactory material shall be removed from the exposed surface by scraping, chipping or other means until sound concrete is exposed.

E. Bonding Construction Joints
1. When the placing of concrete is interrupted and a construction joint formed, provision shall be made for interlocking with the succeeding layer unless otherwise specified or shown on the Plans. The interlock shall be made by forming a shear key produced by the embedment of saturated wooden blocks or strips into the plastic concrete. The shear key thus formed shall be approximately one-third (1/3) the width of the parts joined.
2. The wooden blocks shall be beveled on four (4) sides to facilitate their removal and shall be securely fastened in place to prevent displacement before the concrete has set. The wooden pieces shall be loosened in such a manner as to avoid injury to the concrete.
3. The face edges of all joints shall be carefully finished true to line and elevation for a distance of two (2) inches back from all exposed surfaces.
4. In construction joints exposed to view or in those where seepage of water is particularly objectionable, waterstops shall be placed not less than three (3) inches from the inside face of concrete and shall extend at least three (3) inches into the concrete on each side of the joint. Waterstops shall be joined to be watertight and continuous and shall be carefully protected from damage until covered with concrete. Waterstops shall also conform to any details shown on the Plans and/or Standard Details.
5. Before joining fresh concrete to concrete already set, the forms shall be drawn tight against the latter, the existing surface shall be cut over with suitable tool to remove all loose and foreign materials, then scrubbed with wire brooms, wetted down and kept wet until the new concrete is placed. Immediately prior to placing the new concrete, the existing surface shall be covered with a thin coating of 1:1 mortar or neat cement paste that shall be thoroughly brushed into the surface.

F. Forms
1. Forms shall be designed to resist a weight of one-hundred-fifty (150) pounds per cubic foot of setting concrete, the hydraulic pressure resulting therefrom and in addition thereto, a live load allowance of fifty (50) pounds per square foot on horizontal surfaces.
2. Forms shall be set to the camber shown on the Plans and/or as ordered by the Engineer.
3. All forms shall be built mortar tight and of material sufficient in strength to hold the concrete without bulging between supports and shall be so maintained as to eliminate the formation of joints due to shrinkage of the lumber. Concrete misshaped by bulges or deformations caused by inadequate forms shall be removed or corrected as ordered by the Engineer at no cost to the Owner.
4. Forms shall be filleted at all exposed sharp corners so that the finished concrete will be chamfered as noted in section "Handling and Placing Concrete" unless otherwise shown on the Plans or directed by the Engineer. In the case of railings or similar fine details where

fillets are omitted, the concrete shall be thoroughly worked into the corners, and upon removal of the forms, the sharp edges of the concrete shall be carefully rubbed down to a one-quarter (1/4) inch radius.

5. Forms shall be so constructed that the portions where finishing is required can be removed without disturbing the portions of forms to remain.
6. Special attention shall be paid to bracing and where the forms appear to be insufficiently braced or unsatisfactorily built, either before or during the placing of concrete, the Contractor shall stop the work and reinforce the forms and braces.
7. Any metal ties or anchorages that are required within the forms to hold them to correct alignment and location shall be so constructed that the metal work can be removed to a depth of at least two (2) inches from the face surface of the concrete without injury to such surface. Wire ties will not be permitted, without written permission of the Engineer. In cases where wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least 1/4 inch from the face of the concrete with sharp chisels or nippers, nippers only shall be used on the green concrete. All cavities produced by the removal of metal ties shall be carefully filled with a mortar in the proportion that has been employed for the particular class of concrete treated and the surface left smooth, even and uniform in color. The surface film of all such repaired surfaces shall be carefully removed before setting occurs.
8. All forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened and shall remain in place for the approximate periods hereinafter specified under "Removal of Forms."
9. For narrow walls where access to the bottom of the form is not readily attainable, the lower form boards shall be left loose so that they may be removed for cleaning out all chips, dirt, sawdust or other extraneous material immediately prior to placing concrete.
10. Forms to be reused shall be maintained in good condition as to accuracy of shape, strength, rigidity, watertightness and smoothness of surface. Any warped or bulged lumber shall be carefully resized before being reused. Forms unsatisfactory to the Engineer in any respect shall not be used and, if requested, shall be removed immediately from the work.
11. All surfaces of forms shall be coated to conform with requirements of "Form Coatings" in this Section. Any material that will stick to or discolor the concrete shall not be used.
12. Metal forms that do not present a smooth surface or line up properly, shall not be used. Special care shall be exercised to keep metal forms free from rust, grease and other foreign matter that would tend to discolor the concrete.
13. Forms and their supports shall be removed when permitted by the Engineer and in such manner as they may direct so that the concrete will be stressed gradually and uniformly. Any method of form removal likely to cause overstressing of the concrete will not be permitted.
14. Side forms of beams, girders, columns and walls may be removed as soon as the concrete has attained sufficient strength to sustain its own weight, and such removal will cause no damage to the concrete. Supporting forms and shoring for slabs, beams, girders and other structural members shall not be removed until the concrete has acquired sufficient strength to support its weight and superimposed construction loads. In general, this removal will be after the concrete has attained seventy (70) percent of its twenty-eight (28) day design strength.

15. The minimum period for removing forms listed below are for supporting surfaces when the temperature of the concrete is above forty (40) degrees Fahrenheit and may be used as a guide.

Arch Centers	8 days
Centering Under Beams	8 days
Floor Slabs	10 days
Walls and Beam Sides	5 days

16. All other forms may either be removed as soon as they are no longer necessary to support the concrete during setting or they may be left in place to protect the concrete during the curing period.
17. If high-early strength cement is used, these periods may be reduced as approved by the Engineer.

G. Provisions for Concreting in Cold Weather
1. Concrete shall not be placed when the atmospheric temperature is below forty (40) degrees Fahrenheit unless permission to do so is granted in writing by the Engineer.
2. When permission is granted for cold weather concreting, the required curing temperature may be maintained by either of two (2) methods:
   a. External Heat
   b. Insulated Forms
   c. Insulated Blankets
3. If the Contractor elects to maintain curing temperatures by external heat, furnish sufficient canvas and framework or any other type of housing to enclose and protect the structure in such a way that the air surrounding the fresh concrete can be kept at a temperature above fifty (50) degrees Fahrenheit but not over eighty (80) degrees Fahrenheit for a period of seven (7) days after the concrete is placed. At the end of this seven (7) day period, gradually reduce heat no faster than one (1) degree per hour until it equals the surrounding outdoor temperature.
4. Sufficient heating apparatus such as stoves, salamanders or steam equipment together with fuel shall be supplied to furnish the heat necessary to maintain the specified temperatures continuously and with a reasonable degree of uniformity in all parts of the enclosure. All exposed concrete surfaces within the heated area shall be kept wet during the heating period unless heat is supplied in the form of steam. Materials and equipment necessary to erect the enclosure and to provide external heat shall be present on the job and be in good working order before any concrete is poured.
5. The temperature of the plastic concrete shall be not less than fifty (50) degrees Fahrenheit or more than seventy (70) degrees Fahrenheit at the time of placing in the forms. When concrete is to be placed in contact with cold reinforcing steel or previously placed concrete, measures shall be taken to raise the temperature of the steel and of the set concrete to approximately fifty (50) degrees Fahrenheit before concrete placement shall begin.
6. In cases of extreme weather conditions the Engineer may, at their discretion, raise or lower the limiting temperatures for the plastic concrete.
7. When the air temperature is thirty (30) degrees Fahrenheit or above, and if the aggregates are free of ice and frozen lumps, the desired temperature of the plastic concrete may be obtained by heating the mixing water only, unless otherwise ordered by the Engineer. When the temperature is below thirty (30) degrees F., or whenever ordered by the Engineer, both mixing water and aggregates shall be heated as herein specified.
8. All water used for mixing concrete shall be heated to a temperature of at least seventy (70) degrees Fahrenheit, but not over one-hundred-fifty (150) degrees F. Aggregates shall also be heated either by steam or by dry heat to a temperature of at least seventy (70) degrees F. but not over one-hundred-fifty (150) degrees F. The heating apparatus shall be such as to heat the mass uniformly and preclude the possibility of the occurrence of hot spots which will overheat the material.

9. When either mixing water or aggregates are heated in excess of one-hundred (100) degrees Fahrenheit, the aggregates and mixing water shall be premixed in the mixer drum until the heat of these components has been balanced and is below one-hundred (100) degrees F. before the cement and the admixtures shall be added to the mix.
10. Provide adequate fire protection equipment which shall be accessible at all times when and where heating is in progress and maintain watchperson or other attendants to keep the heating units in continuous operation.
11. Heating appliances shall not be placed in such a manner as to endanger formwork or as to expose any area of concrete to drying-out or injury due to excessive temperatures.
12. For the first five (5) days after the concrete has been poured, a permanent temperature record shall be kept showing the date, hour, outside temperature and temperatures within the enclosure at several points sufficient to show the most favorable and unfavorable conditions to which the concrete has been subjected.
13. Thermometers in sufficient number, in the judgment of the Engineer, shall be furnished by the Contractor. The thermometers shall have a range of at least from zero (0) to two-hundred (200) degrees Fahrenheit and shall be of the maximum-minimum type.
14. Thermometer readings shall be taken at the start of the work in the morning and again in the later afternoon and the data so obtained shall be recorded in such a manner that it will show the location of each reading and any conditions which might have an effect on the temperature. A copy of the temperature record will be made by the Contractor at the close of each day's work.
15. The Contractor may use insulated forms or any other method for providing curing temperatures during cold weather. In general, the material that is part of any method shall be used according to the manufacturer's recommendations. The Contractor shall, however, present for the approval of the Engineer, a detailed description of the method proposed to use together with a list of jobs where it has been successfully used.

H. Curing Concrete
1. Careful attention shall be given to the proper curing of all concrete. No special provisions for curing will be required on surfaces where forms are left in place except that in extremely hot weather, the Engineer may order the forms to be wetted down to reduce surface heat.
2. All other exposed surfaces of concrete shall be cured by means of quilted covers that shall be kept wet, or they may be cured by means of polyethylene coated burlap blankets which will not require wetting. Polyethylene coated blankets shall be laid dry with the burlap side against the concrete; adjoining blankets shall be lapped sufficiently to provide a moisture seal. The curing covers of whatever type shall be placed on surfaces immediately after the concrete has been finished.
3. Curing covers shall conform to the requirements of "Curing Materials" in this Section.
4. Retention of moisture for curing by any of the above methods shall be continued for a minimum of seven (7) days during which time the temperatures of the concrete shall not be allowed to fall below forty (40) degrees Fahrenheit.
5. Open joints shall be placed at locations designated on the Plans and shall be formed by the insertion and subsequent removal of template of wood, metal or other suitable material.
6. The method of insertion and removal of joint templates shall be such to avoid the possibility of chipping or breaking down the edges of the joint and the templates shall be so constructed that their removal may be readily accomplished without injury to the work.
7. When concrete is to be placed against a joint filler, holes or joints in the filler shall be suitably filled with mastic to prevent mortar or concrete from entering the joints and restricting its movement. To seal the joints, the sealer shall be inserted into the joint with tools that will not injure the material and will place the sealer at the proper level in the joint without stretching the material. The lubricant adhesive shall cover both sides of the sealer over the full area in contact with the sides of the joint.
8. The length of the sealer to be installed shall equal the actual length of the joint and shall be installed in the joint without stretching so that after the installation, there shall be no need to cut off any material. Field splices will not be permitted.

9. All expansion joint materials shall conform to the requirements of "Joint Sealing Materials" and "Expansion Joint Filler", paragraph 3.06.M. and paragraph 2.09 of this section.

I. Finishing Surfaces Exposed to View
   1. Immediately after forms have been removed, surfaces exposed to view shall have all projections and irregularities carefully removed and all cavities neatly filled with mortar of the proportion used in the concrete. The same brand of cement and the same kind of aggregate shall be used for filling cavities as that used in the original concrete mix. Plastering of surfaces will not be permitted. The surface film of all such repaired surfaces shall be carefully removed before setting occurs.
   2. Surfaces exposed to view shall be rubbed unless otherwise ordered by the Engineer and the rubbing procedure shall be repeated as many times as the Engineer may deem necessary to secure a satisfactory finish. Immediately before starting the work, the concrete surfaces shall be kept thoroughly saturated with water for a minimum period of three (3) hours and then rubbed with a No. 16 carborundum brick or other abrasive until the surfaces are even, smooth and of uniform appearance. No cement or any other coating shall be applied. The final finish shall be obtained by a thorough rubbing with a No. 30 carborundum brick or other abrasive of equal quality. After the final rubbing is completed, the surface shall be cured as described under the Article "Curing Concrete" unless otherwise directed.
   3. Concrete surfaces that have been disfigured by the drip from the abrasive and that cannot be cleaned by scrubbing with a stiff brush and water shall be thoroughly cleaned by means of a dilute solution of muriatic acid.
   4. All upper horizontal surfaces such as the top of walls shall be formed by placing an excess of material in the forms and removing or striking off such excess with a suitable screed, forcing the coarse aggregate below the mortar surface.

J. Finishing Surfaces Not Exposed to View
   1. Concrete surfaces not exposed to view and concrete surface below grade shall have fins and rough edges removed and all voids left by air bubbles and/or water blisters filled with dry patching mortar.

K. Finishing Sidewalks, Walkways, and Exterior Platforms
   1. To finish sidewalks, walkways and exterior platforms, the concrete surfaces shall be wood floated to a true and even plane and steel troweled. The surface shall then be slightly roughened by using a soft broom, by dragging burlap across the surface or other acceptable means.

L. Weep Holes
   1. Construct weep holes in all retaining walls as such points are indicated on the Plans or designated by the Engineer. Separate payment will not be made for weep holes and the cost of all labor and materials required to construct and protect them shall be included in the price bid for the applicable concrete item.

M. Damaged Concrete
   1. All porous or defective concrete of any kind occurring prior to the final acceptance of the work shall be remedied by the Contractor at no cost to the Owner and to the satisfaction of the Engineer.

3.04 PRECAST CONCRETE

A. General

B. Curing Methods for Precast Concrete
   1. Cure all circular precast concrete units in accordance with the requirements of ASTM C 478 or C 76.
   2. Cure all square or rectangular precast concrete units by one of the following methods:
      a. Steam Curing: Precast concrete units may be placed in a curing chamber free from outside drafts and cured in a moist atmosphere maintained at a temperature between one-hundred (100) degrees Fahrenheit and one-hundred-sixty (160) degrees Fahrenheit, by the injection of steam for a period of not less than twelve (12) hours or

when necessary, for such additional time as may be needed to enable the concrete to meet the strength requirements. Steam curing shall not commence until at least two (2) hours have elapsed since completion of placement of concrete in the forms. When a curing chamber is not available, precast concrete units may be placed in an enclosure of canvas and subjected to steam at the temperature and for the time specified above. The enclosure shall be so erected as to allow full circulation of steam around the entire precast unit. The interior surfaces of the curing room or canvas jackets and the surfaces of the pipe shall be entirely moist at all times.

b. Water Spray Curing: Under the conditions of enclosure described in the above paragraph on "Steam Curing", precast concrete units may be cured by subjecting it to a continuous fine spray of water in an enclosure maintained at a temperature of not less than seventy (70) degrees Fahrenheit for a period of not less than seventy-two (72) hours or such additional time as may be necessary to meet the strength requirements.

c. Saturated Cover Curing: The sides and top of each precast unit shall be covered with heavy burlap or other suitable material saturated with water before applying and kept saturated at a temperature of not less than seventy (70) degrees Fahrenheit for seventy-two (72) hours or such additional time as may be necessary to meet the strength requirements.

C. Fabrication
1. All precast concrete units shall be shop fabricated in an enclosed plant meeting all applicable ASTM requirements.
2. Openings, inserts and plates shall be provided in the precast units as shown on the drawings.
3. Precast units shall be completely cured in accordance with this article prior to delivery and shall be clean, smooth, straight with no projecting fins, broken edges or structural defects.
4. If at any time upon inspection, the Engineer determines that any unit is either visually or structurally deficient, it shall be rejected.

D. Erection
1. All units shall be erected plum and true to specified location, alignment and elevation.
2. All work shall be adequately braced or guyed to maintain proper position until all work is completed.

E. Repairs
1. Minor defects caused by manufacture or mishandling may be repaired if approved by the Owner. Repairs shall be made using a concrete repair material conforming to "Concrete Materials for Repairs" of this Section.
2. Precast units that have any cracks exceeding .01 inch (0.25 mm) in width, cracks completely through the wall of unit, honeycombing or large spalls are not acceptable and shall not be repaired. Surface cracks not exceeding .01 inch in width and appearing on either the inner or outer surface of the unit will not be cause for rejection and need not be repaired.

3.05 CONCRETE PAVEMENT

A. General
1. All the requirements under "Proportioning" and "Batching and Mixing" (Para. 3.02) shall apply to all concrete pavement with the additional requirements detailed within this article.

B. Forms
1. On tangents and on curves of radii of two-hundred (200) feet and over the forms for this shall be of metal, three-sixteenths (3/16) inch minimum in thickness, and at least ten (10) feet long; the height shall be equal to the depth of the concrete and the minimum width of base shall be equal to the height. On curves of radii less than two-hundred (200) feet, wooden side forms may be used.
2. All forms shall be of approved section with the vertical faces rounded on the upper edges to three-fourths (3/4) of an inch radius and with horizontal top face at least two (2) inches wide. Forms shall have a joint connection to insure unbroken lines across the joint.
3. All forms shall be straight, free from bends and warps. They shall be cleaned thoroughly and oiled before concrete is placed against them. Forms shall rest firmly upon a thoroughly

rolled and compacted subgrade throughout their entire length. They shall be jointed tightly and neatly, and shall be staked securely to exact line and grade at least five-hundred (500) feet in advance of the point of placing concrete by using at least three (3) bracing pins or stakes to each ten (10) foot length of side form to resist the pressure of the concrete and the impact of finishing equipment without springing. After the forms have been set, they shall be thoroughly tamped, inside and outside, by means of approved mechanical form tampers.

4. Before placing concrete, all forms shall be carefully checked by "eyeing-in" the horizontal and vertical alignment and corrections shall be made for any irregularities.
5. Placing and finishing concrete pavement without the use of fixed forms may be utilized when approved by the Engineer.

C. Equipment for Placing Concrete
1. All equipment for placing concrete pavement shall be on hand and shall be inspected and approved by the Engineer before concreting operations are begun. Concrete pavement shall be mixed in a paving mixer conforming to the requirements of "Batching and Mixing", in this part. Other sizes and/or types of suitable mixers and other paving methods may be used subject to the approval of the Engineer.

D. Weather Limitations
1. Concrete for pavement and for pavement foundation shall be placed only when the air temperature is forty (40) degrees Fahrenheit and rising, or warmer, and when the temperature of surface of the ground or base is also at least forty (40) degrees F. Paving shall be discontinued when a falling air temperature reaches forty (40) degrees F. Air temperatures are to be measured in the shade; ground temperature shall be taken just below the surface. Materials containing frost shall not be used.
2. When concrete is being placed during cold weather and the air temperature may be expected to drop below thirty-five (35) degrees Fahrenheit, a sufficient supply of straw, hay or other approved insulating blanketing material shall be provided along the work and when ordered by the Engineer. The material so provided shall be spread over the pavement to a depth sufficient to prevent freezing of the concrete, and it shall be maintained as directed by the Engineer.
3. Any concrete laid during cold weather is done at the Contractor's risk and sections of concrete that are damaged, in the judgment of the Engineer, shall be removed and replaced by the Contractor at no additional cost to the Owner.
4. Unless otherwise permitted or ordered by the Engineer, paving mixers will be permitted to stand and to operate on an adjoining paved lane under the following conditions:
   a. Between May 16th and October 15th, after the pavement is nine (9) days old where Type 2 or 2A cement has been used, and after the pavement is two (2) days old where High Early Cement Types 3 or 3A has been used.
   b. Between October 16th and May 15th, when the average temperature is above forty (40) degrees Fahrenheit, after the pavement is twelve (12) days old where Type 2 cement has been used, and after pavement is four (4) days old where Type 3 High Early Cement has been used.
5. A mat at least six (6) inches wider than the treads, at least two (2) inches in thickness, and of a length not less than the length of treads shall be maintained at all times while the mixer is on the pavement. The Contractor will be held responsible for any damage caused by any of operations such as pavement cracks, etc. Where the pavement is damaged, remove and replace the entire damaged sections between joints at no cost to the Owner.

E. Placing Concrete
1. Before any concrete is placed, each section of the subgrade shall be checked with a standard subgrade tester and any defects shall be remedied as directed and approved by the Engineer. This operation shall be continued as the work progresses. A standard subgrade tester shall be kept in place on the forms at the discharge end of the mixer at all times.
2. If the subgrade is dry, it shall be sprinkled with as much water as will be absorbed readily. When the subgrade contains loose dust, it shall be thoroughly wet down on the day or night

preceding the laying of the concrete in order to permit the preparation of a uniform, moist and compacted subgrade.

3. At least five-hundred (500) lineal feet of fine grade shall be prepared ahead of the mixer at all times, unless otherwise permitted by the Engineer. Before concrete is placed adjacent to railway tracks or around structures, the tracks and structures shall be set to the required grade and alignment, and all structures that project through or into the pavement shall be thoroughly cleaned to permit adhesion of the concrete or the placing of expansion joint material where shown on the Plans or as directed by the Engineer.
4. During placing of concrete, a roller weighing not less than five (5) tons shall be maintained in readiness to reroll the fine grade where the surface has for any reason become uneven or defective.
5. The concrete shall be laid in the sections and widths shown on the Plans or ordered by the Engineer. The concrete shall be deposited on the subgrade in successive batches directly from the mixer by means of an approved boom and bucket discharging device. Concrete shall be distributed to the required depth and for the entire width of the slab by an approved mechanical spreader. The use of mechanical spreader may be dispensed with on small or irregular areas if a satisfactory substitute is provided. When Truck Mixed or Central Mixed Concrete is used, it shall not be deposited directly on the grade, but shall be first discharged into an approved bottom dump bucket or mechanical spreader.
6. Where reinforcement is required, it shall be securely held in place to insure its being in the prescribed position after the concrete has been poured. The concrete shall be struck off by means of a template to the required depth below the finished surface before the reinforcement is placed except when the reinforcement is supported by approved metal supports.

F. Vibration

1. After the concrete has been placed and spread to the specified depth but before it is screeded or finished, the surface shall be vibrated.
2. The vibrator shall be of an approved surface-type so constructed as to operate satisfactorily in conjunction with or as a part of either the mechanical concrete spreader or the transverse concrete finishing machine. The vibrator shall be constructed so as to permit its being raised or lowered while moving along the pavement and it shall be mounted so that it will transmit a minimum of vibration to the spreader or finishing machine and to the forms with which it shall not be in contact. The space between the ends of the pan and the forms shall not exceed three (3) inches and if multiple pans are used, the space between the ends of adjacent pans shall not exceed six (6) inches.
3. Each vibrating element shall operate at a frequency of over four-thousand (4,000) cycles per minute. The vibrating elements shall be of a proper type, number and weight to produce impulses of sufficient force, proper direction and point of application such that no more than one pass of the vibrator will be required to consolidate the concrete mass thoroughly throughout its entire depth and width, with all surfaces free from honeycomb or voids. While vibrating the pavement, the vibrating equipment shall not be operated in a stationary position.
4. In addition to the foregoing surface vibration of the concrete pavement, use an approved immersion type of vibrator adjacent to each edge of the pavement and on both sides of every transverse joint. The vibrating element shall be inserted and withdrawn vertically at intervals of approximately eighteen (18) inches and shall remain in the concrete for approximately four (4) seconds at each insertion.
5. Paving shall be discontinued any time the vibration equipment is out of order, not producing satisfactory results, or as directed by the Engineer.

G. Forming Joints

1. Transverse joints shall be placed where shown on the Plans or as directed by the Engineer. Transverse joints for concrete pavement shall be constructed as contraction joints except that adjacent to the structures, expansion joints shall be used. Adjacent to existing

structure, expansion joints shall be used at each end of the structure and in addition at the two joints immediately adjacent to each end.

2. Joint support assemblies shall be utilized at all transverse joints in cement concrete pavement unless otherwise indicated.
3. If due to any emergency concreting must be stopped within ten (10) feet after forming a transverse joint, remove the concrete to the joint previously formed and no additional payment will be made for placing or removing this concrete.
4. At construction joints formed when it is necessary to stop the placing of concrete pavement, a special joint support assembly incorporating a bulkhead device shall be installed. This device shall consist of a joint support assembly with the center plate extended downward to the bottom of pavement elevation and with a bulkhead cap extending to the top of pavement elevation. The bulkhead device shall be approved by the Engineer before pavement operations are begun. Whenever concrete paving operations are stopped and the bulkhead installed, concrete shall immediately be removed from the subgrade in front of the bulkhead device and from all of the exposed parts of the joint support assembly and bulkhead plate. Paving operations shall not be started if there is any concrete ahead of or on any exposed parts of the joint support assembly or on the exposed side of the bulkhead plate.
5. Expansion joints shall be formed as shown on the Standard Sheets for the Construction of Highways and Bridges, unless otherwise permitted by the Engineer. The expansion joint material shall consist of a premolded bituminous fiber felt, meeting the requirements of "Expansion Joint Filler", of this Section.
6. The material shall be one-half (1/2) inch thick and in one piece unless the pavement is wider than thirteen (13) feet. It shall be long enough, however, to fit into the groove of the slab of an adjacent lane, if any, so as to prevent the concrete from flowing around it. Concrete which does not flow around the end of the joint material shall be cut out at the time the forms are removed.
7. Form and support contraction joints as shown on the Standard Sheets for the Construction of Highways and Bridges unless otherwise permitted by the Engineer. The joint support shall be in one piece unless the pavement is wider than thirteen (13) feet. The joint opening at the top of the pavement shall be formed or sawed using a method and procedure approved by the Engineer.
8. All transverse joints and transverse joint support assemblies shall be normal to the center line, perpendicular to the surface and in a straight line across the full width and where applicable shall extend to the bottom of the pavement. Trenching will not be permitted. All joint assemblies shall be undistorted and shall be securely fastened to the subgrade by pins or spikes of an approved type that shall be spaced as directed by the Engineer. Pins or spikes shall be not less than twelve (12) inches in length and shall have flat heads rather than hooks. Form pins or other types of removable pins will not be acceptable for this purpose.
9. Transverse joints, either formed or sawed, will be required in the construction of concrete foundation for pavement at the spacing shown on the Plans as well as at bridges and culverts or whenever it is necessary to stop concrete placement. They shall be either expansion or contraction joints as specified and made to conform to the size and shape shown on the Standard Sheets for "Construction of Highways and Bridges" and/or approved by the Engineer. In the event that a delay occurs in the placing of the pavement course or that the pavement course is not completed until the next construction season, all joints and cracks shall be sealed in accordance with "Sealing Joints and Maintenance of Cracks", of this Section. Transverse joint supports will not be required in the transverse joint formed in concrete foundation for pavement unless shown on the Plans or specified by the Engineer.
10. Longitudinal joints shall be constructed so as to form a continuous tongue and groove joint between adjacent slabs and between concrete curbing and slabs as shown on Standard Sheets for the Construction of Highways and Bridges. Where called for on the Plans or by the Engineer, longitudinal joint ties shall be used.
11. Longitudinal joint ties shall be placed in the joint between adjacent slabs of cement concrete pavement and concrete foundation midway in the depth of the pavement and spaced three

(3) feet four (4) inches apart or as directed by the Engineer, except that the joint ties shall not be placed within twelve (12) inches of the transverse joint in the pavement slab. They shall be installed and secured rigidly in place in an approved manner during construction after the forms are set and prior to placing the concrete.

12. In order to locate the longitudinal joint ties without interfering with the form pin brackets, placement holes may be drilled non- symmetrically in the form length, or the middle hole only may be placed off-center, resulting in a slight variation of uniform spacing. They shall be located to permit the forming of transverse joints at the required spacing and interval with necessary clearance between the joint tie and joint.
13. Where a pavement slab is placed one lane wide, the longitudinal joint between adjacent slabs may be sawed along the joint to a width of three-eights (3/8) of an inch and to a depth of not less than five-eighths (5/8) of an inch. This sawed joint shall be thoroughly cleaned and immediately filled with an approved sealer. When a liquid or semi-liquid sealer is used, the depth of the filler material shall be not less than one-half (1/2) inch or greater than five-eights (5/8) of an inch.
14. Where an approved preformed sealer material is used, the width of the saw cut may be reduced to one-fourth (1/4) of an inch but the depth shall be sufficient to accommodate the sealer. The top of such sealer shall be not less than one-sixteenth (1/16) inch nor more than one-fourth (1/4) inch below the pavement surface. These are maximum dimensions, the intent being to have the sealer approximately one-eighth (1/8) of an inch below the pavement surface.
15. If the Contractor can demonstrate a satisfactory method of forming the longitudinal joint to the above dimensions, such method will be permitted after prior approval by the Engineer. All manipulation of the concrete in the forming process shall be completed within twenty (20) minutes of the time the concrete is placed. Such forming method or methods, even if approved, will be permitted only as long as a satisfactory joint is obtained.
16. The concrete along joints shall be carefully consolidated, finished to a true surface and tested with a ten (10) foot straight edge or template as soon as formed. Any variation from the true surface shall be immediately corrected. Joints shall be open on the edges for their entire depth upon the removal of the forms.
17. Any honeycombing along the edge of a slab shall be patched smoothly before placing concrete for the adjacent slab. If the edge of the slab is not smooth, the Engineer may require that before constructing the adjacent slab, a coating of suitable material be applied to the face in order to eliminate bonding substantially.
18. Before opening the pavement to any traffic, including construction traffic, joints and cracks shall be sealed in accordance with the section "Sealing Joints and Maintenance of Cracks", of this Section. Where traffic is permitted prior to the completion of the full pavement width, protect all edges by planking or other methods as approved by the Engineer.
19. Where the concrete is laid continuously across a bridge or culvert whose floor is at or below grade, transverse joints shall be formed at such distance from each abutment as to insure a bearing at both ends of the slab of not less than five (5) feet beyond the limit of the backfill area.
20. Any spall, including cracked spalls which have not yet been displaced occurring on the pavement along either the transverse of longitudinal joints, during the life of the Contract, shall be repaired by the Contractor in a manner acceptable to the Engineer. The repair shall be made as soon as possible, and in all events, prior to acceptance of the Contract.

H. Installation of Waterstops
   1. Waterstops must form a continuous network. Sections must be tightly butted together or heat-welded to avoid weak spots.
   2. Repair mortor or concrete must be properly consolidated around the waterstop prevent voids, honeycombing, or trapped air pockets.
   3. The surface of the existing concrete must be clean, dry and free of dust, oils, or loose debris when applying the adhesive.

I. Finishing Cement Concrete Pavement

1. Finishing equipment shall be of an approved type and when operated on adjoining new concrete pavement, shall be provided with rubber-tired flangeless wheels to avoid edge damage of adjacent lanes. Sufficient finishing equipment, tools and operators shall be used so that placing and finishing operations can progress at a uniform rate of production.
    a. The surface of the concrete pavement shall be screeded by at least two passes of a transverse finishing machine having two (2) screeds. Care shall be taken to keep the screed bearing directly on the side forms at all times so as to secure a smooth and even surface.
    b. After the above screeding has been completed, the concrete surface shall be leveled and finished by the use of a mechanical longitudinal or diagonal screed of a type approved by the Engineer.
2. Immediately after the concrete has been screeded, a trowel shall be inserted between the form and the concrete for a depth of three (3) inches for the entire length of slab.
3. After the mechanical longitudinal screeding has been completed, hand operated smoothing lutes, starting from the form or adjacent concrete slab, shall be then moved slowly over the surface of the concrete transversely from one side to the other, returned in such a manner that the cutting edge of the lute shall be parallel to the center line of the pavement at all times. Longitudinal movements of the lute shall be made by raising it completely above the surface and lifting it ahead to its next position, allowing for adequate and proper lapping. This manipulation shall continue as directed until visible irregularities are removed. Excess thin mortar accumulating ahead of the finishing lutes shall be removed from the surface of the pavement and shall not be used in filling depressions. One lute and operator shall be furnished and used for each one-thousand (1,000) lineal feet of pavement, or fraction thereof laid during any eight (8) hour working day.
    a. Smoothing lutes may be of aluminum, steel, or wood construction. Metal lute dimensions shall be substantially the same as for wood construction, hereafter described, except for the thickness of materials used. Metal lutes to be satisfactory shall be sufficiently rigid and strong to retain their shape and true straight lines under constant use and shall be as light in weight as is consistent with conforming to these Specifications.
    b. The wood smoothing lute shall be constructed of a smoothly finished approved wood plank two (2) inches in thickness by seven (7) inches in width and ten (10) feet in length, the seven (7) inch dimension being vertical. Both ends of the top surface of the blade for a length of three-and-one-half (3 1/2) feet shall be tapered from the full width of seven (7) inches on the inside to a width of four (4) inches above the bottom face at the ends. The handle for the blade shall be constructed of white pine three (3) inches square in cross section for the first three (3) feet of its length, 2-1/2 inches in diameter for the remainder and shall be twenty-four (24) inches longer than the width of the pavement lane upon which it is being used. The three (3) inch end shall be firmly mortised into a square hole in the longitudinal center of the blade at an angle of fourteen (14) degrees with the flat bottom face of the blade. The handle shall be braced with respect to the ends of the blade with one (1) inch by two (2) inch slats extending on either side of the handle from the upper termination of the three (3) inch square section to points of the top of the blade eighteen (18) inches distant from either end.
    c. Care shall be exercised to ensure that the two (2) inch by ten (10) foot bottom working surface of the blade is perfectly straight and plane. The edges shall be kept sharp and smooth. A master gauge shall be kept near the finishing operations and the blade carefully checked twice daily to ensure its accuracy.
4. Immediately after the smoothing operations have been completed, the surface shall be finished with a burlap drag. The burlap shall be not less than thirty-six (36) inches wide and twenty-four (24) inches longer than the width of the pavement slab. Burlap shall be fastened to a rod which shall be held approximately twenty-four (24) inches above the pavement surface and shall be drawn parallel to the slab so that the burlap drag will move longitudinally over the surface of the pavement. The burlap shall be kept wet and free of hardened concrete particles.

a. The edging tool for transverse joints shall have a flat horizontal face approximately three (3) inches in width and the junction of vertical and horizontal faces shall be filleted to a radius of one-eighth (1/8) inch. The edging tool shall be used only for rounding the corners and to fix the vertical face of the joint.
b. The edging tool for longitudinal joints and edging, when required, shall have a flat horizontal face approximately three (3) inches in width and the junction of the vertical and horizontal faces shall be filleted to a radius of one-fourth (1/4) inch. The edging is used only for rounding the corners and to fix the vertical face of the joint.
c. In edging concrete placed adjacent to a finished slab, an edging tool having a lip at least one-fourth (1/4) inch deeper than the tool used on the finished slab shall be used.

5. Necessary hand finishing of joints and surface irregularities with a wooden float shall be done from a bridge that shall not rest on the plastic concrete at any point.
   a. Workers who perform the final hand finishing and tooling of transverse joints shall be equipped with thirty (30) inch long straight edges to check and correct any surface irregularities resulting from joint finishing operations.
   b. Hand finishing, in general, will not be permitted unless specified on the Plans except on irregular or small areas and except to finish concrete already poured just prior to a breakdown of a finishing machine. If hand finishing is permitted, the surface of the concrete shall be struck off by means of two transverse screeds. The first or forward screed shall be twelve (12) inches in width, at least twenty-four (24) inches longer than the width of slab and shall be constructed of a channel or angles weighing not less than twenty (20) pounds per foot total. The second or follow-up screed shall be ten (10) inches in width, of the same length and construction as the first screed, and shall weigh not less than fifteen (15) pounds per foot. The screeds shall be moved forward with a longitudinal and crosswise movement. After the above screeding has been completed, the hand operated smoothing lutes shall be used as previously specified.
6. The surface of the pavement shall be tested after the mechanical and hand lute screeding but before the initial set of the concrete, with a standard ten (10) foot straight edge laid in successive positions parallel to and transverse to the center line of the pavement in contact with the surface and the whole area tested from one side to the other. Any irregularities shall be promptly corrected to the satisfaction of the Engineer.
   a. The surface of the completed pavement shall not vary more than one-eighth (1/8) inch within any ten (10) foot length.
7. After the concrete has hardened sufficiently, the pavement surface shall again be tested with a ten (10) foot straight edge. Areas that show high spots of more than one-eighth (1/8) inch but not exceeding three-eighths (3/8) inch in any ten (10) foot length shall be marked and immediately ground down with an approved grinding tool. These areas shall be ground to such a plane that when tested with the ten (10) foot straight edge, the surface deviations will not exceed one-eighth (1/8) inch. Where the surface deviations exceed three-eighths (3/8) inch, the pavement shall be removed and replaced at no cost to the Owner or the condition remedied to the satisfaction of the Engineer.

J. Finishing Concrete Foundation for Pavement
1. The concrete shall be spread, vibrated, and finished by mechanical means as specified for "Concrete Pavement" except that the longitudinal or diagonal screed will not be required. The use of the smoothing lute will also not be required and special care shall be taken to keep the screed bearing directly on the side forms at all times so as to secure a smooth and even surface. Necessary hand finishing shall be done with a wooden float.
2. The surface of the concrete shall be tested immediately after finishing with the standard ten (10) foot straight edge laid parallel to the center line and any irregularity exceeding three-eighths (3/8) inch shall be immediately corrected, to the satisfaction of the Engineer.
3. After the concrete has been placed, the surface shall be roughened slightly with either a broom or burlap drag, to the satisfaction of the Engineer.
4. Where mechanical means are impracticable, the surface of the concrete may be struck off instead by means of a hand operated screed at least twelve (12) inches in width and at least

twenty-four (24) inches longer than the width of the concrete slab as approved by the Engineer.

5. Take the special precautions specified above for mechanical screeds and in addition conduct the finishing operations by hand in such a manner as to produce a surface true to the template section and satisfactory to the Engineer.

K. Opening Concrete Foundation for Pavement to Traffic

1. If the concrete foundation for pavement is placed too late in the construction season to permit the placing of the wearing course, the Engineer will order the foundation to be opened to traffic for the duration of the winter if necessary to maintain traffic. Before opening the foundation to traffic, seal joints and cracks in accordance with the applicable portion of "Sealing Joints and Maintenance of Cracks", of this Section.
2. Before placing the wearing course during the following construction season, the concrete foundation shall be cleaned and any damage repaired as directed by the Engineer.

L. Protection of Concrete

1. During threatening weather, the concrete shall be protected with waterproof paper blankets immediately following finishing.
2. Traffic shall be directed from the concrete by the erection and maintenance of substantial barricades for the entire period during which the pavement is to remain closed to traffic. Logs, ties, barriers, or other obstructions shall be placed at proper intervals so that traffic cannot enter onto the pavement.
3. As ordered by the Engineer, temporary cross-overs shall be constructed at street and road intersections and private drives to accommodate traffic. A cross-over shall consist of a four (4) inch layer of suitable soil free from stone and a three (3) inch thick plank roadway at least sixteen (16) feet wide and securely held in place. Cross-overs for use immediately after laying pavement shall be bridged.

M. Curing of Concrete

1. All curing materials shall conform to the requirements of "Curing Materials" of this Section.
2. All blankets shall not be less than twenty (20) nor more than seventy-five (75) feet in length and shall be of a width that will provide complete cover for the surface of the pavement. In order to produce a waterproof joint, all seams in the blankets shall be securely cemented together. The seam shall have a minimum lap of five (5) inches and the adhesive shall be an asphaltic cement having a melting point approximately one-hundred-eighty (180) degrees Fahrenheit. Supplemental stringer sheets at least eighteen (18) inches wide shall be placed along the edge of the pavement under the blankets.
3. All covers shall be placed, as soon as practicable after the finishing operations are completed, directly on the Concrete Pavement or Concrete Foundation course in such a manner that the surface of the concrete will not be appreciably marred. Covers shall be wide enough to cover the top surface and the edges and with enough additional material to anchor the edges of the covers securely. The covers shall be securely weighted by placing a windrow of earth on the blankets just inside the forms or by other approved methods. When placed, the covers shall overlap at least twelve (12) inches and the lap shall also be securely weighted down to form a closed joint.
4. Unless otherwise permitted or ordered by the Engineer, the forms shall be stripped the next morning. The covers shall then be brought down over the exposed edges of the pavement and the extra width turned at the bottom and pulled out flat. The edges of the covers shall then also be weighted down with a windrow of earth or by other approved methods.
5. After the concrete has hardened sufficiently, additional earth shall be placed along the overlapping joints and elsewhere as may be required to secure the covers satisfactorily.
6. Walking on the covers will not be permitted at any time. Any tears or holes shall be repaired by cementing or other approved methods.
7. The concrete pavement or concrete foundation for pavement shall be cured for the periods shown in the table which follows hereinafter.
8. Covers shall conform to all the requirements specified above and in addition, the covers or method of curing shall conform to the applicable requirements specified below:

a. Quilted Covers: Quilted covers shall be thoroughly wetted and kept wet for the entire curing period shown in the table which follows hereinafter.
b. All Other Covers: For the three (3) types of covers other than quilted covers specified above, precautions shall be taken to guard against checking of the concrete pavement.

9. In the event that weather conditions are such that hair checking does occur before the covers can be applied, initial curing to produce a water film shall be done with wet burlap, quilted covers or by other approved methods to be followed by curing with the covers the Contractor selected for use.
10. Only a concrete foundation may be cured with hay and water. The concrete shall first be protected and cured with burlap or quilted covers laid directly on the pavement as soon as completed. Sufficient covers shall be provided for pavement laid in any single day. The strips shall be at least twenty-four (24) inches wider than the pavement, shall overlap not less than twelve (12) inches, shall be thoroughly wetted when placed, and shall be kept wet by spraying until the covering is placed. The covers shall then be kept wet until removed.
11. After twenty-four (24) hours, the burlap or quilted covers shall be removed and the entire surface of the pavement including the edges and sides wetted thoroughly and covered with hay or buckwheat straw to a depth of not less than six (6) inches. The covering shall be kept wet by sprinkling with water for the curing period shown in the table. The water shall be applied by means of a tank truck sprinkler with a fan spray unless otherwise ordered or permitted by the Engineer.
12. The minimum period before laying adjacent slabs, the minimum period before opening to traffic and curing periods for different types of curing are shown in the following table:
    a. Curing Table for Concrete Pavements

Portland Cement	**Period Before Laying Adjacent Slabs**	**Period Before Opening to Traffic**	**Types of Curing**	
			Blanket Covers	Hay & Water
Concrete Laid from May 16th thru October 15th				
	Days		**(Minimum)**	
Normal	5*	9	4	8
High Early	1	2	2	2
Concrete laid from October 16th thru May 15th when the average temperature is above 40 degrees Fahrenheit (4.44 degrees Celsius), unless otherwise authorized by the Engineer:				
Normal	7*	12	6	12
High Early	2	4	4	4

    b. *If a finishing or spreading machine is not used for placing concrete foundation for pavement, this time may be reduced by two (2) days.

N. Sealing Joints and Maintenance of Cracks
1. All expansion, contraction and construction joints and all cracks shall be sealed, after the removal of the curing covers and before the pavement is opened to traffic, including construction traffic, just prior to discontinuing operation when the work is suspended during the winter, and just prior to acceptance. The joints and cracks shall be thoroughly cleaned using whatever equipment or method necessary and when they are free of foreign material and dry, an approved cold applied joint sealer shall be poured or placed into them. Care shall be exercised to conform with the requirements for the material especially with regard to temperature and also to prevent any sealer from spreading onto the surface of the pavement. Such protection as is indicated for the type of material used shall be provided.
2. If the preformed elastic joint sealer is used, install by suitable hand or machine tools and thoroughly secur in place with the lubricant-adhesive which shall cover both sides of the sealer over the full area in contact with the sides of the concrete joint. The lubricant-

adhesive may be applied to the concrete or sealer or both. The sealer shall be installed in a substantially compressed condition and shall at all times be below the level of the pavement surface by not less than 1/16 inch (1.59 mm) or more than 1/4 inch. The sealer shall be in one piece for the full width of the transverse joint. In longitudinal joints, the sealer shall be placed in as long lengths as is practical but in no case less than the length of the panel, except that one splice of the type approved by the Engineer, may be permitted in a panel to connect substantial lengths of sealer. Such splices shall be a minimum of two panel lengths apart. Any joints and splices shall be adequately sealed with additional lubricant-adhesive. Contraction joints in which preformed elastic joint sealer is used may be sawed or formed by an approved method and shall not be narrower than 1/4 inch or wider than three-eighths (3/8) of an inch plus or minus one-sixteenth (1/16) of an inch. Preformed elastic joint sealer may be installed immediately on removal of the curing paper or other media.

3. The Contractor may elect to delay the placing of the final filler until the fall season and place a temporary filler of an approved material in the joints. The temporary filler shall be such that it will not appreciably prevent the expansion of the concrete or permit the entrance of foreign material into the joint. Thorough cleaning of the joint and joint faces shall precede filling with the final material.
4. The method of installation shall be such that the joint sealer material shall not be stretched more than five (5) percent nor compressed more than two (2) percent of the minimum theoretical length. The method of installation shall be checked for stretching and compression by installing a sealer in five (5) transverse joints and removing the sealer immediately after installation and checking the length. An alternate method for checking stretch and compression, where applicable, may be performed by pre-marking or pre-cutting the sealer to length prior to installation. If the measurement of any of these five (5) sealers demonstrates that stretching in excess of five (5) percent or compression in excess of two (2) percent is occurring, the installation method shall be modified to meet the requirements or discontinued.
5. Once sealing operations begin, one (1) joint per one-hundred (100) shall be removed by the Contractor in the presence of the Engineer to check for stretch in excess of five (5) percent and compression in excess of two (2) percent. If the sealer is found to be stretched in excess of five (5) percent or compressed in excess of two (2) percent at this joint, the sealer material shall be removed in successive joints in both directions until sealers are found that meet the stretch and compression requirements. All joints found to be sealed with material having excess stretch or compression shall be replaced at the expense of the Contractor. Any joint sealer material that is removed and found to meet the stretch and compression requirements may be replaced in a manner approved by the Engineer.

O. Test Cores
1. Test cores will be taken from the finished concrete pavement and from the cured concrete foundation for pavement at specified intervals in each lane, prior to final acceptance. On a project over five-thousand (5,000) feet in length, cores will be taken every one-thousand (1,000) feet; on a project less than five-thousand (5,000) feet but more than three-thousand (3,000) feet in length, cores will be taken at intervals of seven-hundred-fifty (750) feet to the nearest interval; and on a project less than three-thousand (3,000) feet in length, cores will be taken at five-hundred (500) feet intervals. Where defective cores are found, additional cores may be taken for testing as described hereinafter.
2. The holes from the core drilling operation shall be filled by the Contractor as soon as possible but not later than seven (7) calendar days after the core is taken, unless otherwise ordered by the Engineer. Before the holes are filled, they shall be carefully cleaned to remove dust, dirt, water and other foreign material. The holes shall then be filled with concrete of the same mix used in pavement. Any damage to the core holes by traffic or any other cause shall be repaired by the Contractor at no cost to the Owner.

P. Tolerance in Thickness of Pavement and Adjusted Payment
1. It is the intent of these Specifications that all pavements be constructed strictly in accordance with the thickness requirements shown on the Plans. Any variation in thickness, either plus

or minus is undesirable and shall be kept to an absolute minimum. No payment will be made for concrete placed in excess of the specified depth. The following shall apply relative to the adjustment of payment for, and the replacement of pavement deficient in thickness.

2. Where a core is found to be deficient in thickness by more than five-and-one-half (5-1/2) percent from the specified thickness, the area of the pavement which it represents shall be considered unacceptable. Additional cores will be taken at ten (10) foot intervals in both directions parallel to the centerline of roadway until acceptable cores are obtained. Areas of pavement which are found to be deficient in thickness by more than five-and-one-half (5-1/2) percent shall be removed and replaced at no cost to the Owner.
3. Cores that are deficient in thickness by five-and-one-half (5-1/2) percent or less of the specified thickness will be acceptable, and payment for the pavement area as represented by each such deficient core will be made for the number of cubic yards computed on the basis of the core thickness of the pavement.

Q. Cores Deficient in Strength

1. The cores will be tested for compressive strength and shall conform to the following minimum requirements:

Class of Concrete	Strength @ 28 to 90 Days
4000 psi (27579.04 kPa)	4000 psi

2. Should a core show a test strength below that indicated in the table, the area of pavement which it represents will be rejected. However, the Contractor may take two (2) additional cores from this area and test them. If the average strength of all three (3) cores is equal to or greater than the twenty-eight (28) days strength and no individual core falls below the specified strength by more than 500 psi (3447.38 kPa), the pavement will be accepted. If the strength is below, the pavement will be rejected and the Contractor shall remove it and replace it with new pavement at no cost to the Owner.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the provisions for furnishing all labor, materials, equipment and tools required for the construction of masonry work below grade.

1.02 SUBMITTALS

A. Prior to purchase and delivery, submit seven (7) bricks of each type used and three (3) blocks of each type, structural and nonstructural.

B. Prior to purchase and delivery, submit samples of Portlant Cement and/or Mortar Mix Cement to the Engineer.

C. Submit certificates of material compliance before delivery for prepackaged materials.

PART 2 - MATERIALS

2.01 BRICK MASONRY

A. Brick Units
   1. Brick shall be whole, free from cracks or other defects (chipped) etc., sound, hard burned, give a clear ringing sound when struck together, and be uniform in quality.
   2. Brick shall meet the requirements of ASTM C32 Grade MS or ASTM C55 Grade N, Type I.

2.02 CONCRETE BLOCK MASONRY

A. Concrete Block Units
   1. Concrete block units shall be made from Portland cement and clean, well graded aggregates, free from dust or other injurious matter. They shall be thoroughly cured, whole, sound and free from cracks or other defects that interfere with the proper placing or impair the strength or permanence of the construction.
   2. Concrete block units shall conform to the requirements of ASTM C139.

2.03 MORTAR FOR BRICK AND BLOCK, AND PLASTER

A. Mortar shall be one (1) part Portland cement, 1/4 to 1/2 parts hydrated lime or lime putty, and three (3) parts sand.

B. Plaster shall be (1) part Portland Cement and three (3) parts sand.

C. Portland cement shall conform to the requirements of ASTM C-150, Type II cement except where Type III cement is specified.

D. Lime shall conform to the requirements of ASTM C207, Type S.

E. Sand shall conform to the requirements of ASTM C144 and meet the gradation requirements specified in Table 1:

Table 1: Fine Aggregate Gradation

Sieve Size	Percent Passing by Weight
No. 4	100
No. 8	95-100
No. 50	10-40
No. 100	0-15

A. Water shall be clean and free from injurious impurities and of potable quality.

B. No admixtures shall be used in mortar or plaster unless otherwise specified or approved by the Engineer.

PART 3 - EXECUTION

3.01 PREPARATION

A. General

1. Mix mortar and plaster in a mechanically operated batch mixer of the drum type. Hand mixing will be permitted provided the quantities of materials and water are accurately measured and provided that the method of mixing is approved by the Engineer. Thoroughly mix cement, lime, and sand, then add water and mix for at least four (4) minutes. Do not use mortar that has obtained its initial set or has been mixed for longer than forty-five (45) minutes.
2. All bricks shall be wetted before laying.

3.02 INSTALLATION

A. General
1. Cover completed work each day to prevent rain or melting snow from penetrating the mortar of upper courses. Do not uncover until immediately before new work is to be laid. Protect new masonry for a period of not less than seventy-two (72) hours immediately following laying.
2. Masonry shall not be laid when the air temperature is below 40 degrees Fahrenheit on a falling thermometer, or when it seems probable that temperatures below 40 degrees Fahrenheit will be encountered before the mortar has set, unless adequate means approved by the Engineer are provided for protecting the work from freezing. Masonry work may be started at thirty-four (34) degrees Fahrenheit on a rising thermometer, with the approval of the Engineer. When the temperature reaches or is above forty (40) degrees Fahrenheit, proceed as under warm weather conditions. During hot weather, protected masonry from direct rays of the sun.

B. Laying of Masonry
1. Masonry shall be laid plumb, true to line, with level and accurately spaced courses, with reveals and corners plumb and true, and each course breaking (half bond) joint with the course below.
2. Cement joints shall be three-eighths (3/8) of an inch thick unless otherwise indicated.
3. For courses curved or in non-parallel planes the vertical (cross) joint thickness shall not exceed one-quarter (1/4) of an inch.
4. "Float" (rub) bricks into mortar to a position within not less than one-half (1/2) inch nor more than two (2) inches of mortar surrounding bricks.
5. Whenever possible, use full masonry units in lieu of cut or broken units. All cutting required at the job site shall be performed in such a manner as to provide true and even surfaces.
6. Each brick unit shall be laid with a full cross joint in a full bed of mortar. Units shall be shoved-up, not laid, so that the soft mortar can rise between and completely fill the cross joint.
7. All courses of brick shall be laid in a full bed of mortar for the full width and length of the units. The mortar for all joints shall be smooth, not furrowed, and shall be of such thickness that it will be forced out of the joints as the units are being placed in position.
8. All courses of concrete block units shall be laid in a full bed of mortar across the block ribs for the full width and length of the each unit. The mortar for all joints shall be smooth, not furrowed, and shall be of such thickness that it will be forced out of the joints as the units are being placed into position.

C. Masonry Pipe Bulkhead
1. All brick masonry plugs or bulkheads shall be installed in the openings of manholes and pipes at places called for on the Plans or as ordered by the Engineer.
2. All plugs or bulkheads shall be made watertight by plastering.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY OF WORK

A. This section provides for the clearing and grubbing of trees, bushes, brush, stumps, roots, and related debris from areas within the right-of-way, easement lines, and parklands, including work designated in permits and other agreements, in accordance with the Contract Documents. The work includes the removal and disposal of cleared and grubbed vegetation, pruning as required to facilitate the work and the protection of existing trees and other plants.

PART 3 - EXECUTION

2.01 GENERAL

A. Prior to the start of construction, survey the entire work site with the Engineer who will define areas to be cleared and grubbed, trees to be pruned, extent of tree pruning, and/or areas which are to be cleared but not grubbed. Only trees, bushes, and brush existing within the area to be excavated shall be removed. Should it become necessary to remove a tree, bush, brush, or other plants adjacent to the area to be excavated, the Contractor shall do so only after permission has been granted by the Engineer.

B. The number and locations of trees, and other vegetation shown on the Plans and originally designated or ordered removed by the Engineer are not exact. For the duration of the Contract, the Contractor, when directed by the Engineer, shall return to areas previously cleared and grubbed and shall remove trees and bushes which are in poor condition or have died during the term of the Contract.

2.02 REMOVAL

1. Trees, bushes and brush shall be removed in such a manner to avoid damage to trees and other vegetation designated to remain.
2. Trees ordered by the Engineer to be removed shall be felled and the stumps and roots shall be completely removed by grubbing and excavating. Trees felled outside the immediate trench excavation and other excavation areas shall have their stumps cut to grade except that stumps in built-up areas, public lands, and other areas as directed by the Engineer shall be chipped out to a depth not less than six (6) inches below finished grade and the holes backfilled as ordered by the Engineer.

2.03 DISPOSAL

A. All wood, brush, stumps, roots, tree trunks, branches, and related debris shall be promptly removed from the site and disposed of by the Contractor outside the limits of the work in a manner satisfactory to the Engineer.

B. Material resulting from clearing and grubbing operations will not be permitted in backfill and shall not be disposed of by burning on the jobsite.

2.04 PROTECTION

A. Protect and guard against injury to all trees, bushes, brush or other plants which are not to be removed. Replace, at no cost to the Owner, all plants destroyed or damaged beyond repair as a result of the work. The species and size of the replacement shall be as specified in Section 329000, "Planting".

B. Work under sidewalks or in areas where trees are located along the line of the work will require extra effort and care by the Contractor and may entail limiting the size of equipment, changing the method of operation, changing the type of sheeting, special removal and pruning procedures in order to avoid damage to trees, bushes, plants, poles and adjacent properties. The Contractor shal be especially careful of both overhead and underground utilities, when removing, topping and pruning trees. All work shall be done by qualified personnel in accordance with accepted horticultural practice and only with the approval of the Engineer.

C. Where required by the Engineer, the Contractor shall lash or place fences and boards around trees and other plants or provide other appropriate methods to prevent damage from construction equipment, tools, and operations.

D. Soil which has become excessively compacted over the roots of trees to be preserved shall be restored by proper cultivation to a condition which will permit the entrance of water and the proper aeration of roots.

2.05 REPAIR

A. All injury and damage to trees and other plants caused by clearing and grubbing operations within the limits of work and adjacent thereto shall be repaired immediately. Work shall be done by qualified personnel in accordance with accepted horticultural practice and as herewith specified or as approved by the Engineer. The Contractor shall:
   1. Remove broken branches and tree limbs. Remove tree limbs and branches at a point where the remaining branch or limb is at least one-third (1/) the diameter of the parent limb or branch.
   2. Make cuts flush with the parent tree trunk or limb.
   3. Cleanly cut all cuts with sharp tools. Scar trace all tree bark wounds immediately.
   4. Apply tree wound dressing on deciduous tree cuts greater than one (1) inch diameter and on all exposed deciduous tree cambium resulting from scar tracing.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall make to the widths and depths necessary for proper construction, all earth excavation required for this Contract. He shall excavate any other material, which in the opinion of the Engineer, is required for any purpose pertinent to the construction of the work.

B. The Contractor shall be responsible at all times for carrying out all excavation operations in a safe and prudent manner so that the workersand the public will be protected from hazard. All applicable Local, State and Federal requirements shall be observed and necessary permits shall be acquired by the Contractor at no cost to the Owner.

C. The removal of all pavements, except Concrete pavements with steel reinforcement, shall be classified as Earth Excavation. Concrete pavement shall be removed in two operations as specified in Section 321200, "Roadway Pavement".

D. The removal and satisfactory disposal of all unsuitable materials as defined herein in locations where such removal is required for the installation of the work. Locations and quantities of unsuitable materials shall be determined by the Engineer and documented at the time of excavation. The Contractor shall dispose of the material at offsite sanitary landfill or other disposal areas authorized to accept such materials.

E. Definitions
   1. Excavation - Any man-made cavity, hole, depression, or undermining in the Earth's surface, including its sides, walls, or faces, formed by earth removal.
   2. Earth - Shall include all materials except ledge or bedrock, boulders or masonry structures larger than thirteen (13) cubic feet, and steel reinforced concrete pavement.
   3. Unsuitable Material - Any material not suitable for backfill or for foundations of pipes and structures. Included are excavated materials containing sod, trash, organic materials, mulch or excess moisture which cannot be reasonably reduced by temporary stockpiling and drainage. Streambed and pond sediments consisting of black to brown silty sand (SM) to organic silt and clay (MH/OH) materials as classified in accordance with ASTM D2487 shall automatically be considered unsuitable. Refer to Section 312333, "Backfill".

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 PREPARATION

A. General
   1. Before any work is started that may affect the existing facilities of any utility, comply with all requirements as stated in Section 014100, "Relevant Project Requirements".

3.02 PERFORMANCE

A. Shoring of Excavations
   1. Provide shoring of all excavations in accordance with the requirements specified in Section 314100, "Shoring of Excavation".

B. Dewatering and Disposal of Water
   1. All dewatering required for excavations shall be performed in accordance with the requirements specified in Section 312319 "Dewatering and Disposal of Water".

C. Excavation Near Utilities
   1. Use proper caution when excavating in and around utility service facilities. Machine excavation shall be stopped at a horizontal and vertical distance of two-and one-half (2-1/2) feet from the location of the utility and excavation shall proceed by hand. Locate and expose the utility using hand excavation. After exposing the utility line the Contractor may proceed with the careful use of power equipment.

D. Excavation of Trenches

1. In excavating trenches, where different strata of soil are encountered, some of which are suitable and some unsuitable for backfill, separate the suitable material from the unsuitable. The Contractor shall store and use the suitable material for backfill and dispose of the unsuitable material. Top soil shall be stockpiled if directed by the Engineer.
2. The lower three (3) inches of excavation shall be done by hand so as to insure an accurate, undisturbed foundation for the pipe, manholes, and structures. Bell holes of sufficient size and depth shall be dug at each joint to permit the installation of a proper joint.

E. Extra Earth Excavation
1. When ordered by the Engineer in writing, conduct extra earth excavation which may be necessary for the proper construction of the work to be done under this Contract. It shall include excavation for test pits ordered by the Engineer.
2. Where unsuitable material is encountered below the foundation grade of pipes and manholes, it shall be removed to such depths and widths as shown on the drawings or ordered by the Engineer in writing. Perform excavation in a manner which minimizes the quantity of unsuitable material which must be disposed of.

F. Unauthorized Excavation
1. Whenever the excavation is carried beyond or below the lines and grades shown on the Plans or given by the Engineer, except as specified above, the Contractor shall, at no cost to the Owner, refill such excavated space in accordance with the requirements specified in Section 312333, "Backfill".

G. Disposal of Material
1. All unsuitable material and excavated suitable material in excess of that required for backfilling shall be transported and disposed of by the Contractor. Secure the Engineer's approval prior to the disposal of excess excavated suitable material.
2. Unsuitable material shall be segregated from in place or stockpiled earthfill and topsoil materials.
3. Maintain the construction site and haulage equipment in such a manner as to prevent spillage or tracking of excavated materials outside the construction area. All loaded trucks shall be covered.

H. Odor Control
1. As an odor abatement measure, cover,at the end of each work day, all areas of organic or odorous material which were exposed during excavation with a minimum six (6) inch and a maximum twenty-four (24) inches of clean fill. Excavated organic or odorous material shall be immediately removed off-site and shall not be stockpiled on-site.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section covers the provisions for removal and proper disposal of all water entering or that might enter excavations.

1.02 QUALITY ASSURANCE

A. Any proposed dewatering operation shall be carried out by only licensed well drillers in accordance with Section 15-1525 of the Environmental Conservation Law.
   1. The entire dewatering operation and the apparatus connected therewith shall at all reasonable hours be open to inspection and test by duly accredited representatives of the Department of Environmental Conservation.

1.03 SUBMITTALS

A. Submit to the Engineer:
   1. Shop drawings of the proposed system to the Engineer for record.
   2. A copy of the NYSDEC approved dewatering permit to the Owner prior to start of work.
   3. Prior to starting dewatering pumps, a record of each observation well including well number, location, depth of water to existing ground surface and all other information as required by the Engineer.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. Settling/Frac Tank
   1. Where water is to be discharged to a surface water body a settling/frac tank or other approved means of sediment capture shall be utilized prior to point of discharge.
   2. The tank shall be sized to accommodate the dewatering design flow, and to support the hydrostatic pressure at full capacity.
   3. Weirs shall be located inside the tank to trap sediments.
   4. Tank shall include catwalk for inspection.
   5. Intake and outlet valves shall be properly located and capable of connecting to the header and discharge piping.
   6. A side hatch shall be conveniently located to facilitate clean out of the Tank.
   7. The tank shall be equipped with all safety equipment required by OSHA, the Owner and regulatory agencies having jurisdiction.

2.02 REGULATORY REQUIREMENTS

A. Where well points are to be used for dewatering, the Contractor shall submit:
   1. An application to the New York State Department of Environmental Conservation for a "Dewatering and Operating Permit"
   2. This application shall be submitted immediately after the Notice to Proceed, and shall give the following details in full:
      a. The proposed starting date of the dewatering operation
      b. The name of the licensed well driller
      c. The details of the dewatering system to be installed
      d. The size, number, and spacing of the well points
      e. The pump capacity, pumping rate, and expected volume of water to be withdrawn
      f. The amount of water table drawdown
      g. The final disposition of water
      h. The expected duration of the operation
   3. Before any dewatering operation is to begin, approval of all the aforementioned items is required. If any unforeseen emergency construction arises, notify the New York State Department of Environmental Conservation as soon as possible that dewatering under such circumstances has been started. Notification will be made to the following:

      New York State Department of Environmental Conservation

Regulatory Affairs, C/O Regional Permit Officer
Buliding No. 40
SUNY at Stony Brook, New York 11790-2356
Telephone: (631) 444-0405

PART 3 - EXECUTION

3.01 PREPARATION

A. Equipment
   1. Dewatering equipment shall have the capability of extracting and maintaining the ground water level at an elevation of at least six (6) inches below the bottom of the sewer trench or the bottom of excavation for structures, and maintain this elevation until construction is complete.

B. Effect of Dewatering on Private Wells
   1. Take special precautions where the removal of water may affect the production of private wells.
   2. Prior to the start of any dewatering operations, notify in writing all owners of water supply wells in areas within or adjacent to the Contract site where dewatering operations may affect the quality and/or pumping capacity of their wells. In addition, prior to and after construction as directed by the Engineer, test the water quality and pumping capacity of each well that may be affected by dewatering operations. The Contractor shall be solely responsible for determining the extent of influence the operations will have on existing water supply wells and in addition will be solely responsible for contacting in writing all affected well owners. If requested, the Owner may assist the Contractor in notifying affected water supply well owners, but it is to be understood that the Contractor shall assume all responsibility for notification and damages and shall indemnify and hold the County harmless from any claim from either direct or indirect damages resulting from dewatering operations either directly or indirectly.

3.02 PERFORMANCE

A. Groundwater shall not be discharged directly into creeks, ponds, storm drains, lakes, or waterways without written permission from the proper authorities. Every effort shall be made to discharge ground water into existing recharge basins.

B. Water from dewatering operations shall undergo chemical treatment, physical treatment, filtration, settling basins, or other agency approved methods to reduce the amount of contaminates, sediment, and/or pollution contained in the water to allowable levels prior to discharge, as determined by the governing agency.

C. All catch basins, storm drains, or recharge basins adversely affected by the accumulation of silt resulting from dewatering operations, shall be restored by the Contractor to their original condition. This work shall be done at no additional cost to the Owner.

D. The use of dewatering system utilizing central pumping stations and header or discharge lines which remain in place at one location for more than six (6) weeks shall not be permitted unless approved in writing by the Engineer. All well point header and discharge lines shall 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.

E. All dewatering pumps shall be acoustically shielded from neighboring residences. Sound absorbing material shall be used on the inside of the enclosure surrounding the pump motor and engine. The installation shall also be free of vibration during operation.

F. Noise levels for dewatering pumps measured at a distance of twenty-five (25) feet from the pumps shall not exceed sixty (60) decibels.

G. Where private wells, used for water supply, have become dry or cease to produce potable water, maintain continuous water service to the homes and buildings affected by the dewatering. In order to maintain continuous service, the Contractor may elect to deepen existing wells or install new

wells where deepening is not practical. In all cases these wells shall extend to a depth below the drawdown caused by the dewatering operations.

H. Any method of dewatering excavations which does not satisfactorily fulfill and maintain the desired water elevation shall be discontinued and a method of dewatering which will produce the required results shall be submitted to the dewatering permitting agency for approval so a revised permit may be issued. Water shall not be allowed to rise over concrete until it has set and attained sufficient strength, or around pipes or other structures, where it might cause damage to the work.

I. Conduct operations so that drainage from work will not be directed to or interfere with the construction operations of any other Contractor, the Owner, and the public.

J. At major intersections and where directed by the Engineer, bury the header and/or discharge pipes.

K. Observation type well points shall be installed and maintained every five-hundred (500) feet and as otherwise directed by the Engineer. These observation wells shall be of similar construction as standard well points and shall be fitted with a tee, plug and valve so that water levels can be read. All observation wells shall be properly numbered by contract number and observation point numbers.

L. Observation wells shall be left in place until the adjacent sewer line has passed the final leakage test. The observation well points shall be pulled and removed after the Final Leakage Test.

END OF SECTION

PART 1 - GENERAL

1.01 SUM

A. The work to be done under this section includes the removal and disposal of all unsuitable materials as defined herein in locations where such removal is required for the installation of sanitary sewer lines and/or structures.

B. Locations and quantities of unsuitable materials to be paid for under this item shall be determined by the Engineer and documented at the time of excavation.

PART 2 - PRODUCTS

2.01 DEFINITIONS

A. Unsuitable materials shall consist of excavated materials containing sod, trash, organic materials, mulch or excess moisture which cannot be reasonably reduced by temporary stockpiling and drainage. Streambed and pond sediments consisting of black to brown silty sand (SM) to organic silt and clay (MH/OH) materials classified in accordance with ASTM D 2487 shall be considered unsuitable.

PART 3 - EXECUTION

3.01 GENERAL

A. Unsuitable materials shall be removed and properly disposed of by the Contractor at offsite sanitary landfill or other disposal areas authorized to accept such materials.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. All trenches and excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown on the Contract Plans or as directed by the Engineer. All backfilling shall be placed as expeditiously as possible after the installation of the pipes and as soon as all cast-in-place concrete and masonry has attained sufficient strength.

B. The Contractor shall compact the backfill using the various methods of compaction described herein, as shown on the Contract Plans or as directed by the Engineer.

C. Definitions
   1. Foundation - The area below the bottom of pipes or structures extending from trench wall to trench wall.
   2. Foundation Grade - The elevation at the bottom of the excavation on which the pipe or structure will rest - see Standard Details for typical pipe bedding.
   3. Embedment Zone - The area around the pipe which extends from the foundation grade to six (6) inches above the crown of the pipe and from trench wall to trench wall.
   4. Haunch Area or Pipe Bedding - The area under the pipe which extends from the foundation grade to the spring line of the pipe.
   5. Initial Backfill Zone - The backfill from the spring line of the pipe to one (1) foot above the crown of the pipe.
   6. Unsuitable material for backfill is defined as all soils and all organic materials not meeting the requirements of this Section.

1.02 QUALITY ASSURANCE

A. Soil Gradation and Compaction
   1. Comply with the applicable provisions and recommendations of the following standards:
      a. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
      b. ASTM D 1556 - Density and Unit Weight of Soil in Place by the Sand-Cone Method.
      c. Unless otherwise specified, backfill shall be compacted to a minimum dry density of ninety-five (95) percent of the Standard Proctor Maximum Density.

B. Testing
   1. Engage an approved independent testing laboratory to perform all compaction tests.
   2. The Owner reserves the right to perform its own compaction tests in addition to the tests to be performed by an independent testing laboratory.

1.03 SUBMITTALS

A. Independent Testing Laboratories
   1. Submit to the Owner for review and approval a list of three Independent Testing Laboratories which proposed to be used for the required soil compaction tests.
   2. Test results of the compaction tests performed by an independent testing laboratories shall be forwarded to the Engineer as expeditiously as possible.
   3. The Testing laboratory will submit the following reports directly to Engineer with a copy to Contractor:
      a. Tests of Backfill material.
      b. Field density tests.
      c. Optimum moisture-maximum density curve for each soil used for backfill.

B. Compaction Equipment
   1. Submit a list of mechanical and hand equipment to be used for compaction for approval by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All fill material shall be free of organic matter, refuse, vegetable matter, frozen material and other objectionable material.
   1. Excavated materials from the work shall be used for backfill whenever they meet the requirements of the materials specified in paragraph 2.02, "Soil Material".

B. Select fill material shall be well graded granular material or bank run gravel, free from organic matter. Not more than eighty (80) percent by weight shall pass through a No. 40 sieve; not more than ten (10) percent by weight through a No. 200 sieve; and one-hundred (100) percent shall pass a three (3) inch square sieve.

C. General fill material shall be free of organics, clay, rock or gravel larger than 6 inches in any dimension, debris, waste, frozen materials and other deleterious matter. No more than thirty (30) percent by weight shall pass through a No. 200 sieve.

D. Granular embedment material shall be crushed rock with not less than ninety-five (95) percent passing a one-half (1/2) inch sieve, not less than ninety-five (95) percent retained on a No. 4 sieve and maximum five (5) percent passing a No. 10 sieve or pea gravel.

E. Crushed stone and gravel shall meet the following gradation:

Sieve Size	Percent Retained on Sieve
2 inch	0
1-1/2 inch	0-10
1 inch	30-65
3/4 inch	85-100
3/8 inch	95-100

   1. Crushed stone shall meet all the material requirements specified in Section 321200, "Road Pavement" paragraph 2.03.C.5. for Crushed Stone, Type A.
   2. Gravel shall meet all the material requirements specified in Section 321200, "Road Pavement", paragraph 2.03.C.6. for Crushed Gravel, Type A.
   3. Pea gravel shall consist of clean naturally rounded aggregate with a range of particles between 1/4 inch and 3/8 inch in conformance with gradation requirements of ASTM C-33. The material shall not have more than three (3) percent passing a #8 sieve. Deleterious substance limitations and soundness shall conform to requirements of ASTM C- 33.
   4. Light-weight fill shall be Solite or approved rotary kiln substitute meeting all requirements of ASTM C330, and shall consist of tough, durable, non-corrosive particles with the following physical properties:
      a. Delivered Gradation

Sieve Size	Percent Retained
1" (25mm)	0
3/4" (20mm)	0-20
#4 (5mm)	90-100

F. Dry loose unit weight shall be less than or equal to 55 lbs/ft3 (pounds per cubic foot).

G. Unsuitable material for backfill is defined as all soils not meeting the requirements of Paragraphs 2.02.1. through 2.02.6. and all organic materials.

H. Filter fabric shall be Mirafi 140-N.S as manufactured by Celanese Fiber Marketing Company, or an approved equal. The fabric shall be non-woven nylon/polypropylene fabric having the following properties:

Properties	Specification
Minimum Weight	140 g/m2
Average Thickness	30 mils

Grab Strength, Wet Retention @ 70° Fahrenheit.	120 Lbs. 100 %
Grab Elongation, Wet Retention @ 70° Fahrenheit.	130 % 40 %
Trapezoid Tear Strength	65 Lbs.
Air Permeability	250 cfm/ft2

PART 3 – EXECUTION

3.01 GENERAL

A. All pipe trenches and excavations for structures shall be backfilled with the type of material listed below except where shown otherwise on the Contract Drawings.

Location	**Type of Backfill**
Pipe Bedding and Haunch Area	Granular embedment material or pea gravel
Initial Backfill Area	Select Fill
Replacement of unsuitable Material below Foundation Grade	Crushed Stone or Gravel
Locations Shown on the drawings	Crushed Stone
Locations Shown on the drawings	Pea Gravel
Locations Shown on the drawings	Light Weight Fill
All Locations not enumerated above	General Fill

1. Unless otherwise specified, backfill shall be compacted to a minimum dry density of ninety-five (95) percent of the Standard Proctor Maximum Density.
2. All backfill shall be placed in the dry.

B. All backfilling shall be placed as expeditiously as possible after the installation of the pipes and as soon as all cast-in-place concrete and masonry has attained sufficient strength.

C. There shall be at least three (3) test per three hundred (300) feet of trench (minimum 3 per Contract) or as otherwise specified.

3.02 PREPARATION

A. In all backfilling of trenches and around structures, remove all lumber, braces, rubbish, and refuse from the space to be backfilled, and no such materials will be permitted in the backfill.

3.03 INSTALLATION

A. Backfill Below Foundation Grade

1. Whenever an excavation must be carried below the foundation grade of pipes and structures, crushed stone or gravel shall be placed and compacted from the bottom of the excavation to the foundation grade of pipes and structures and shall extend to the trench walls of the excavation to provide the proper foundation for the pipe or structure. The crushed stone or gravel shall be wrapped in filter fabric as shown in the Standard Details.
2. Place the material in lifts no greater than six (6) inches in thickness. Each such lift shall be mechanically compacted to the minimum density as specified herein.
3. All backfill shall be placed in the dry. If water is encountered, the Contractor may use trench side pumps in addition to the well points to remove the water. Gravel or crushed stone may be used as an underdrain in conjunction with such trench side pumps. The minimum depth of such underdrain shall be six (6) inches, and the width shall extend to the trench walls of the excavation.

B. Backfilling Haunch Area and Concrete Cradle or Encasement

1. Unless otherwise specified in the Contract Documents or directed by the Engineer, provide pea gravel or granular embedment material to backfill the bedding and the haunch area of the pipe. This material shall be hand placed and compacted in no more than six (6) inch lifts up to the springline of the pipe for the full width of the trench. Each lift shall be compacted to the minimum density as specified herein.
2. Care shall be taken to ensure that sufficient material has been worked under the haunches of the pipe to provide uniform support for the pipe and that the pipe does not shift or move during the placement and compaction of the haunch material.
3. All of the haunch material shall extend to the walls of the trench excavation.
4. Backfill around concrete for a cradle or encasement shall be placed in accordance with all Specifications concerning such cradles or encasement as required in Section 033000, "Concrete".

C. Initial Backfill
1. Unless otherwise specified in the Contract Documents, or directed by the Engineer, provide select fill material in the initial backfill zone as shown in the Standard Details. This material shall be placed in maximum six (6) inch lifts in such a manner as to avoid injuring piping and structures or unequal loads on them. Each lift of this material shall be compacted to the minimum density as specified herein.

D. General Backfill
1. All excavations not listed above shall be backfilled with materials meeting the requirements for "General Fill". Provide General backfill in lifts not exceeding eight (8) inches and shall be mechanically compacted. Place a grade pole, marked in eight (8) inch increments, in the middle of the area to be backfilled.

E. Backfill of Excavations with Sheeting
1. When sheeting is withdrawn, all cavities left by its withdrawal shall be solidly filled and compacted. When sheeting is left in place, all cavities behind the sheeting shall be solidly filled and compacted by methods approved by the Engineer.

F. Backfill Around Utilities
1. Owners of all utilities affected by the excavation shall be notified at least before backfilling commences.twenty-four (24) hours
2. Special care shall be taken by the Contractor when backfilling around any utility.
3. The Contractor shall be fully responsible for providing proper compaction of the backfill to protect the utility from any damage due to settlement.
4. Prior to backfilling, a LIPA representative shall inspect all gas facilities. All damaged facilities will be repaired by the utility company before backfilling.

G. Backfill of Undermined Areas
1. Concrete or Bituminous Concrete Roads, Aprons, Gutters, Curbs and Sidewalks
   a. Wherever any pavements, aprons, gutters, curbs and sidewalks have been undermined during construction, the undermined sections of any such pavement, apron, gutter, curb and sidewalk shall be removed before any backfill can proceed.
   b. Once these undermined sections have been removed, the backfill operation can be resumed.
2. Buildings and Structures
   a. Wherever buildings and structures have been undermined during construction, place and compact the backfill material under them to provide a proper foundation for any such building or structure. If the fill can not be placed, replace the undermined section of the foundation for the building or structure.
   b. The Contractor shall assume all responsibility and cost for any damage which occurs from undermining of a building or structure.

H. Select Fill from Outside Sources
1. Provide select fill from outside sources as backfill in trenches where unsuitable material was excavated above the top elevation of the initial backfill zone and suitable backfill material is

not available from other excavations within the Contract Area. The select fill shall be placed as specified for General Fill.

3.04 METHODS OF COMPACTION

A. General
   1. Backfill within the haunch area and the initial backfill zones shall be hand tamped.
   2. Backfill above the initial backfill zone shall be solidly compacted by mechanical tamping as the work progresses.

B. Mechanical Compaction
   1. Vibratory compaction equipment, suitable and adequate for uniform compaction of thebackfill material to the specified densities, shall be used and shall be on hand before backfill operations are started.
   2. Backfill material shall be compacted at a moisture content suitable for attaining the required density.
   3. When the moisture content in the layer is less than the required optimum amount, add water shall uniformly and thoroughly incorporate into the material by such means as approved by the Engineer. When the moisture content of the layer exceeds the required optimum amount, dry material shall be thoroughly incorporated into the material, or the wet material shall be dried to the required Optimum Moisture Content.

C. Hand Compaction
   1. Hand compaction equipment, suitable and adequate for uniform compaction of the backfill material to the specified densities, shall be used and be on hand before backfill operations are started by the Contractor.
   2. Compact backfill material shall be compacted in six (6) inch layers or less at a moisture content suitable for attaining the required density.
   3. During hand compaction of the pipe bedding and embedment zone, care shall be taken to avoid disturbing, shifting, damaging or distorting the pipe.
   4. When the moisture content in the layer is less than the required optimum amount, water shall be added uniformly and thoroughly incorporated into the material by such means as approved by the Engineer. When the moisture content of the layer exceeds the required optimum amount, dry material shall be thoroughly incorporated into the material, or the wet material shall be dried to the required Optimum Moisture Content.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section covers the furnishing, installing, and removing of shoring for excavations. Shoring shall be used as required for the safety of employees exposed to the hazard of falling or sliding material from any trench excavation or where protection of adjacent structures and utilities is required in accordance with the Specifications of this Section.

B. All trenches shall be shored with the minimal protection of sheeting as listed in the OSHA regulations 29 CFR Part 1926 (Safety and Health Regulatins for Construction), Subpart P, "Excavations, Trenching, and Shoring".

C. Shoring of excavations shall be provided by the use of sheeting boxes, wood sheeting and bracing, steel sheeting and bracing, or other methods that are capable of providing adequate safety and support for excavations specified herein.

D. At all times carry out all excavation operations in a safe and prudent manner so that the workers and the public are protected from any hazard.

E. The type of sheeting used is at the option of the Contractor except where otherwise shown, noted or specified on the Plans.

F. Install stabilization fabric in those areas where bog and/or meadowmat is encountered at the sewer pipe elevation or where directed by the Engineer.

1.02 QUALITY ASSURANCE

A. Provide adequate sheeting and bracing to protect personnel working in the trench in accordance with applicable requirements. The Contractor will in all instances be held responsible for the adequacy of the sheeting.

1.03 INFORMATIONAL SUBMITTALS

A. Provide details of proposed sheeting for information only.

B. Design and supporting calculations shall be prepared by or under the supervision of a Professional Engineer licensed in the State of New York. These documents shall bear the seal and signature of the professional engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All timber materials used for wood sheeting shall meet the requirements for Douglas Fir Dense Construction grade or Southern Pine No. 2, Dense S3.
   1. Used material shall be in good condition, not damaged or excessively pitted.

B. All steel materials used for steel sheeting shall meet the requirements of ASTM A36.

C. If stock steel is furnished, there will be no mill inspection, but the Contractor shall furnish the Engineer with two (2) certified copies of the records of chemical and physical tests and an affidavit that the material furnished is a product of the open hearth method of manufacture.

D. All material will be subject to surface inspection. Material ordered from the mill will be subject to tests in accordance with ASTM A36.

E. Nails, spikes, bolts, chains, or wires which are used to fasten or secure timber or steel materials shall have the proper cross section, length, and strength required for the specific shoring method being utilized.

F. Filter fabric used shall be Mirafi 140 Fabric as manufactured by Celanese Fiber Marketing Company, or an approved equal. The fabric shall be non-woven nylon/polypropylene fabric and shall meet the following Specifications:

Properties	Specification
Minimum Weight	140 g/m2
Average Thickness	30 mils

Grab Strength, Wet Retention @ 70° Fahrenheit	120 lbs 100%
Grab Elongation, Wet Retention @ 70° Fahrenheit	130% 40%
Trapezoid Tear Strength	65 lbs
Air Permeability	250 cfm/ft2

PART 3 – EXECUTION

3.01 PREPARATION

A. A. Pilot Cut
   1. The Contractor may, if soil conditions permit, excavate a pilot cut prior to the installation of sheeting. This pilot cut shall not exceed a five (5) foot depth, and shall be performed in accordance with Section 312316, "Earth Excavation" . The depth of pilot cuts for sheeting installation adjacent to rigid pavements shall be governed by a forty-five (45) degree angle of repose. The Engineer may direct that there be no pilot cuts deeper than the pavement subgrade.
   2. Upon installation of tight sheeting in a pilot cut, timmediately and without delay backfill the void behind the sheeting and thoroughly compact the material in accordance with all requirements of Section 312333, "Backfill". No more than twenty-five (25) linear feet of sheeting may be installed in the pilot cut ahead of this backfilling and compaction procedure.

B. Areas with Limited Work Space
   1. In areas where the Contractor's working space will be limited by the presence of trees, overhead and underground utilities, structures, etc., review with the Engineer a plan of the proposed method of construction. The plan shall include details of the method of shoring and type and size of equipment the Contractor proposes to use.
   2. The plan will be reviewed by the Engineer prior to the beginning of construction in these areas. If the Contractor's method of construction will, in the opinion of the Engineer, present a threat of damage to the adjacent trees, utilities, structures, etc., the Contractor shall, at the direction of the Engineer, make adjustments to the proposed method of construction.
   3. Such adjustments may include, but not be limited to, the use of an alternate sheeting method, the use of double stage sheeting, the use of smaller sheeting boxes, and/or the use of smaller equipment. The Contractor will not receive additional compensation for any adjustments in the proposed method of construction ordered by the Engineer in accordance with these Specifications.

C. Tight sheeting will be required where it is necessary to protect structures such as, but not limited to, buildings, rigid pavements, drains, sewers, water mains, etc. and where shown on the drawings or wherever directed by the Engineer. Where tight sheeting is required, provide in such a manner which will adequately prevent the undermining of structures, rigid pavement, drains, and other utilities.

3.02 INSTALLATION

A. In general, when sheeting is used for shoring of excavations it shall be driven in advance of the excavation so as to maintain the lower end of the sheeting at least twelve (12) inches below the excavation. Sheeting shall extend at least six (6) inches below the foundation grade of rigid pipes, structures, cradles or encasements.
   1. When sheeting is used to support trenches within which flexible conduits such as PVC sewer pipes are to be installed, the sheeting shall either:
      a. Not be driven below an elevation six (6) inches above the crown of the pipe, or if driven below.
      b. Be cut off at an elevation a minimum of six (6) inches above the crown of the pipe and be left-in-place.
      c. No payment will be made for the sheeting left-in-place.

B. When sheeting boxes are used to support trenches within which flexible sewer pipes are to be installed, the bottom of the sheeting box shall not be placed below an elevation six (6) inches above the crown of the pipe.

C. Unless otherwise shown on the plans or ordered by the Engineer, all sheeting shall extend at least one (1) foot above the ground.

D. All sheeting shall be framed and fitted and firmly fastened with adequate nails, spikes, bolts, chains, or wires of such sizes and lengths and at such places and in such manner as required for strength and stability. Handiwork shall be in accordance with recognized standard practices and be performed by skilled mechanics.

E. When sheeting is withdrawn, all cavities in or adjoining the trench shall be solidly filled and compacted.

F. The type of sheeting used is at the option of the Contractor except where otherwise noted or specified on the Plans.

3.03 TEMPORARY STEEL SHEETING

A. The Contractor shall furnish and install temporary steel sheeting including the necessary waling and bracing in all locations shown on the Plans or where ordered by the Engineer.

B. The sheeting shall be installed and withdrawn by methods which will not cause any damage to adjacent buildings, structures, utilities and rigid pavements.

3.04 WOOD OR STEEL SHEETING ORDERED LEFT-IN-PLACE

A. Sheeting shall be left in place where shown on the plans. In other locations where soil or other conditions make it necessary that sheeting be left in place, the Engineer will so order the Contractor in writing.

B. Before the backfill is completed, the sheeting to be left-in-place shall be cut off 18 - 48 inches below the final ground surface unless ordered otherwise by the Engineer. All material that is cut off and all struts and wales shall be removed from the trench and properly disposed of.

C. When sheeting is left in place, all cavities behind the sheeting shall be solidly filled and compacted in accordance with all requirements of Section 312333, "Backfill".

3.05 FILTER FABRIC

A. The area to be covered shall be free of all sharp objects which might damage the fabric during installation. The filter fabric shall be installed as indicated in the "Trench Requirement for Unsuitable Subgrade Below Foundation Grade" detail in the contract drawings (sheet C 500). The filter fabric shall cover the perimeter of the trench in one piece and shall be carefully laid so as to form a continuous lining in the trench between manholes. Fabric damaged or punctured during installation shall be repaired by placing a patch cut large enough to overlap the damaged areas completely by at least three (3) feet all around. At joints in the fabric, the overlap shall be a least one (1) foot.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section describes the methods of replacing and maintaining the surface of sewer and house connection trenches which are cut through the various classes of pavements in the course of constructing sewers, manholes and house connections. During the period after the trench is backfilled and up to the time the permanent wearing surface is constructed, the trenches shall be maintained in a satisfactory manner so as to provide streets suitable for public use.

B. The maintenance of the street surfaces, other than the trench areas, which have been damaged through the Contractor's operations, is also included under this section.

C. The removal and disposal of existing pavement to re-establish surface profile.

D. Pavement Classifications
   1. Class "A" Pavement
      a. Finished Portland Cement Concrete Pavement with or without steel reinforcement.
      b. Portland Cement Concrete Base Pavement with or without steel reinforcement.
   2. Class "B" Pavement - shall include those pavements three (3) inches or greater in depth constructed entirely or in part with the following materials:
      a. Plant mixed asphalt three (3) inches or greater in depth.
      b. Stone or dense graded aggregate base with asphalt top.
      c. Soil cement base with asphalt top.
      d. Built up seal coat that is a mixture of oil and stone built up to a thickness of three (3) inches or greater.
      e. Asphalt stabilized base with asphalt top.
      f. Nonreinforced low-grade concrete base (normally six (6) inches or less in the thickness) with asphalt top.
   3. Class "C" Pavement - Shall include those pavements less than three (3) inches in depth regardless of material.

E. Installation Restraints
   1. No permanent pavement shall be installed over sewer and house connection trenches until post-rehabilitation CCTV footage has been taken. CCTV footage must be taken prior to final inspections.

1.02 SUBMITTALS

A. All weight tickets for truck loads of plant mixed bituminous material shall have the Nassau County Contract number, time, and date recorded thereon. One copy of the automatically recorded weight tickets will be required for County use. The County plant inspector will sign this ticket and after recording the figures in their daily report, give it to the truck driver who shall in turn surrender it to the Owner's inspector at the site of the work.

PART 2 - PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Approval of Materials for Bituminous Concrete
   1. Laboratory approval of the sources of supply of the coarse and fine mineral aggregates and the acceptance of the mineral filler, hydrated lime, bituminous materials, liquefiers, and any other materials that are used in the mix shall be obtained by the Contractor. No delivery of mixed material shall be made from any bituminous mixing plant until such approval is obtained.

B. Bituminous Materials
   1. Submit data on the temperature-viscosity relationship for each lot of asphalt to be used on the project. This data shall take the form of a graph approved by the Engineer and shall cover the range of temperatures and viscosities within which the asphalt may be used.

C. Crushed Concrete Aggregate Base Course and Stone Blend Base Course

1. Acceptance Testing. The Contractor (or Contractor's supplier) shall designate one or more stockpiles to be used for the project. The Engineer shall test and either reject or approve the material in the preferred stockpile. The Engineer shall determine the number of tests needed to perform the acceptance testing. The tests shall include but are not restricted to: Mechanical Analysis, Moisture Density Relationships (10# Rammer, 18" Drop), Plasticity of minus #40 material and C.B.R. tests.
2. The Engineer shall be given a minimum of five (5) working days lead time to perform these tests.
3. The portion of the base course blend that is smaller than the No. 40 screen shall have a Plasticity Index of zero (0), according to ASTM D424. The coarse aggregate shall have a resistance to abrasion by the Los Angeles abrasion test of not more than fifty (50) percent.
4. The coarse aggregate, when subjected to five (5) cycles of the soundness test, shall have a weight loss of not more than twenty (20) percent when sodium sulfate is used or thirty (30) percent when magnesium sulfate is used.
5. The stone blend base course shall achieve a dry density of not less than 145 lbs. per cubic foot at optimum moisture content when tested in accordance with ASTM D1557, Latest Edition, Method D, except that the sample used shall retain all of the course aggregate sizes.
6. CBR Valued (Crushed Concrete). The average laboratory compacted California Bearing Ratio (ASTM D1883) of the material shall be not less than one-hundred (100) (unsoaked). The test specimen shall be compacted at optimum moisture by the method outlined in ASTM D1557, Method D.

2.02 PORTLAND CEMENT CONCRETE

A. Finished Portland Cement Concrete Pavement
   1. Portland Cement Concrete used in the replacement of Finished Portland Cement Concrete Pavement shall meet all the requirements of Division 3, Section 033000 "Concrete" for 4,000 psi (27579.04 kPa) concrete.

B. Portland Cement Concrete Base Pavement
   1. Portland Cement Concrete used in the replacement of Portland Cement Concrete Base Pavement shall meet all the requirements of Division 3, Section 033000, "Concrete" for 3300 psi (22752.71 kPa) concrete.

C. Cement Concrete for Pavement Repairs
   1. Cement concrete pavement repairs shall be made with Portland Cement Concrete meeting all the requirements of Division 3, Section 033000, "Concrete" for 4000 psi (27579.04 kPa) concrete with the following modifications:
      a. The concrete shall be designed to achieve a strength of 2000 psi (13789.52 kPa) within four (4) hours after placement using appropriate accelerators.
      b. Type 3 Portland Cement shall be used. The minimum cement content shall not be less than 826 lbs/cy. The water cement ratio shall not exceed 0.39. Air content shall be 7.0%.
   2. The insulating materials for the curing of the concrete shall be 1" of polyurethane insulation board meeting the requirements of ASTM C591, 2" of polystyrene insulation board meeting the requirements of ASTM C578, or 3" of cellulose fiber insulating board meeting the requirements of ASTM C208.

2.03 STEEL REINFORCEMENT

A. Steel Reinforcement used in the replacement of Portland Cement concrete pavement shall meet all the requirements of Section 032100, "Steel Reinforcement". When used in New York State Roads, the reinforcing steel shall conform to the latest New York State Department of Transportation, Office of Engineering, Standard Specifications.

2.04 BITUMINOUS CONCRETE

A. Fine Aggregates

1. General Requirements: All samples of fine aggregates will be secured and sent to the laboratory by a representative of the Owner.
2. All approved operating sources will be sampled when:
   a. The latest test for a source is two years old.
   b. A change in the character of processed fine aggregate occurs.
   c. The location of the source of raw material is shifted or a change in the character of raw material occurs.
   d. Considered necessary by the Engineer.
3. Non-approved or rejected operating sources equipped with adequate and proper processing facilities will be sampled and tested upon approval by the Commissioner. Approval of such sources will depend on the results obtained by periodic sampling and testing.
4. Proposed new sources of material will also be sampled. The results of tests on such samples shall be for information only and shall be interpreted as indicative of the potential fitness of the sources. Action in regard to acceptance or rejection of a source will be taken only after processing facilities have been established, inspected and approved.
5. Materials meeting test requirements will be rejected if, in the judgment of the Commissioner, service records indicate that they are unsound or otherwise unsatisfactory.
6. Fine aggregates shall consist of material conforming to the requirements of this section except for gradation and rational analysis, and except that approved limestone screening may be used.
7. If undesirable material is furnished from acceptable sources of supply through faulty operation or any other cause whatsoever, the source of supply and any objectionable material therefrom will be rejected by the Engineer.
8. All sources of fine aggregate shall be stripped of all inferior and objectionable material before operations are started and shall be kept stripped far enough from the working face to insure against undesirable material becoming mixed with the output.
9. All natural sand shall be satisfactorily washed before using.

B. Fine Aggregate Details: Fine aggregate shall consist of sand, stone screening, iron ore tailings, artificial sand that is prepared from an accepted source of dolomite rock and contains not less than thirty (30) percent of magnesium carbonate, or a mixture of these, that shall conform to the gradation requirements shown below. The aggregate shall consist of grains or particles of hard durable rocks, the surfaces of which are not coated with any injurious materials. Any fine aggregate will be rejected, if in the judgment of the Commissioner, it contains sufficient deleterious or unsound material to be harmful.
   1. Fine aggregate when dry shall conform to the following gradation requirements:

Gradation Table	**By Weight**	
Description	Minimum %	Maximum %
Passing 3/8" Sieve	100	----
Passing No. 4 Sieve	90	100
Passing No. 8 Sieve	75	100
Passing No. 16 Sieve	55	85
Passing No. 30 Sieve	25	60
Passing No. 50 Sieve	10	30
Passing No. 100 Sieve	1	10
Passing No. 200 Sieve (Wet)	----	3

      a. Fine aggregate are classified into four types -- a, b, c, and d and shall meet the composition requirements in the table in section 2.03.B.1 unless accepted by the Engineer on the basis of service records, petrographic examination, geological studies, and/or quarry reports.

b. If fine aggregate is found unsatisfactory when examined for organic impurities, the aggregate will be rejected unless it passes the mortar strength tests for tension and compression prescribed by the Laboratory. Fine aggregates so tested shall achieve a tensile or compressive strength at least one hundred percent of that developed by the Standard Ottawa Sand Mortar.

2. Test Methods. The details of all tests and test methods for fine aggregates may be obtained by the Contractor from the County, by request.
   a. Composition Table for Fine Aggregates and Test Requirements

Rational Analysis	By Weight	Type			
		a	b	c	d
Kaolin	Max. %	6	8	*	*
Quartz and Feldspar	Min. %	85	75	*	*
Soundness					
10 Cycle Sodium Sulfate	Max. % Loss	6	7	8	10
5 Cycle Magnesium Sulfate	Max. % Loss	15	18	22	*

C. Mineral Filler
1. Mineral filler for bituminous mixes shall consist of limestone dust, Portland cement, diatomaceous earth, fly ash, or other approved material and shall be free from foreign or other objectionable material. It shall be dry and free from lumps and when tested by means of laboratory sieves, the mineral filler shall meet the following gradation requirements:

Passing No. 30 mesh sieve	100%
Passing No. 80 mesh sieve	85 min. %
Passing No. 200 mesh sieve	65 to 100%

2. In all bituminous mixing plants where mineral filler is added, for filler or incorporated in the mix to satisfy gradation requirements, accurately weigh and introduce filler in the required amount into the mix through the weigh box. It shall not be passed through the drier, but shall be fed by elevator, separate storage bin or other acceptable means directly to the designated bin or mixer unit.
3. The excess portion of the approved fine and coarse aggregates which passes a No. 200 sieve may be considered as filler and the added mineral filler be reduced proportionally.

D. Coarse Aggregates
1. Throughout these Specifications where the term "Broken Stone" or "Broken Slag" is used, it is to be interpreted as being synonymous with the term "Crushed Stone" or Crushed Slag" respectively.
2. General Requirements. All samples of coarse aggregates are to be sent to the laboratory by a representative of the Owner.
3. All approved operating sources will be sampled when:
   a. The latest test for a source is two (2) years old.
   b. A change in the character of processed coarse aggregate occurs.
   c. The location of the source of raw material is shifted or a change in the character of raw material occurs.
   d. Considered necessary by the Engineer.
4. Non-approved or rejected operating sources equipped with adequate and proper processing facilities will be sampled upon approval by the Commissioner. Approval of such sources will be conditioned on the results obtained by the periodic sampling and testing as prescribed by the Department.

5. Proposed unopened sources of material will be sampled upon approval by the Commissioner. The results of tests on such samples shall be for information only and shall be interpreted as indicative of the potential fitness of the sources. Action in regard to acceptance or rejection of a source will be taken only after processing facilities have been established, inspected, and approved.
6. Materials meeting test requirements may be rejected if, in the judgment of the Commissioner, service records indicate that they are unsound or otherwise unsatisfactory.
7. If undesirable material is furnished from acceptable sources of supply through faulty operation or any other cause whatsoever, the source of supply and any objectionable material therefrom will be rejected by the Engineer.
8. All sources of coarse aggregates shall be thoroughly stripped of all inferior and objectionable material before operations are started and shall be kept stripped far enough from the working face to insure against undesirable material becoming mixed with the output.

E. Coarse Aggregate Details: Coarse aggregates shall consist of well graded, uniformly mixed broken stone, crushed gravel, or broken slag, and shall meet the requirements given for these materials. Screened gravel and run of bank gravel will not be permitted for coarse aggregate.
1. If deliveries of coarse aggregates show segregation of sizes, material shall be mixed to the specified gradation before using.
2. Coarse aggregates shall contain not more than thirty (30) percent of particles that are flat or elongated to the degree of 3:1 and shall contain not more than ten (10) percent of particles that are flat or elongated to the degree of 5:1. The method of measurement of flatness or elongation shall be as defined by ASTM Designation C-125. The sizes to be used for this determination shall be as directed by the laboratory in accordance with the intended usage of the aggregate.
3. The amount of deleterious substances contained in any primary size of crushed coarse stone or crushed coarse aggregates shall not exceed the following:

Max % of Deleterious Substances	
Description	**% By Weight**
Material Passing the No. 200 Sieve	0.7
Shale or Other Lightweight Materials	1.0*
Coal or Lignite	1.0
Clay Balls or Lumps	0.2
Other Deleterious Substances	1.0

a. *This requirement may be waived if service records and/or abrasion and soundness tests indicate to the Department that the aggregate is satisfactory. Coarse aggregates containing more than these specified amounts of deleterious substances shall be washed or otherwise processed until the Specifications are satisfied.

4. Sizes of Stone, Gravel, and Slag: Stone, gravel, and slag shall conform to the gradation requirements for the various sizes as shown in the following table:

Gradation Table for Coarse Aggregates										
	Percentage By Weight Passing Square Openings									
Primary Sizes =	4"	3"	2-1/2"	2"	1-1/2"	1"	1/2"	1/4"	1/8"	No.80
Screening*	-	-	-	-	-	-	100	90-100	-	-
1B	-	-	-	-	-	-	-	100	90-100	0-15

1A	-	-	-	-	-	-	100	90-100	0-15	-
1	-	-	-	-	-	100	90-100	0-15	-	-
2	-	-	-	-	100	90-100	0-15	-	-	-
3	-	-	100	90-100	35-70	0-15	-	-	-	-
4A	-	100	90-100	-	0-20	-	-	-	-	-
4	100	90-100	-	0-15	-	-	-	-	-	-
5	90-100	0-15	-	-	-	-	-	-	-	-

a. *Screening shall include all of the fine material passing a 1/4" screen.

5. All crushing plants installed on the work shall be fitted with tailing chutes so that no stone will reach the bins other than that which passes through the proper screens.
6. All stone, gravel, or slag shall be of the required sizes when placed in the work; breaking up of stone, gravel or slag by hammers or otherwise will not be permitted.

F. Crushed Stone: Crushed stone shall consist of clean, durable, sharp angled fragments of rock, including iron or tailings, of uniform quality throughout. Gravel hardheads retained on a four inch scalping screen and then crushed will be acceptable as crushed stone provided such crushed hardheads meet the gradation and the other requirements for the type of stone specified.

1. Crushed stone as a coarse aggregate is classified into three types: A, B and C. Each type shall meet the test requirements specified in the following table unless accepted by the Engineer on the basis of service records, petrographic examination, geological studies, and/or quarry reports.
   a. Crushed Stone Tests

Description	Type A	Type B	Type C
Los Angeles Abrasion Test, ASTM Designation C131 Percent Loss Max. by Weight	35.0	35.0	35.0
Magnesium Sulfate Soundness Test, ASTM Designation C88 Percent Loss @ 10 Cycles, Max. by Weight	1.0	10.0	12.0

G. Crushed Gravel: Crushed gravel shall consist of clean, sound, tough, hard gravel, free from coatings, and shall be thoroughly washed. The gravel shall contain at least seventy-five (75) percent of fractured particles in each primary size and shall meet the gradation requirements for coarse aggregates. A satisfactory fractured particle shall have at least one fractured face and the total area of face fracture shall exceed twenty-five (25) percent of the maximum cross-sectional area of the particle.

1. Gravel is classified into three types: A, B and C. Each type shall meet the test requirements of the following table unless accepted by the Engineer on the basis of service records, petrographic examination, geological studies and/or quarry reports.
   a. Gravel Tests

Description	Type A	Type B	Type C
Los Angeles Abrasion Test, ASTM Designation C131 Per Cent Loss Max. by Weight	35.0	35.0	35.0

Magnesium Sulfate Soundness Test, ASTM Designation C88 Per Cent Loss @ 10 Cycles, Max. by Weight	15.0	15.0	25.0

H. Screened Gravel: Screened gravel shall consist of clean, sound, tough, hard stone free from coatings and shall be thoroughly washed. Screened gravel may consist of all uncrushed particles or of crushed particles up to seventy-five (75) percent of the total in each primary size
   1. Screened gravel is classified into three types: A, B and C. Each type shall meet the test requirements specified in the table for crushed gravel tests.
   2. In conducting the abrasion test and the soundness test, uncrushed particles shall be used.

I. Crushed Slag: Crushed slag shall be air-cooled blast furnace slag, hard and durable, composed of angular fragments uniform in density and quality, free from injurious amounts of sulfur and free from thin, elongated or glassy pieces, dirt, and other objectionable matter. Crushed slag shall contain not more than three (3) percent metallic ore by weight. The dry rodded weight of crushed slag shall weigh not less than seventy (70) pounds per cubic foot.
   1. All slag shall be obtained from approved sources.
   2. The crushed slag shall meet the gradation requirements shown in the gradation table for Coarse Aggregates. Crushed slag shall meet the requirements of the following tests:
      a. Los Angeles Abrasion Test,
         1) ASTM Designation C131: 40% Max. Loss
      b. Magnesium Sulfate Soundness Test,
         1) ASTM Designation C88: 6% Max. Loss @ 10 Cycles
      c. Test Methods: The details of all tests and test methods for coarse aggregates may be obtained by the Contractor from the Engineer, by request.
   3. Slag aggregates, fine or coarse, shall not be used without written approval by the Commissioner. When slag is permitted as the aggregates, the asphalt content of the mix shall be increased by approximately twenty-five (25) percent.
      a. Other products from recycled materials may be considered upon approved request of the Commissioner.

J. Bituminous materials
   1. The bituminous material shall be of approved quality and shall meet the requirements shown under its respective item in Table I, Table II and Table III for the kind of material furnished. The material furnished shall be of one brand and shall show a uniform test, unless special permission to furnish other brands of materials is given, in writing, by the Commissioner.
   2. Where more than one grade of material is called for under any item, the Engineer may specify the grade required at the time of use.
   3. Bituminous material will be sampled by a representative of the Owner and the samples sent to the laboratory. Specific gravity at seventy (70) degrees Fahrenheit shall be reported on any producer's certified test results for petroleum asphalt.
   4. Bituminous material wasted through careless handling will not be paid for. Bituminous material that has been rendered unfit for use by overheating or by long continued heating and bituminous emulsions which have separated because of freezing or mishandling will be rejected

K. The method to be used for volume corrections for petroleum products shall be the Standard Abridged Volume Correction Tables for Petroleum Oils ASTM D1250
   1. For purposes of measurement, a gallon shall be a volume of 231 cubic inches, and measurement will be based on the volume of the bituminous material at a temperature of sixty (60) degrees Fahrenheit

L. Anti-Stripping Additive: When required an additive shall be added to the bituminous material which will cause it to coat and adhere more effectively to wet and unheated aggregates. The additive shall have no deleterious effect upon the bituminous material and shall be completely miscible in all types of bituminous materials.

1. Anti-Stripping additives shall be added only at the refinery except as ordered by the Engineer and shall be blended thoroughly throughout the bituminous material.
2. Bituminous material containing an anti-stripping additive shall conform to the Specifications for untreated material. In addition, it will be required to show not less than ninety-five (95) percent area coated when subjected to a stone coating test. Details of this test may be obtained by the Contractor from the County, by request.
3. The following tables give the detail requirements for each kind of Bituminous Material:

Table I - Asphalt & Asphalt Filler

Type	**Paving Asphalt**			**Asphalt Filler**		
Grade	85-100	100-120	60-70	50-60	A	B
Water	0.0	0.0	0.0	0.0	0.0	0.0
Homogeneous	Yes	Yes	Yes	Yes	Yes	Yes
Pen. @ 77 °F., 100 G., 5 sec	85-100	100-120	60-70	50-60	30-45	30-45
Pen. Ratio (39.2 °F/77 °F x 100)	30.0+	30.0+	30.0+	55-70	60-75	60-75
%Loss @ 325°F., Max. ***(1)***	1.0	1.0	1.0	1.0	1.0	1.0
% Pen. of Res., Min.	60.0	60.0	60.0	60.0	60.0	60.0
% Sol. In CC @ 4% Min. ***(2)***	99.5	99.5	99.5	99.5	99.5	99.5
Flash Point, °F., Min.	347	347	347	392	392	392
Duct. @ 77 °F., Min	60	60	60	10	4	4
Soft. Pt. °F. (B&R)	-	-	-	140-167	160-180	180-200
Typical Uses	Hot & Cold Laid Plant Mix	Pen. Constr.	Hot Plant Mix	Joints and Cracks	Brick Filler, Light Heavy Traffic	

Table II - Asphalt Emulsions

Grade	**-**	**-**	**C *(4)***	**A**	**-**	**-**
Material Designation	MS-3	RS-1	RS-2	MS-1	SS-1	_
Water %	30-35	40-45	30-40	32-37	40-45	50-55
Asphalt %	65	55	60	63	55	45-50
Homogeneous	Yes	Yes	Yes	Yes	Yes	Yes
Ash; % Max.	2.0	2.0	2.0	2.0	2.0	2.0
Furol Viscosity @ 77 °F.	-	20-100	-	Satisfactory	-	Satisfactory
Furol Viscosity @ 122 °F.	100-500	-	100-400	-	-	-
Settlement, 7 Days Max.	-	3.0	3.0	3.0	3.0	3.0
Cement Mixing	-	-	-	-	2.0	-
Screen Test, % Max.	.1	.1	.1	.1	.1	.1

Demulsibility, N/50 (35) Min.	-	60	60	-	-	-
Demulsibility, N/10 (50)	-	-	-	-	-	5-45
Asphalt Base for Emulsions:						
Pen. @ 77 °F. 100 G., 5 Sec.	100-250	100-250	100-250	***(7)***	100-250	100-250
Pen. Ratio: (39.2 °F./77 °F. x 100) , Min.	30	30	30	30	30	30
% Sol. In CC @ 4% Min.	97.5	97.5	97.5	97.5	97.5	97.5
Ductility @ 77 °F., Min.	60	60	60	60	60	60
Flash Point., °F. Min.	347	347	347	347	347	347
Pen. of Distil, Res. @ 77 °F.	100-200	100-200	100-200	100-200	100-200	100-200
Oil in Distillate, % by Vol. ***(6)***	5-11	0-2.0	0-2.0	0-10.0	0-10.0	0-2.0
Typical Use	Patching Plant Mix Traveling Plant Mix	Surface Treatment Penetration Spray Patch	Surface Treatment	Road Mix Base or Shoulder Stabilization	Granular Material Stabilization	Curing Concrete

Table III - Rapid Curing Asphalt Cutbacks

Grade	RC-30	RC-70	RC-250	RC-800	RC-3000
Water, Max. (%)	0.2	0.2	0.2	0.2	0.2
Kinematic Viscosity @ 140 °F. Centistokes ***(8)***	30-60	70-140	250-500	800-1600	3000-6000
Distillation: % Total Distillate to 680 °F., by Volume.					
to 374 °F Min.	15	10	-	-	-
to 437 °F Min.	55	50	35	15	-
to 500 °F Min.	75	70	60	45	25
to 600 °F Min.	90	85	80	75	70
Residue from distillation to 680 °F. % Volume by difference min.	50	55	65	75	80
Tests on Residue: Pen 77 °F., 100 g., 5 sec	80-120	80-120	80-120	80-120	80-120

Pen. Ratio: (39.2 °F./77 °F x 100), Min.	30	30	30	30	30
Ductility, 0.16 feet (5 cm)./min., @ 77 °F., cm., Min.	100	100	100	100	100
% Sol. in CC @ 4% Min. ***(9)***	99.5	99.5	99.5	99.5	99.5

1. 1.0% limit for petroleum asphalt; 3.0% for fluxed natural asphalt.
2. 99.5% petroleum asphalt, 95.0+ for Bermudez; 81.0+ for Cuban; 66.0+ for Trinidad.
3. Pen: @ 32 °F., 200 g., 60 sec. = 10+; pen. @ 115 F., 50 g., 5 sec. = 60-; shall not foam at 400 °F
4. Requires heat application
5. Bituminous material supplied under Items 44A, 44D, and 44E will be required to pass the stone coating test prescribed by the Laboratory.
6. Based on total emissions.
7. Float test at 140°F.: 1200 seconds minimum.
8. Viscosity test, Alternate Method

Grade	Furol Viscosity	
30	@ 77 °F	75 to 150 sec.
70	@ 122 °F	60 to 120 sec.
250	@ 140 °F	125 to 250 sec.
800	@ 180 °F	100 to 200 sec.
3000	@ 180 °F	300 to 600 sec.

   a. Note: In case of non-agreement of results of Kinematic and Furol Viscosity tests, the results of the Kinematic Viscosity test shall govern.
9. 99.5% + for petroleum products; 90.0% + for blended native Asphalt.

M. General Notes
1. On request, a sample of the emulsion may be taken by an inspector of the Department from a factory lot of material of not less than 20,000 gallons. The samples so submitted shall meet the requirements of the above Specifications. Any material accepted at the time of shipment that proves defective within thirty (30) days after date of delivery will be rejected and no payment will be made therefor.

N. Paving Plants
1. Acceptance and Uniformity: Bituminous mixing plants shall be so designed, coordinated and operated as to produce a uniform mixture of the material. Each plant, whether fixed or portable, shall be inspected and approved by the Department. The right is reserved by the Owner to discontinue the use of any previously approved equipment at any time if unsatisfactory results occur during the progress of the work.
2. Equipment for Preparation of Bituminous Materials: Tanks for the storage of bituminous material requiring heat shall be capable of heating the material under effective and positive control, at all times, to the temperatures required by the Specifications or ordered by the Engineer. Heating shall be accomplished by steam or oil coils, electricity or other means in such a manner that no flame will come in contact with the heating tank. Storage tank capacity shall be sufficient for at least one (1) day's run.
3. A circulating system for the bitumen shall be provided, of adequate size to insure the proper and continuous circulation between storage tank and mixer during the entire operating period. Separate tanks and separate pipe lines shall be provided if mixtures containing asphalt cement and liquid asphalt materials are to be mixed in the same mixer. Separate storage tanks and separate pipe lines shall also be provided if tar products or emulsified asphalt are to be used as the binding medium in bituminous mixtures.
4. Dryers and Feeders: All plants shall be equipped with at least one dryer for the mineral aggregates. The dryer shall be of the cylindrical rotating type and be capable of drying and heating mineral aggregates in quantities in excess of the operating capacity of the plant.

The dryer shall also be capable of maintaining the specified temperatures so that there will be no unburned oily residue on the aggregate when it is discharged from the dryer.

5. The aggregates shall be fed to the dryer by such procedures and/or feeders, as approved by the Engineer, that they will be substantially in the proportions specified for the finished mix. Both fine and coarse aggregate may be fed simultaneously into the dryer.

O. Screens: Each mixing plant shall be equipped with screens capable of screening all aggregates to the sizes required for proportioning the mix. The operating capacities of the screens shall be in excess of the full capacity of the mixer.

P. Aggregate Storage Bins: The bituminous mixing plant shall include storage bins of sufficient capacity to insure uniform and continuous operation. There shall be at least four storage bins so arranged as to insure separate storage of the fractions of the aggregates required for proportioning the mix. Each bin shall be provided with an overflow chute that shall be of such size and location to prevent any backing up or overflow of material into other bins.

1. Bins shall also be provided with adequate telltale devices to indicate the position of the contained aggregate at the lower quarter points.
2. Adequate and convenient facilities shall be provided for obtaining representative aggregate samples from each bin for any selected batch.

Q. Bituminous Control Unit: Satisfactory means, either by weighing, metering, or volumetric measurements, shall be provided to furnish the specified amount of bituminous material in the mix. Suitable means shall be provided by steam jacketing or other insulation for maintaining the specified temperatures of the bituminous materials in the pipe lines, meters, weight buckets, spray bars and other containers and flow lines.

1. If metering or volumetric devices are used to proportion bituminous materials for plant mixtures, suitable valves and bypasses shall be provided so that each measuring device may be conveniently checked by actual weight.

R. Thermometric Equipment: An armored Fahrenheit thermometer with a range sufficient to cover the specified temperature range of the bituminous material shall be fixed in the bituminous feed line at a suitable location near the discharge valve at the mixer unit. An approved thermometric instrument shall also be placed at the discharge chute of the dryer and in the lower quarter of the fine bin so as to show the temperature of the heated aggregates. All the thermometers shall be accurate to two-and-one-half (2.5) degrees Fahrenheit.

S. Dust Collectors: Bituminous mixing plants shall be equipped with adequate dust collecting systems so that objectionable dust and fumes will be removed.

T. Weight of Truck Loads: Each bituminous mixing plant shall be equipped with approved platform scales of sufficient capacity and size to weigh accurately the heaviest loaded trucks or tractor-trailers that are used for the delivery of the plant mixed bituminous materials from that plant. The platforms shall be of sufficient length to accommodate all of the truck wheels or all of the tractor and trailer wheels during the weighing operation. The weighing of wheels or sets of wheels separately will not be permitted.

1. The platforms scales shall have dials graduated in twenty (20) pound increments and equipped with attached printers so that all weighing will be automatic. The automatic recorders shall print weights to the nearest twenty (20) pounds.
2. All trucks shall be weighed for each trip, both empty and loaded. Tare weights shall not be discounted by means of tare weight beams to secure net weights. Gross weight and tare weight shall be recorded and the net weight written in for each truck load. All weighing shall be done in the presence of a representative of the Engineer.
3. When the net weight of a truck load of plant mixed bituminous material varies by more than two (2) percent from the product of the batch weights times the number of batches in each truck, the load of material may be rejected.
4. Platform scales shall be approved by a representative of the Nassau County Department of Public Works Laboratory immediately prior to their use for any County work and both scales and shipments shall be subject to inspections by the Nassau County Bureau of Weights and Measures at any time.

5. Testing of Plant Scales: All plant scales, including truck scales, shall be tested at the expense of the Contractor by a competent scales technician as follows:
    a. Prior to use in Work.
    b. At intervals of not more than thirty (30) calendar days thereafter.
    c. At any time ordered by the Engineer.
6. Subsequent to each adjustment by a scales technician, the scale shall be sealed by the Sealer of Weights and Measures. The Contractor shall furnish, for use in testing proportioning scales, at least ten (10) Standard fifty (50) pound test weights. For each scale, a cradle or platform approved by the Department shall be provided for applying the test weights.

U. Safety Requirements: Adequate and safe stairways to the mixer platform and guarded ladders to other plant units shall be placed at all points required for accessibility to plant operations. All gears, pulleys, chains, sprockets and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading space. This space shall be kept free of drippings from the mixing platform.
    1. Each mixing plant shall be equipped with adequate fire fighting equipment.

V. Plant Inspection: Each bituminous mixing plant site shall be provided with suitable buildings or rooms for use as an office and for testing purposes for the exclusive use of the Engineer and their inspectors. The plant shall provide in such buildings or rooms: an asphalt extraction apparatus and a suitable power driven sieving machine each with a capacity of at least 1000 grams; scales and appropriate sieving equipment for each type of material to be produced; and a telephone. Suitability of all office and testing space and equipment will be subject to approval by the Engineer.

W. Batching Plants
    1. All requirements under "Paving Plants," shall apply with the following additional requirements:
        a. Weigh Box or Hopper: This equipment shall include means for accurately weighing each bin size of aggregate in a weigh box or hopper suspended on dial scales. The weigh box shall be of ample size to hold a full batch without hand raking or spillage. The gates on the aggregate bins and the hopper shall be so constructed as to prevent leakage when closed.

X. Aggregate Scales: Scales for any weight box or hopper shall be the springless dial type with a full complement of index pointers and of a standard make and design. They shall be accurate to one-half (0.50) percent, have minimum graduations not greater than one-quarter (0.25) percent and shall be readable and sensitive to one-eighth (0.125) percent or less -- the preceding percentages being based on total batch weight. Scales shall be so located as to be easily readable from the operators normal work station.
    1. The batching controls shall meet the following delivery tolerances, based on total batch weight, with respect to the various components weighed in each batch:
        a. Combined Aggregate Components.....+/- 1.5%
        b. Mineral Filler..... +/- 0.5%
        c. Asphalt..... +/- 0.1%
    2. The total weight of the batch shall not vary more than plus or minus two (2) percent from the theoretical design weight.

Y. Bituminous Bucket and Spray Bars: The asphalt cement may be introduced into the mixer by means of an asphalt bucket, by steam pressure and a spray bar or by a pressure pump and spray bar.
    1. If a bituminous bucket is used, the bucket shall have a working capacity of not less than eleven (11) percent by weight of the rated capacity of the mixer, it shall be heated in an approved manner by steam, oil, electricity or other approved means, and it shall be so arranged that it will deliver the bituminous material in a thin uniform sheet or in multiple streams the full length of the mixer. The bucket shall be suspended on adjustable dial scales so that the tare weight can be conveniently brought to zero reading at all times.

2. If spray bars are used to introduce the bituminous material into the mixer, they shall be so heated and constructed as to distribute the bituminous material uniformly upon the mineral aggregates.

Z. Bituminous Measuring Devices: All measuring devices except scales shall be accurate to one-tenth (0.10) percent, have minimum graduations not greater then five-hundredth (0.050) percent, and shall be readable and sensitive to twenty-five-hundredth (0.025) percent or less -- the preceding percentages being based on total batch weight. They shall be so located as to be easily readable from the operator's normal work station.
   1. If Bitumen is proportioned by weight, the scales shall be of the springless dial type of a standard make and design.

AA. Mixer Unit: The mixer unit shall be of an approved twin shaft pugmill type. The mixer unit shall be capable of producing a satisfactory uniform mixture within the limits specified and shall have a capacity of not less than two thousand pounds. The blades of the pugmill shall have a clearance from all fixed and moving parts not in excess of three-quarters (3/4) of an inch. Paddle blades reduced by wear in excess of twenty-five (25) percent in face area from their new condition shall be replaced. The mixer shall be so constructed as to prevent leakage of contents until the batch is discharged.
   1. The use of batteries of small batch mixers will not be permitted.

BB. Time Locking Device: The mixer shall have an accurate time locking device to control the operation of a complete mixing cycle by locking the weight box gate, after the mixer is charged, until the closing of the mixer discharge gate at the completion of the cycle. It shall lock the bituminous material feed throughout the dry mixing period and shall lock the mixer discharge gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the commencement of application of the bituminous material. The wet mixing period is the interval of time between the commencement of application of the bituminous material and the opening of the mixer discharge gate.
   1. The control of the timing shall be flexible and capable of being set at intervals of not more than five seconds throughout the cycles up to three minutes. Changes in mixing time shall be made only when ordered by the Engineer.
   2. The point of control of the time locking device shall be so located that it is readily accessible to the operator of the mixing plant.

CC. Continuous Mixing Plant
   1. General: The Contractor may at ownoption use a continuous mixing plant of an approved type. All requirements under "Paving Plants" shall apply with the following additional requirements.
   2. Gradation Control Unit: The unit shall have interlocked feeders mounted under the compartment bins. Each bin shall have an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from each respective bin compartment. The feeding orifice shall be of adequate dimensions to provide a positive feed without bridging; the dimension shall be adjustable by positive mechanical means that shall be provided with a lock. Indicators graduated to tenths of an inch shall be provided on each gate to show the calibrated gate opening. When added mineral filler is specified, a separate bin and feeder shall be furnished with its drive interlocked with the aggregate feeders. The interlocked feeders shall be equipped with a revolution counter reading to .01 of a revolution to facilitate the calibration of the aggregate flow.
   3. Each compartment of the hot aggregate bin shall be equipped with an approved indicator that shall warn the operator before a compartment becomes empty.

DD. Weight Calibration of Feeds: The plant shall be provided with means for calibrating the gate openings and bitumen flow by the use of weight test samples. The aggregates for the test samples shall be fed out of the bins through individual orifices and bypassed to a suitable test box, the material from each compartment being confined in a separate container or box section. The plant shall be equipped to handle conveniently test samples of adequate size to provide an accurate gate calibration commensurate with the aggregate size, the gate opening and the plant capacity set up.

1. An approved accurate platform scale with a minimum capacity of three-hundred (300) pounds shall also be provided.

EE. Synchronization of Feeds: Satisfactory means shall be provided to afford positive mechanical interlocking control between the flow of aggregate from the bins and the flow of bitumen from a positive displacement metering pump. The point of control of the metering pump capacity shall be so located that it is not accessible to the operator from the mixer platform.

FF. Mixer Unit: The plant shall be equipped with a continuous, steam jacketed, twin shaft, pugmill type mixer that shall be capable of producing a uniform mixture within the job mix tolerances. The paddles shall be of a type adjustable for angular position on the shafts and shall be reversible to retard the flow of the mixture. The mixer shall be equipped with a discharge hopper having a capacity of approximately one ton. The hopper shall be equipped with dump gates which will permit rapid and complete discharge of the bituminous mixture and shall be of a design approved by the Department. The mixer shall carry a manufacturer's plate showing the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge.

1. Charts shall be provided showing the rate of feed of aggregate per feeder revolution for the specific aggregate being used. Determination of mixing time shall be by the weight method using the following formula:
   Mixing Time in Seconds = [Pugmill Dead Capacity in Lbs] / [Pugmill Output in Lbs. per sec]

1. The weights will be determined for the job by tests made by the Department.
2. The plant shall have a rated capacity of not less than forty (40) tons per hour.

GG. Preparation of Bitumin-ous Materials: Bituminous material shall be delivered to the mixer at a temperature within the range specified for the type material being mixed.

HH. Preparation and Composition of Mixture: Each size of properly heated aggregate, the dry mineral filler if required, and the bituminous material shall be measured separately and accurately to the proportions in which they are to be mixed. The volume of the mineral aggregates and the asphalt cement, when placed in the mixer, shall not be so great as to extend above the tips of the mixer blades when these blades are in a vertical position nor such as to exceed the manufacturer's rated capacity of the mixer. In no case shall the total quantity of material mixed be less than fifty (50) percent of the manufacturer's rated capacity of the mixer unit. After the properly heated aggregates and mineral filler, if required, have been charged into the mixer and thoroughly mixed for a period of not less than fifteen seconds or as directed by the Engineer, the proper amount of bituminous material shall be added and the mixing continued for a period of at least forty-five (45) seconds to produce a uniform and homogeneous mixture in which all particles of the mineral aggregate are completely and uniformly coated with the bituminous material.

1. The introduction of the materials into the mixer and the mixing operation shall be carried out as outlined above unless the mixing operation, for the particular type of material that is being manufactured, calls for some other method of procedure, in which case that particular specification for mixing operations shall be followed.
2. The number of batches produced in one (1) hour from one mixer shall not be in excess of a rate of fifty (50) batches per hour, except for higher volume plants of adequate design and condition, this rate may be increased only by written authorization of the Department.

II. Job Mix Formula: For any bituminous mixture required in the Contract, formulate and submit a job mix formula that satisfied the General Limits imposed in Table IV "Composition of Mixtures for Plant Mixed Bituminous Materials".

1. Once approved, the mix shall be kept within the Job Mix Tolerances set forth in Table IV. The aggregate tolerances shall be based on the total weight of the aggregate and the asphalt cement tolerances shall be based on the total weight of the mix. However, in no case shall the Job Mix Tolerances fall outside the General Limits for a particular item.
2. If for any reason a change in materials occurs or is contemplated, a separate Job Mix Formula shall be used to fit each change in materials or conditions.

Table IV - Composition of Mixtures for Plant Mixed Bituminous Concrete

	Dense Base*		Type 1A (Hot Process)*		Type 1AC	
Screen Sizes	General Limits % Pass	Job Mix % Tol	General Limits % Pass	Job Mix % Tol	General Limits % Pass	Job Mix % Tol
2"	100	0				
1-1/2"	90-100	0				
1"	78-95	+/- 5	100	0		
3/4"	57-84	+/- 6	95-100	+5	100	
1/2"	40-72	+/- 7	65-85	+5	90-100	
3/8"	26-57	+/- 7	32-65	+4	45-70	+/- 6
20	12-36	+/- 7	15-39	+4	15-40	+/- 7
40	8-25	+/- 7	7-25	+3	8-27	+/- 7
80	4-16	+/- 4	3-12	+2	4-16	+/- 4
200	2-8	+/- 2	2-6	+2	2-6	+/- 2
Asphalt Cement %	4.0-6.0	+/- 0.4	5.8-7.0	+/- 0.4	6.0-8.0	+/- 0.4
Penetration of Asphalt Cement	85-100		85-100		85-100	
Placing Temperature	250-325		225-300		250-325	
Texture Surface	Coarse		Granular		Smooth, Gritty	
Typical Uses	Base Course		Binder Course Temp. Pvmt		Wearing Course	

a. Note: All aggregate percentages are based on the total weight of the aggregate.
b. All other percentages are based on the total weight of the mix.
c. *30% of the aggregate that passes the No. 4 Sieve may be glass products.

2.05 GRANULAR SUBBASE COURSE

A. Materials for Subbase Course shall consist of Gravel, approved Blast Furnace Slag or Stone. All material furnished shall be well graded from coarse to fine and free from organic or other deleterious materials.

B. Materials furnished for Types 1, 3 and 4 shall consist of approved Blast Furnace Slag, Stone, Sand and Gravel or blends of these materials. Material furnished for Type 2 shall consist solely of approved Blast Furnace Slag or of Stone which is the product of crushing ledge rock.

C. Gradation:

Type	Sieve Size Designation	Percent Passing by Weight
1	3 inch (76.2 mm)	100
	2 inch (50.8 mm)	90-100
	1/4 inch	30-65
	No. 40	5-40
	No. 200	0-10
2	2 inch	100
	1/4 inch	25-60

	No. 40	5-40
	No. 200	0-10
3	4 inch (101.6 mm)	100
	1/4 inch	30-75
	No. 40	5-40
	No. 200	0-10
4	2 inch	100
	1/4 inch	30-65
	No. 40	5-40
	No. 200	0-10

D. Soundness: Material for Types 1, 2 and 4 will be accepted on the basis of a Magnesium Sulfate Soundness Loss after 4 cycles, of twenty (20) percent or less. Material for Type 3 will be accepted on the basis of a Magnesium Sulfate Soundness Loss after 4 cycles, of thirty (30) percent or less.

E. Plasticity Index: The plasticity index of the material passing the No. 40 mesh sieve shall not exceed five (5.0).

F. Elongated Particles: Not more than thirty (30) percent, by weight, of the particles retained on a one-half (1/2) inch sieve shall consist of flat or elongated particles. A flat or elongated particle is defined herein as one which has its greatest dimension more than three (3) times its least dimension. Acceptance for this requirement will normally be based on a visual inspection by the Owner.

G. All material shall meet the specified gradation prior to placement on the grade.

H. All processing shall be completed at the source.

2.06 CRUSHED CONCRETE AGGREGATE BASE COURSE AND STONE BLEND BASE COURSE

A. The Crushed Concrete Aggregate Base Course shall consist of a natural or artificial mixture of soils and crushed materials free of any wire or steel reinforcement.

B. The Stone Blend Base Course shall consist of crushed stone, blended with crushed stone screening.

1. The Base Course material used shall be well graded and have the following mechanical gradation:

Sieve Size	General Limits Passing
1-1/2"	100%
1"	90%-100%
1/2"	65%-85%
1/4"	55%-75%
#4	40%-55%
#8	30%-45%
#16	22%-36%
#30	11%-27%
#50	6%-20%
#100	3%-15%
#200	1%-10%

2.07 LIMESTONE SCREENING

A. Stone screening shall be limestone and may be crusher run provided one-hundred (100) percent passes a one-half (1/2) inch screen, fifteen (15) percent to thirty-five (35) percent passes a No. 20 screen, and a maximum of five (5) percent passes a No. 200 screen. Screening need not be washed, provided they contain no clay, loam, or other deleterious material.

PART 3 - EXECUTION

3.01 PREPARATION

A. Break up, remove and satisfactorily dispose of all existing Portland cement concrete pavement required to be removed in order to construct the work.

B. The use of a demolition ball operated from a crane or other equipment will not be permitted.

C. Concrete pavement shall be removed in two separate operations. In the first operation, the pavement shall be removed to the width of the trench. In the second operation, the pavement shall be removed to an additional width not to exceed eighteen (18) inches beyond the edge of the trench or excavation just before the restoration of pavement. In areas where the pavement has been undermined to a greater extent than eighteen (18) inches, the undermined area shall be restored by an approved method. Prior to the second operation saw cut the concrete pavement to a depth of at least one-half (1/2) of the pavement thickness along the lines of removal unless directed otherwise by the Engineer. Where, in the opinion of the Engineer, it is necessary or desirable to remove the pavement or pavement base beyond the limits given above, remove same to the lines ordered by the Engineer. In crossing or traversing state roads or parkways, the limits for pavement removal shall be in accordance with the State requirements.

D. All material shall be promptly removed from the site and disposed of by the Contractor.

3.02 INSTALLATION

A. Permanent paving materials other than crushed concrete aggregate or stone blend base course may be placed only when the air temperature is forty (40) degrees Fahrenheit and rising or warmer and the surface on which the paving is to be laid is forty (40) degrees Fahrenheit or higher. All temperatures are to be measured in the shade. No pavement shall be placed on wet surfaces or during rain storms.

B. Bituminous pavement for temporary pavements, that are not and will not become part of a permanent pavement, will not be subject to the above regulations in regard to weather limitations. No pavement, however, shall be laid on a frozen subgrade.

3.03 REPLACEMENT OF FINISHED PORTLAND CEMENT CONCRETE PAVEMENT (CLASS "A" PAVEMENT)

A. The replacement of finished Portland Cement Concrete Pavement (Class "A" Pavement) includes the removal of any temporary pavement, excavation, removal of sufficient shoulder area materials to permit placing of pavement forms, replacing all Reinforced Portland Cement Concrete Pavement removed in constructing the work and replacement, in kind, of the original materials in the shoulder areas disturbed or damaged through the operations of the Contractor.

B. All excavation, removal of temporary pavement, fine grading, compacting and furnishing and placing of all materials required to replace the removed pavement, and disturbed or damaged shoulder areas to the original grade and dimensions with new materials, are included in this work.

C. Where steel reinforcement is required, the reinforcement shall be steel bars, dowels, or welded wire fabric and shall conform to the requirements in Section 032100, "Steel Reinforcement".

D. Methods and Materials used in the replacement of finished Portland cement concrete pavement shall be in accordance with Section 033000, "Concrete". Concrete shall not be placed unless an inspector is present. The Engineer shall have authority to suspend mixing operations at any time when in their judgment temperature, weather conditions or darkness may interfere with the proper execution and completion of the work.

3.04 REPLACEMENT OF PORTLAND CEMENT CONCRETE BASE PAVEMENT (CLASS "A" PAVEMENT)

A. The replacement of Portland Cement Concrete Base Pavement (Class "A" Pavement) includes the removal of any temporary pavement, excavation, removal of sufficient shoulder area materials to permit placing of pavement forms, replacing of all Portland cement concrete base pavement removed in constructing the work and the replacement, in kind, of the original materials in the shoulder areas disturbed or damaged through the operations of the Contractor.

B. All excavation, removal of any temporary pavement, fine grading, compacting and furnishing and placing of all materials required to replace the removed concrete base pavement, and disturbed or damaged shoulder areas to the original grade and dimensions, are included in this work.

C. Methods and Materials used in the replacement of Portland cement concrete base pavement shall be in accordance with Section 033000, "Concrete". Concrete shall not be placed unless an inspector is present. The Engineer shall have authority to suspend mixing operations at any time when in their judgment temperature, weather conditions or darkness may interfere with the proper execution and completion of the work.

D. Where steel reinforcement is required, the reinforcement shall be steel bars, dowels, or welded wire fabric and shall conform to the requirements given under Section 032100, "Steel Reinforcement".

3.05 FORMS FOR BITUMINOUS CONCRETE PAVEMENT

A. Forms for bituminous concrete pavement, where required, shall be straight, free from bends and warps, and of sufficient thickness to resist the forces incidental to their use and retain a rigid and straight face and profile. They shall be cleaned and oiled thoroughly each time they are used.

B. The forms shall rest firmly upon the thoroughly compacted subgrade throughout their entire length and be securely staked or pinned to the subgrade in such a manner to resist any movement or displacement of the bituminous material while being placed, formed or compacted into its final shape and position. The finished result shall have straight or smoothly curved lines and profile, without pockets or hollows and fit the topography of the area which it is designed to serve.

3.06 TRANSPORTATION AND DELIVERY OF BITUMINOUS CONCRETE MIXTURES

A. The mixture shall be transported from the mixing plants to the work site in tight vehicles previously cleaned of all foreign materials and each load shall be covered with canvas or other suitable material of sufficient size and thickness to protect it from weather conditions. No loads shall be sent out so late in the day as to interfere with spreading and compacting the mixture during normal working hours. The mixture shall be delivered within temperature limits specified herein.

B. When the air temperature is near the minimum permitted for laying the pavement, insulate the sides of steel bodied vehicles used for the transportation of plant mixed material.

C. Just before the vehicles are loaded, the inside surfaces of the vehicles used for the transportation of plant mixes shall be lightly coated with a whitewash of lime and water, soap solution or detergents approved by the Engineer. The use of any asphalt or tar solvents for coating the inside of the vehicles will not be permitted.

3.07 PLACING BITUMINOUS CONCRETE PAVEMENT

A. Base and Binder Course Pavement
   1. Base and binder course materials shall be placed and spread with spreading equipment acceptable to the Engineer.
   2. Provide the base and binder course material in lifts of a maximum unconsolidated depth which does not exceed the depth necessary to produce a compacted thickness of four-and-one-half (4-1/2) inches.
   3. All defective areas in a foundation for a base/binder course shall be repaired, as directed, in advance of laying the base/binder course. Placing of the mixture by machine shall be continuous at a rate which will prevent the formation of cold joints.

B. Wearing Course Pavement
   1. Provide paving materials only where the surface to be covered is dry and clean. Paving materials shall be placed only when weather conditions, in the judgment of the Engineer, are suitable.
   2. The course shall be laid with finishing machines of approved type. If there are less than 1,500 sq yards in the Contract, or the areas to be paved are small and scattered, a finishing machine may be dispensed with and the course spread by hand methods as directed by the Engineer.

3. The equipment for spreading and finishing shall be mechanical, self-powered pavers, capable of spreading and finishing the mixture true to the line, grade and crown required. Each finishing machine shall have an edging attachment to aid in securing a satisfactory joint between lanes.
4. The pavers shall be equipped with electronically controlled depth and slope devices which, by following a predetermined grade reference, automatically control the screed and assure an accurate control of the depth or thickness of the course being laid and provide a precise angle for the crown of the road, unless otherwise permitted by the Engineer.
5. During laying operations, the screeds shall be heated to maintain the required temperature as set forth in the Specifications for the mix. Screeds shall be of the vibrating type.
6. The term "screed" includes any cutting, crowding or practical action that is effective in producing a finished surface of the evenness and texture specified without tearing, shoving or gouging. When screed extensions are permitted by the Engineer for placement of the final wearing surface, such extensions shall be the same design as the main screed.
7. If, during construction, it is found that the spreading and finishing equipment leaves tracks or indented areas or other objectionable irregularities the use of such equipment shall be discontinued. Other satisfactory spreading and finishing equipment shall be provided by the Contractor.
8. In placing and compacting abutting courses of bituminous concrete pavement items, that constitute the final or wearing surfaces, approved joint heater devices shall be used on all joints.

C. Prior to placement of the wearing course, mill the existing pavement at all locations where the wearing course will meet the existing roadway surface to permit the wearing course to make a uniform transition into the existing surface. The new existing surfaces shall meet in a flush joint. The milling operation shall create a notch that is a minimum of □ inch in depth and a minimum of five (5) feet in width. The edges of the notch shall be saw cut to ensure a straight and true joint at the point where the two pavements meet.
   1. The contact surfaces of all curbing, gutters, manholes, and of adjacent pavement edges shall be painted or sealed with approved bituminous material before placing the pavement material.
   2. Upon arrival, the mixture shall be dumped into the approved mechanical spreader and immediately spread and struck off to the full width required and to such appropriate loose depth that when the work is completed, the compacted thickness required will be secured. Where hand spreading is necessary, the mixture, upon arrival, shall be dumped on acceptable dump sheets and immediately distributed into place by suitable tools and spread in a uniform loose layer of such depth as will result in a completed pavement having the thickness required.
   3. Before any rolling is started, the finished surface shall be checked, any imperfections adjusted, and all unsatisfactory material from any source removed. Any deviation from standard crown or section shall be immediately remedied by placing additional material or removing surplus material as directed.

3.08 COMPACTING BITUMINOUS CONCRETE PAVEMENT

A. Compaction Method
   1. After placing and while still hot and workable, the course shall initially be rolled with a 10-12 ton power-driven roller, an 8-10 ton tandem roller or a roller producing a compression with the rear wheels of not less than two-hundred-fifty (250) pound per inch of tread. The rollers used for this rolling shall have steel wheels. During the initial rolling, the roller shall travel parallel to the centerline of the pavement beginning at each edge and working toward the center, overlapping on successive trips by one half the rear wheel of the roller. The rolling shall proceed continuously at the rate of not more than twenty-five (25) tons of mixture per hour for each roller.
   2. Immediately following the initial rolling, the bituminous course shall be compacted using vibratory compaction equipment to compact the various bituminous courses in accordance with these requirements. Vibratory rollers shall operate at a uniform speed not exceeding

two-and-one-half (2-1/2) miles per hour (220 feet (6705.6 cm) per minute) on all pavement courses.

3. Immediately following the intermediate rolling, the courses shall be finish rolled with a ten (10) ton steel-wheel tandem roller. This final rolling shall be both longitudinal and diagonal and shall remove all shallow ruts and ridges and other irregularities from the surface. Rolling shall be continued until all roller marks are eliminated.
4. No pavement course shall be compacted to thicknesses in excess of four and one-half (4-1/2) inches.
5. One vibratory roller and one steel-wheel tandem roller shall be provided for each nominal twelve (12) foot width of paving. Dual vibrating drum rollers meeting the requirements of a steel-wheel tandem roller and operating in the static mode may be used as the finish roller. However, this single vibratory roller shall not be used as both the initial roller and the finish roller.

B. All turning of the compaction equipment shall be completed on material which has had a minimum of one (1) roller pass.
   1. The required number of passes listed in the table below are minimum and may be increased by the Engineer. A single (one) pass shall be defined as one movement of the roller over any point of the pavement in either direction. The required number of vibrating passes may be reduced by one-half (1/2) for dual vibrating drum rollers when the drums are tandem and are both vibrating. Static rolling shall continue until all ruts, ridges, roller marks or other irregularities are removed from the surface.
      a. Required Number of Passes (minimum)

Pavement Courses	**Vibratory Roller** Vibrating Passes	**Steel-Wheel Tandem** **Finish Roller** **Static Passes**
Base	4	2
Binder	2	2
Wearing	2	2

      a. Unless otherwise directed by the Engineer, dual vibrating drum rollers shall compact the joint by overlapping the longitudinal joint in two passes with both drums operating static.
   2. In all places inaccessible to a roller, the required compaction shall be accomplished with mechanical tampers.

C. Supplemental Requirements
   1. The wheels of the roller and paver shall be kept clean at all times. They may be kept moist with water or a mixture of water with not more than ten (10) percent lubricating oil. Dirty water, petroleum solvents, or grease shall not be allowed to drop from the roller or paver onto the pavement.
   2. If depressions remain after rolling, more of the paving material shall be added at such points and firmly rolled into place. After the rolling has been finished, the surface of the course shall have the required crown, density and compacted thickness and be at the grade established for the surface of the finished pavement. At the direction of the Engineer, any unsatisfactory areas that develop shall be removed and replaced with suitable material at the expense of the Contractor.
   3. Provide suitable means for keeping all small tools clean and free from bituminous accumulations. The surface of pavement shall be protected from drippings of oil, kerosene, etc. used for the cleaning of small tools.
   4. Asphalt concrete wearing courses shall be compacted to a minimum density of ninety-five (95) percent of the theoretical density as determined by the following formula:

$$D = \frac{100}{\frac{\%\ of\ mineral\ aggregate}{S.G.of\ aggregate} + \frac{\%\ of\ bituminous\ material}{S.G.of\ bituminous\ material}}$$

5. Tests for conformance with the above minimum density shall be determined from bulk specific gravity computations made in accordance with the standard method of test for Specific Gravity of Compressed Bituminous Mixtures, AASTHO TL66
6. The County's Laboratory will make the tests on pavement samples cut from the finished course or courses by the Contractor under the direction and from the locations as ordered by the Engineer. One (1) sample shall be taken for each day or fraction of a day when bituminous material is placed. In addition, samples shall be taken whenever a substantial change is made in the job mix formula. Any additional labor and materials required for the removal and replacement of samples used by the Laboratory for testing purposes shall be included in the price bid for the appropriate asphalt bituminous concrete items.

3.09 TEMPORARY PAVEMENT OVER ALL SEWER TRENCHES

A. General
1. Provide temporary pavement, as described herein, over all sewer trenches for the purpose of maintaining pedestrian and vehicular traffic over these trenches until the final pavement and sidewalk restoration commences. Temporary pavement shall be placed as soon as possible, but not later than the Friday following the backfilling of the sewer trench.

B. Construction
1. After the trench has been properly backfilled, excavation shall be made over the trench area and the subgrade compacted so as to permit the placing of a one-and-one-half (1-1/2) inch minimum compacted thickness of bituminous concrete unless otherwise shown on the Plans. The subgrade shall be smooth and parallel to the desired surface of the finished temporary pavement.
2. The temporary pavement shall be Type 1A Bituminous Concrete as specified herein. The Bituminous Concrete shall be compacted with steel wheel tandem rollers. A minimum of two passes shall be required. In places inaccessible to rollers, the required compaction shall be accomplished with mechanical tampers.
3. Maintain the temporary pavement in satisfactory condition free of potholes until permanent pavement is installed. All manhole castings shall be set flush with the road surface.

3.10 PERMANENT BITUMINOUS CONCRETE PAVEMENT OVER SEWER TRENCHES

A. General
1. The work included under various items consists of furnishing and placing the base course, binder course, and wearing course pavement.
2. All excavation, removal of any temporary pavement, fine grading, compacting, furnishing and placing of all materials required to replace the removed pavement, and disturbed or damaged shoulder areas to the original grade and dimensions with new materials are included in the items.
3. All manhole and utility castings shall be set flush with the final pavement surface.
4. All existing pavement surfaces to be paved shall be cleaned prior to the placement of additional pavement material.

B. Construction
1. As soon as possible, after the trench has been properly backfilled, compacted and the sewers have been tested, the trench area shall be excavated to the proper depth and compacted by rolling or other approved method, so that the compacted pavement will be at the proper street grade when finished.
2. The type of the bituminous concrete plant mix for the individual pavement courses shall be as specified in Table V.
3. Base Course materials for Class "B" pavements shall be either:
   a. Bituminous Concrete (Dense Base Mix).

b. Crushed Concrete Aggregate.
c. Stone Blend.
d. The Base Course shall consist entirely of one of these materials to the depth specified in Table V.

4. Base Course materials for Class "C" pavements shall be bituminous concrete plant mix of the type specified in Table V.
5. The Binder Course shall consist of Bituminous Concrete Type 1A, placed to a minimum depth of one-and-one-half (1-1/2) inches or the thickness of the existing binder course.
6. Asphalt covering existing concrete base pavement or resurfaced concrete pavement shall be removed for a minimum width of one (1'-0") foot on either side of any area where the concrete has been removed so that the new concrete base may be properly screeded. The one (1) foot minimum shall be measured from the saw cut line of the concrete base. The cutting and removing of this asphalt shall be in a manner approved by the Engineer and shall produce a straight, even and true line.
7. Wearing course mix shall be bituminous concrete Top Course Type 1AC, compacted to a minimum thickness of three-fourths (3/4) inch. In general, the wearing course shall be placed curb to curb.
8. The Bituminous Concrete wearing course shall not be placed until curbs, gutter aprons, driveway aprons, surface inlets, catch basins and manhole have been constructed.
9. A tack coat consisting of Asphalt Emulsion RS-1 shall be applied to the existing paved surface to provide bond between this surface and the bituminous concrete wearing course. This tack coat shall uniformly cover the surface of the area to be paved. Tack coat shall only be applied to areas which will be paved the same day at a rate of 0.05 to 0.15 gallons per square yard. In places where the distributor bars cannot reach, apply the tack coat with a hand spray.
   a. Adjacent areas such as curbs, gutters, aprons, grass, etc., shall be protected in a manner satisfactory to the Engineer. In the event that any of these adjacent areas are covered or splattered, clean and restore them to their original condition.
10. Forms, transportation and delivery, placing, and compacting of the bituminous concrete plant mix shall be as directed in the preceding subsections 3.05, 3.06, 3.07 and 3.08.
11. The following Table V shall be used to determine the requirements for placement of pavement replacement.

Table V - Typical Pavement Replacement

Pavement Classification	Base Pavement		Wearing Course
	Base Course	Binder Course	
"A" P.C.C. (finished)	None	None	Depth in Kind or as Specified or as shown
"A" P.C.C. (Base)	Depth in Kind or as Specified or as shown	Match existing thickness- Min. 3/4" (Type 1A)	3/4" (Type 1AC)
"B" (b)	4 1/2" Dense Base	1 1/2" (Type 1A)	3/4" (Type 1AC)
"B" (b)	6" Crushed Concrete (a)	1 1/2" (Type 1A) (a)	3/4" (Type 1AC)
"B" (b)	6" Stone Blend (a)	1 1/2" (Type 1A) (a)	3/4" (Type 1AC)
"C"	3" Dense Base	None	3/4" (Type 1AC)

a. Notes:
   1) Vibratory Compaction is a mandatory requirement with this option.
   2) Contractor's choice

3.11 PLACEMENT OF GRANULAR SUBBASE COURSE

A. Placement of granular subbase course includes all excavation and the furnishing, placing and compacting of a granular subbase course for pavement in locations shown on the plans or as determined by field conditions and ordered by the Engineer. Unless otherwise stated in the plans the Contractor may elect any of three (3) options as follows:

Option A	- Subbase construction consisting of two (2) separate layers of Type 4 and Type 3 Subbase Course.
Option B	- Subbase construction consisting of a single layer of Type 1 Subbase Course.
Option C	- Subbase construction consisting of a single layer of Type 2 Subbase Course.

B. Provide granular subbase material over a properly backfilled and compacted trench area in a manner to minimize segregation. Uncontrolled spreading from piles dumped on the grade resulting in segregation will not be permitted. The course shall not be placed in excess of five-hundred (500) linear feet without being compacted.
   1. Should the subbase become mixed with the subgrade or any other material, through any cause whatsoever, the Contractor shall, at own expense, remove such mixture and replace it with the appropriate subbase material. No traffic, or hauling other than that necessary for bringing material for the next course, shall be permitted over this course.
   2. After compaction, the top surface of this course shall not extend above, nor more than one-half (1/2) inch below true grade and surface at any location. The subbase course, at any location, shall be compacted, finished and completed to the stated tolerance, and approved by the Engineer, before any forms for concrete pavement or any succeeding course is placed at that location. Any depressions or holes shall be filled with approved subbase course material and the surface rerolled.

3.12 LIMESTONE SCREENING

A. Provide limestone screening where shown on the plans, specified or as ordered by the Engineer. Where directed by the Engineer, limestone screening shall be used to stabilize subgrade beneath temporary pavements and under base pavements over sewer trenches through Class "C" Pavements.

B. Perform all excavation required, the grading and compaction of the subgrade, and the placing of the limestone screening as described below.

C. The screening shall be spread evenly and thoroughly rolled with an approved roller, weighing not less than ten (10) tons, until thorough consolidation is obtained. All depressions shall be filled with screening, and the process of rolling and filling shall continue until a thoroughly compacted uniform surface, satisfactory to the Engineer, is produced. No segregation of large or fine materials will be permitted, but the screening shall be sprinkled with water at times and in the amounts necessary to provide consolidation.

3.13 CEMENT CONCRETE FOR PAVEMENT REPAIRS

A. Equipment
   1. The Contractor shall have the option of using Truck Mixed Concrete and/or Mobile Mixers.
   2. The mixers shall provide positive control of the flow of the air entraining admixture and the accelerator admixture into the mixing chamber. Flow meters shall be used to control the amount of admixture added to the mix. The system shall introduce the accelerator and the air entraining agent at two (2) separate points in the mixing auger. The accelerator shall be introduced at the same point as the mixing water. The air entraining agent shall be separated from this point by a distance of one foot. This separation shall be accomplished by the extension of the tube carrying the air entraining agent in a manner satisfactory to the

Engineer. The system shall be capable of adding admixture in the amount necessary to achieve the required air content and accelerator percentage. The system shall be equipped with a bypass valve suitable for obtaining a calibrated sample of admixture to determine batching accuracy.

B. Quantity:
   1. The maximum amount of concrete to be produced at any one time by one (1) mixer shall be six-and-one-half (6.5) cubic yards. This amount may be increased subject to the approval of the Engineer for large monolithic placements.
   2. A sufficient number of mixers shall be supplied to provide for placement of concrete without cold joints within the entire pour.

C. Test Equipment
   1. Furnish a Schmidt Pendulum Hammer for testing compressive strength of the pavement repairs.

D. Construction Details
   1. Repairs shall conform to the details shown on the Plans or be in accordance with the directions of the Engineer.
   2. Concrete Placement Weather Limitation. Concrete placement operations may be started when the air temperature is in the range of fifty-five (55) degrees Fahrenheit to ninety-five (95) degrees Fahrenheit and when the minimum and maximum temperatures for the forty-eight (48) hours immediately after placement of concrete shall be within the range of forty (40) degrees Fahrenheit to ninety-five (95) degrees Fahrenheit based on national weather service reports which the Contractor shall obtain on a daily basis. All temperatures shall be measured in the shade. Placement of concrete will not be permitted when the air temperature is or can be expected to lie outside these ranges. Concrete shall not be placed when it is raining or when rain is expected during working hours.
   3. If at any time during the curing period the air temperature is outside the range specified for curing, the concrete shall be inspected for damage. Concrete damaged by temperature as determined by the Engineer shall be removed and replaced by the Contractor at no cost to the Owner.
   4. The temperature of concrete at the point of discharge shall be between eighty-five (85) degrees Fahrenheit and ninety-five (95) degrees Fahrenheit. Heat or cool the mixing water as necessary to achieve this discharge temperature.
   5. Concrete shall be placed, spread, consolidated and struck off using methods and equipment approved by the Engineer. Placement of concrete less than ten (10) feet long shall be struck off with the screed oriented in a longitudinal direction to match any wheel track wear. The concrete surface shall be tested while plastic. Concrete may be placed on grade directly from an approved mixer. Chutes used to place concrete in final position shall be steel lined. Baffled chutes or other non- segregating devices shall be used to avoid segregation. Details of these devices shall be submitted to the Engineer for approval prior to the start of concrete placement operations.
   6. The wheels of the concrete mixing and placing equipment shall not be allowed on the grade or within two (2) feet of the sawcut ends of the existing pavement. Mechanical spreading and finishing will not be required. Precautions shall be taken to prevent segregation of the concrete during placement and spreading.
   7. Concrete shall be deposited from the mixer, as close to its final position as possible and shall be thoroughly consolidated by immersion type vibrators. Have immediately available at the job site a spare vibrator system to be used in the event of a failure of the primary system.
   8. The Contractor is advised that the design of this concrete is such that the initial set will take place within a short period of time of mix completion. To insure that the concrete is discharged in the shortest possible time, the Contractor shall have a sufficient labor force available at the job site to insure the rapid and expeditious incorporation of the concrete into the Project. During and immediately after deposition, the concrete shall be thoroughly compacted by vibrating the concrete internally with immersion spud (hand operated)

vibrators whose diameter shall not be less than two inches. Movement of concrete by use of vibrators will not be permitted. Concrete that cannot be properly placed and consolidated will be rejected and removed from the job site.

9. To join fresh concrete to concrete which has already set, chip the face of the set concrete to provide an irregular surface and then sandblast the face. The face shall be coated with cement mortar consisting of one (1) part cement and one (1) part fine sand immediately prior to the placement of fresh concrete.
10. Curing: Upon completion of the concrete placement operation, the repair shall be allowed to cure uncovered until the initial set has occurred. Initial set shall be defined as having occurred when no cement paste is lifted from the repair when it lightly rubbed with the fingers of one's hand.
11. As soon as initial set has occurred, the repair shall be covered with a four (4) mil thick polyethylene sheet, and thermal insulating board conforming the insulating material described in the "Materials" section of this specification.
12. Shrinkage cracks occurring due to the Contractors failure to cover the repair as soon as set has occurred will be cause for rejection of the repair. The polyethylene and insulating material shall extend a minimum of twelve (12) inches beyond the length of the repair and six (6) inches beyond its width. The polyethelyne insulating material shall be securely weighted down to prevent the uncovering of the concrete. Particular care shall be taken to insure that the edges of the insulating material are weighted sufficiently to insure intimate contact with the existing pavement surrounding the repair and to prevent wind intrusion beneath the polyethylene vapor barrier. The polyethylene film and insulating material shall not be removed until just prior to opening the pavement to traffic.
13. When the concrete pavement has reached 2000 psi, based upon pendulum type Schmidt hammer testing, the concrete surface shall be immediately coated with clear curing compound at the rate of one (1) gallon per 150 sq feet. Concrete placement operations shall be timed within the work day such that all concrete placement is completed a minimum of four (4) hours prior to the time specified on the Plans for opening the lane, in which the repair lies, to traffic. If compressive strength testing with the Schmidt hammer demonstrates that 2000 psi is being achieved in less than four hours, than the Engineer may allow placement operations to proceed later in the work day. In the event that the concrete strength of 2000 pounds per square inch is not achieved in four (4) hours, then the Engineer may direct the Contractor to complete all placement operations more than four (4) hours prior to the lane opening time specified on the Plans.
14. The repaired pavement section shall not be opened to traffic prior to the concrete having reached a compressive strength of 2000 psi.

3.14 PAVEMENT STRIPING

A. Provide pavement striping shall be performed in accordance with Section 015526, "Maintenance of Traffic" of these Specifications.

3.15 MILLING OF ROADWAY PAVEMENT

A. Remove and dispose of existing surface pavement for a depth, length and width as shown on the plans and/or as directed by the Engineer.
   1. Removal shall be by means of a planer (grinder miller) or other such equipment to be prior approved by the Engineer. Areas adjacent to concrete curbs, valve boxes, catch basins, manholes, etc., not removedby the large grinder miller will have to be removed by a smaller machine or by hand to the satisfaction of the Engineer.
   2. All roadway pavement that is removed shall be swept up with a mechanical sweeper and/or by hand so that there is no dust left after the operation is completed.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section provides for furnishing and planting of trees in places where large caliper trees have been removed in order to construct the sewer lines and includes provisions for planting of shrubs and small caliper trees as shown on the drawings or that have been removed, preserved and restored as described in other sections of this specification.

1.02 SUBMITTALS

A. Submit certificates of inspection of plant materials required by Federal, State, and Local or other authorities. To be submitted to the Engineer for each shipment of plants at delivery.

B. Submit certification of positive identification of any plant species and /or variety in addition to those specified herein.

C. Submit certificates of material compliance before delivery of each type of fertilizer and the anti-desiccant to be supplied.

1.03 QUALITY ASSURANCE

A. Nomenclature
   1. The common and scientific names of plants shall be in conformity with the approved names by Standardized Plant Names prepared by the American Joint Committee on Horticultural Nomenclature 1942 Edition or its successor as the American Association of Nurserymen's recognized authority on Botanical Nomenclature.

B. Standards
   1. Plants including root spread and ball size shall be in accordance with the current edition of "USA Standard for Nursery Stock", a code of standards sponsored by the American Association of Nurserymen as modified herein and as otherwise specified.

C. Inspection
   1. All trees and shrubs shall be subject to inspection and approval of the Owner at the growing site, but approval and marking at the growing site shall not obligate the Owner to pay for any tree or shrub until it has been delivered and planted at the planting site in a satisfactory condition. The removal of nursery stock rejected at the planting site and its replacement in compliance with Specifications shall be made at no extra cost to the Owner.
   2. All plants shall be subject to inspection at any place and at anytime. The Contractor shall be represented at all inspections.

1.04 CERTIFICATIONS

A. Plant Material
   1. The Contractor shall be responsible for all certificates of inspection of plant materials which may be required by Federal, State, Local or other authority to accompany shipment of plants. Certificates of Inspection shall be submitted to the Engineer for each shipment of plants at delivery.
   2. Labeling shall be in accordance with normal nursery labeling practice except that the Contractor shall be required at any time to supply certification of positive identification of any plant species and/or variety in addition to those specified herein.

1.05 WARRANTY

A. Guarantee
   1. Guarantee the life of all plants for a period of one (1) year after the Engineer has made their final inspection and the planting has been confirmed in writing by the Engineer as having been satisfactorily completed. Any plant which is damaged, destroyed or dies from whatever cause during the above period shall be replaced not later than the next succeeding planting season as specified upon written notice to the Contractor from the Engineer. Plants that have died during the period of establishment shall be replaced and shall be guaranteed for an additional year.

PART 2 - PRODUCTS

2.01 PLANTS

A. General
   1. Trees and shrubs shall have a normal habit of growth and be typically characteristic of their respective kinds. When a minimum and maximum size is specified, an average size is required. Plants shall not be pruned before delivery and no plants shall be cut back from larger sizes to meet the sizes specified. Plants shall be free from injury. Plants shall be nursery grown unless otherwise specified and bear evidence of proper nursery care normal to current nursery practice.

B. Abbreviations:
   1. B&B - Indicates plants to be Balled and Burlapped.
   2. B&P - Indicates plants to be Balled and Platformed.
   3. B.R. - Indicates plants to be dug with Bare Roots.
   4. Cal. - Indicates the Caliper of the trunk of the tree.
   5. C.G. - Indicates Container-Grown plants.
   6. P.G. - Indicates Pot-Grown plants.

C. Substitutions:
   1. No change of quantity, size, kind or quality of plants as specified will be accepted except upon written approval by the Engineer.

D. Digging and Handling:
   1. Plants shall be dug with care and skill immediately before shipment. No cold storage plants will be accepted unless approved by the Engineer. Plants stored temporarily shall be properly heeled in or otherwise protected from injury. Digging shall avoid all possible injury to, or loss of roots but roots cut shall be cleanly cut.
   2. After plants are dug, their roots shall be protected from injury such as caused by heat, sun, wind and freezing temperatures. All bare roots of trees, shrubs and vines shall be puddled at the time of digging unless otherwise approved by the Engineer. Puddling shall be done in a wet clay mixture, of a quality to adhere to all parts of the root system. Roots of bare root plants which have been thoroughly covered at the time of digging with an anti- desiccant will not require puddling. Bare roots shall be further protected by wrapping in wet straw, moss, burlap or other suitable material.
   3. Burlap or other equivalent covers shall be placed over plants transported by open trucks or by open freight cars. Doors on closed trucks shall be kept closed to prevent drafts. Shipments made in box cars or closed trucks shall be adequately ventilated to prevent "sweating." The heads of trees shall be tied in carefully to prevent fracturing or breaking the branches. Trunks and branches shall be adequately supported and padded to avoid scraping or bruising.

E. Trees
   1. Where ordered by the Engineer to replace a tree over four (4) inches in caliper that has been removed to construct the work, furnish two (2) inch to two-and-one-half (2-1/2) inch caliper trees B&B and of Specimen Quality from the following approved list:
      a. * Zelkova Serrata "Village Green" (Village Green Zelkova)
      b. Quercus Borealis (Northern Red Oak)
      c. * Gleditsia Triacanthos Inermis "Shademaster" (Shademaster Honey Locust)
      d. Platanus Acerifolia (London Planetree)
      e. Quercus Palustris (Pin Oak)
      f. * Tilia Cordata "Greenspire" (Greenspire Linden)
      g. * Pyrus Calleryana "Bradford" (Bradford Pear)
      h. * Acer Platanoides "Summer Shade" (Summershade Norway Maple)
      i. * Tree species and variety shall be certified.
   2. The species will be selected by the Engineer during construction. The selection will be based on conformity to existing area planting and availability of the species.

3. Nursery grown trees shall have no cuts of limbs which are not healing and no cuts over three-fourths (3/4) inch which have not completely calloused over, no cut back crowns and no abrasions of the bark. The center leader on all major trees shall be intact. Trees must have good fibrous root systems characteristic of the kind. The tops of deciduous trees shall be well formed structurally with reasonably straight trunks and normal spread of crowns.
4. Specimen quality trees shall have straight trunks, single leader intact, having a minimum deviation from the vertical which is characteristic of the kind, with well branched, symmetrical tops and with the lower branches 6 - 7 feet (213.36 cm) from the ground.
5. Bare root trees shall not require earth adhering to the roots except as required for puddling.
6. Balled and burlapped trees shall be properly dug and protected to preserve the natural earth in contact with the roots. No manufactured balls will be accepted. The balls shall be of the required size, firmly wrapped and tied with minimum three (3) ply sisal or equal. No balled tree will be acceptable if the ball is cracked or broken.
7. Balled and Platformed trees shall be balled as specified for B&B trees. Platforms shall be square or octagonal shaped of a size slightly larger than the diameter of the bottom of the soil mass inserted under each ball by means of ties from the platform corners to the rope collar on top of the ball.

F. Shrubs
1. The quality of balled and burlapped shrubs shall be as specified for B&B trees herein. Shrubs shall have good fibrous root systems.

G. Container Grown Plants
1. The sizes of containers shall be as specified on the Plans or may have a root ball twenty-five (25) percent less in diameter and depth than that specified for B&B material. A fifteen (15) percent tolerance will be allowed in diameter and depth provided that the volume of the resultant root ball is no less than the volume of the root ball as specified. This specification is intended to determine the size of the root ball produced from a container and is not to be construed as a determination of the actual dimensions of the container.
2. Container grown plants shall exhibit a well rooted condition which is evidenced by the firmness of the ball. The outside of the ball shall be well netted with healthy working roots which have not been restricted. Plants shall have been adequately hardened off before shipment.
3. Containers shall be of such a shape as to permit easy removal of the plant and shall be rigid enough to maintain the shape of the ball. No plant will be accepted if the ball is cracked or broken.

2.02 TOPSOIL

A. The topsoil shall consist of a fertile, friable, natural topsoil of loamy character, without admixtures of subsoil, uniform in quality and shall be free from refuse of any nature, hard clods, stiff clay, sods, hard pan, pebbles larger than three-fourths (3/4) inch in diameter, coarse sand, noxious weeds, sticks, brush, or other rubbish.

B. The topsoil shall be taken from a well drained, arable site, preferably one which has been under cultivation at least five (5) years previous to the time of removal.

C. The topsoil shall contain not less than five (5) percent nor more than twenty (20) percent organic matter, as determined by loss on ignition of oven-dried samples. The samples shall be thoroughly ovendried to constant weight at a temperature of two-hundred-twenty-one (221) degrees Fahrenheit.

Sieve Size	% Passing by Weight
1 inch (25.4 mm)	100
1/4 inch (6.35 mm)	97-100
# 100	40-70
# 200	Minimum 20%

D. The Hydrogen Ion value of all topsoil shall be not less than five (5) and not more than seven (7). After the testing of the samples of material, if the top soil is found to be unsatisfactory for the

intended use, the Engineer may require that the Contractor, without additional compensation, add to the topsoil proposed by him for use, lime, particular fertilizer, or particular humus, as directed in order to make the topsoil suitable.

E. Mechanical Analysis: The sieve analysis on an oven-dried sample shall be as shown in Table above.

2.03 FERTILIZER

A. Composition
   1. The fertilizer shall be a slow release type contained in polyethylene bags, perforated with micropore holes for controlled feeding. The packets shall contain four (4) ounces of soluble fertilizer (analysis 16-8-16) minimum per unit to last for eight (8) years. Minimum guaranteed analysis shall be a fertilizer containing nitrogen, phosphoric acid and potash in the ratios of 16-8-16 with approximately one-half (1/2) the nitrogen in the ammonium form and one-half (1/2) in the nitrate form.
   2. Fertilizer on mulch shall be a mixed granular commercial fertilizer containing nitrogen, phosphoric acid and potash in the ratios of 10-6-4 as specified in Section 329219, "Seeding and Sodding" .

B. Packaging
   1. Fertilizer packets shall be packed in the manufacturer's standard containers weighing not over one-hundred (100) pounds each with the name of the material, net weight of contents, and the manufacturer's name and guaranteed analysis appearing on each container.

2.04 MULCH

A. Wood Chips
   1. Wood chips for mulching plants may be either hardwood or softwood chips as produced by any standard chipping machine. No leaves, young green growth, wood shavings, sawdust or foreign materials which are injurious to plant growth shall be mixed with the chips. Chips shall be one-eighth (1/8) inch nominal thickness with fifty (50) percent having an area of not less than one (1) square inch nor more than six (6) square inches.

B. Peatmoss
   1. Peatmoss shall be composed of the partly decomposed stems and leaves of any or several species of spagnum moss. It shall be free from wood, decomposed colloidal residue and other foreign matter. Acidity range: 3.5 pH to 5.5 pH. Water absorbing ability shall be minimum 1100% by weight on an oven-dry basis.

2.05 WATER

A. Water shall be from fresh water sources and free from oil, acids, alkalis, salt or any other substance injurious to plant growth.

2.06 PROTECTION OF PLANTS

A. Stakes for Supporting Trees
   1. Stakes for supporting trees shall be of white or red cedar wood. Cedar stakes of eight (8) to ten (10) feet long shall have a minimum diameter of two (2) inches. The maximum diameter of cedar stakes shall not exceed three (3) inches and the deflection shall be less than one-half (1/2) inch for every one (1) foot of length. All stakes shall be sound and free from insects. Stakes shall be pointed.

B. Guy Stakes
   1. Guy stakes used to anchor guy wires which support trees shall be of the quality and sizes required for the operations calling for their use.

C. Wire
   1. Wires for guying plants shall be new annealed galvanized wire No. 12 or No. 10, A.S.& W. gauge as specified and/or as shown in the Details.

D. Jute Burlap

1. Jute burlap for wrapping trees shall be in four (4) inch wide strips and weigh eight (8) ounces per square yard.

E. Paper Wrapping
1. Paper for wrapping trees shall be water proof paper 30-30-30 krinklecraft or equal in four (4) inch strips.

F. Hose
1. Hose for protecting the bark from guy wires shall be good quality braided rubber or reinforced materials. Hose shall be at least three-fourths (3/4) of an inch outside diameter.

G. Twine
1. Twine for use in wrapping trees shall be jute twine, not less than two (2) ply. Green plastic ties or masking tape as approved by the Engineer will be acceptable. Plastic ties shall be a minimum of one-half (1/2) inch in width and shall have a smooth surface with the ability to stretch as the tree grows.

H. Anti-Desiccants
1. Anti-desiccants shall be emulsions which will provide a protective film over plant surfaces, permeable enough to permit transpiration. Acceptable materials shall be Wilt-pruf, Vanex, or equal.

I. Tree Wound Dressing
1. Tree wound dressing shall be antiseptic, waterproof, adhesive and elastic such as asphalt, gutta percha, and certain oils with a fungicide and which remains tacky for four hours and retains elasticity after setting when tested under the heat of the hand. It shall not contain kerosene, coal tar, creosote or other material harmful to the living tissue of the trees.

2.07 SOURCE QUALITY CONTROL

A. Topsoil
1. Sample testing shall be performed by the County Testing Facility unless otherwise directed. Representative samples of the top soil or soil mixture will be taken by a County Inspector from the intended source of supply. Provide the necessary personnel, equipment and containers required to obtain the samples and will assist the Inspector in collecting and transporting of the samples to the County Testing Facility.
2. Topsoil shall not be used until after the samples have been approved by the Engineer.
3. Notify the Engineer at least three (3) weeks in advance of the scheduled use of the material to allow time to secure the sample and complete the necessary testing thereon.

B. Peatmoss
1. Sampling shall be as specified herein for "Topsoil". Testing shall be in accordance with the latest methods of the Association of Agricultural Chemists.

PART 3 - EXECUTION

3.01 GENERAL

A. Planting Seasons
1. Unless otherwise approved, deciduous material shall be planted between March 1st and May 1st, and from October 15th to December 15th. Evergreen material shall be planted from March 1st to May 15th and from August 15th to December 15th. Container grown plants shall be planted from March 1st to May 15th and between August 15th and December 15th.

B. Obstructions
1. In the event that rock or other underground obstructions are encountered in excavating plant pits, the pits shall be relocated as ordered by the Engineer.
2. In all locations where utilities are located, plant pits shall be dug by hand as ordered by the Engineer.

C. Delivery

1. The Contractor shall give notice to the Engineer at least forty-eight (48) hours in advance before delivering any plant material, unless otherwise approved. The Engineer shall be furnished a legible copy of the invoice for every shipment showing sizes and kinds of materials included.

D. Storage
   1. All plants shall be properly protected from drying out. Such protection shall include the time when the plants are in transit, being handled or in temporary storage on the project. Bare root plants which are not planted immediately upon receipt shall be heeled-in in trenches with the bundles opened, the plants spaced separately and all roots covered. Balled plants shall have their earth balls protected by earth, wet cloth, straw or may be heeled-in as ordered by the Engineer. Plants which have not been protected as specified or which have not been planted within two (2) calendar days of delivery will be rejected unless otherwise approved by the Engineer.

3.02 GROUND PREPARATION

A. Layout
   1. Locations for plants and outlines of areas to be planted shall be marked out on the ground by the Contractor to the satisfaction of the Engineer before any pits or planting beds are dug.
   2. The Contractor shall be held responsible for the proper location of each tree. Any species of tree planted in the wrong location shall be replaced with a new tree in the next succeeding planting season.

B. Size of Pits
   1. Unless otherwise specified the minimum diameter of plant pits shall bear the following relation to the spread of roots (or diameter of balls) of the plants to be planted in them. Pit diameter twice the root spread for plants up to and including a two (2) foot spread, pit diameter equal to root spread plus two (2) feet for root spreads of two (2) to four (4) feet, pit diameter one-and-one-half (1-1/2) times the root spread for spread of roots over four (4) feet. The depth of all pits shall be adequate to permit a minimum of six (6) inches of planting soil under all roots and balls.
      a. In concrete and asphalt areas along roads, the tree pit shall have a minimum length of forty-eight (48) inches. The width shall be thirty-six (36) inches.
      b. In grass areas along roads, the tree pits shall be a minimum of forty-eight (48) inches long and the widths shall be from the back of the curb to the edge of the sidewalk or where room allows, the width shall be a minimum of forty- eight (48) inches.
      c. Where undesirable material is encountered in digging the pits, the pits shall be enlarged as approved and backfilled with acceptable material. When planting in wooded areas, cut the existing vegetation or grub out an area twice the size of the plant pit as directed by the Engineer. In planting bed areas, existing vegetation shall be removed as directed.
      d. Before excavating tree pits in locations where asphalt and/or stone block pavement exist, the Contractor shall, as directed by the Engineer, remove the existing pavement. Asphalt pavement shall be saw cut prior to removal and stone pavement shall be reset after the trees are planted.

C. Drainage
   1. Where an impervious stratum of soil is encountered during the excavation of plant pits or planting beds, all such soil shall be removed to a depth determined by the Engineer and backfilled with acceptable material.

D. Disposal of Excavated Materials
   1. Topsoil and subsoil excavated from tree pits and planting beds shall be disposed of off the site by the Contractor.

E. Planting Beds

1. Unless otherwise specified, the depth of planting beds for shrubs shall be eighteen (18) inches deep. Depth of beds shall be taken from existing grades. Backfill material for planting beds shall be as indicated on the Plans.

F. Planting Soil
1. Backfill soil for planting shall be topsoil except that for ericaceous plants backfill soil shall be topsoil and peatmoss thoroughly mixed in the proportions of 2 to 1 respectively.

G. Fertilizer
1. Fertilizer packets as described under "Materials" of this specification shall be placed in the plant pits prior to completion of backfilling. During the entire planting operation the Contractor will not be allowed to use any damaged packets and he shall ensure that all packets remain undamaged. The fertilizer packet shall be placed six (6) inches to eight (8) inches deep as follows:

a. SHRUBS

12 inch (304.8 mm). to 23 inch (584.2 mm). high	1 packet next to the ball
24 inch (609.6 mm). to 35 inch (889 mm). high	2 packets on opposite sides of the ball
3 feet (91.44 cm) to 6 feet (182.88 cm) high	3 packets equally spaced around the ball

b. DECIDUOUS TREES

1 inch (25.4 mm) to 1 3/4 inch (19.05 mm) caliper	2 packets on opposite sides of the ball
2 inches (50.8 mm) to 2 1/2 inches caliper	3 packets equally spaced around the ball
2 1/2 inches to 3 inches (76.2 mm) caliper	4 packets equally spaced around the ball
3 1/2 inches to 4 inches (101.6 mm) caliper	5 packets equally spaced around the ball
4 1/2 inches to 6 inches (152.4 mm) caliper	6 packets equally spaced around the ball

c. EVERGREENS (Excluding Ericaceous Plants, Rhodendrons, etc.):

2 feet (60.96 cm) to 5 feet (152.4 cm) high	2 packets on opposite sides of the ball
6 feet (182.88 cm) to 7 feet (213.36 cm) high	3 packets equally spaced around the ball
8 feet (243.84 cm) to 11 feet (335.28 cm) high	4 packets equally spaced around the ball
12 feet to 17 feet high	5 packets equally spaced around the ball
18 feet to 20 feet (609.6 cm) high	6 packets equally spaced around the ball

d. LARGE SHRUBS AND SMALL TREES

6 feet (182.88 cm) to 9 feet (274.32 cm) high	2 packets on opposite sides of the ball
10 feet (304.8 cm) to 14 feet (426.72 cm) high	3 packets equally spaced around the ball

3.03 SETTING PLANTS

A. General
1. Plants shall be planted below existing grade as directed with a minimum saucer depth of three (3) inches and a maximum saucer depth of six (6) inches except as otherwise directed by the Engineer. In grass areas and other areas where mulch will not be required, saucer depth shall be in direct proportion to the size of plant.
2. In planting beds, plants shall be planted three (3) inches below proposed grade. Ericaceous plants may be required to be planted at existing grade as directed by the Engineer. Backfill material may be either carefully placed into plant pits in layers of approximately four (4) inches in depth and firmly tamped before additional material is placed or backfill may be

compacted by thorough watering. Regardless of which method is used, backfill soil for all plants shall be watered three (3) times prior to mulching, to insure compaction of backfill, and backfill shall be added as necessary.

B. Balled Plants (B&B, B&P, C.G.)
   1. Root balls are to be planted with backfill carefully tamped or compacted by thorough watering under and around the sides of each ball to fill voids. As directed by the Engineer, burlap, cloth, rope and restraining ties shall be cut and pulled away from the tops of root balls but not removed from the sides of root balls or pulled out from under root balls. Platforms shall be removed.

C. Bare Root Plants
   1. Roots of B.R. plants shall be properly spread out in a natural position and backfill soil shall be carefully worked in among them. All broken and frayed roots shall be cleanly cut off.

D. Wrapping
   1. Unless otherwise directed, the trunks of all deciduous trees over one-and-one-half (1-1/2) inches in caliper shall be wrapped immediately after planting unless otherwise approved. Wrapping shall extend beyond the point where hose and wires pass around the tree trunk. Wrapping shall be a single layer of burlap bandage wound spirally, starting from the base and overlapping one-and-one-half (1-1/2) inches. The wrapping shall be tied in place with twine, green plastic ties or masking tape at about one (1) foot intervals.

E. Staking, Guying and Anchoring
   1. All trees shall be firmly staked or guyed at the time of planting as shown on the Standard Details for the Construction of Sanitary Sewers unless otherwise approved. Stakes shall be pointed and shall not injure plant balls. Wires used for tying the trunk to stakes or for guying shall be secured to the tree by passing them through a rubber hose to prevent chafing and injury to the trees. Guy wires fastened to guy stakes shall be tightened by driving the stakes, leaving the wires to be twisted for tightening during the period of establishment.

F. Pruning
   1. Pruning shall be done as specified and as directed by the Engineer. Deciduous trees and shrubs shall be pruned to reduce the vegetative growth by one-third (1/3) of its total branching unless otherwise directed. Wood removed shall be inferior branches, competing branches, crossing branches and dead and damaged wood. The natural branching habit of the plant shall be adhered to at all times.
   2. Container grown trees may be pruned at the time of potting to reduce the length of branches one-third (1/3) to one-half (1/2). Minor pruning may be required at the time of planting.
   3. Trees used in street tree plantings, parking areas and playground areas shall have all branches removed up to a height of six (6) feet or as otherwise directed.
   4. Tree wound dressing shall be applied on all pruning cuts exceeding one (1) inch on deciduous trees.

G. Mulching
   1. Depth of mulch shall be three (3) inches. Mulch shall completely cover the areas of all plant pits, planting beds and/or entire planted areas. Mulch shall be wood chips.
   2. After planting is completed and as directed by the Engineer, fertilizer (10-6-4) shall be broadcast on all mulch, except mulch on ericaceous plants, at the rate of 0.015 pounds of nitrogen per square foot.
   3. The Engineer may direct that mulching be omitted from around plant pits within designated grass areas. Where so directed, the area over the plant pit shall be restored in accordance with Section 329219, "Seeding and Sodding".

H. Progress and Sequence of Planting
   1. All the provisions of Setting Plants shall be accomplished within seven (7) calendar days after the plant is set in the pit except that the Engineer shall take into consideration unexpected interruptions in work due to emergencies, storms, etc., severe enough to stop

work. Scheduled non-work days such as weekends, holidays, etc., shall not be a reason for extending the seven (7) day limitation. The sequence of planting shall be as follows:
   a. Wrapping, staking or guying and wiring
   b. Three (3) waterings to insure compaction of backfill and addition of backfill as necessary.
   c. Mulching
2. If this sequence is not adhered to, and as a result the operations subsequent to setting and backfilling are not being accomplished within the specified time, the Engineer may stop all setting and backfilling of plants and any other planting operations they may deem necessary, until such time they are satisfied that the sequence of planting operations is again on schedule.

I. Restoration
1. Areas disturbed by the planting operations shall be left in an orderly condition. Excess soil and rubbish shall be disposed of as directed. Grassed areas disturbed by planting operations shall be restored to a satisfactory condition which may include filling to grade, fertilizing and seeding.

3.04 MAINTENANCE

A. Care of Plants Prior to Satisfactory Completion of Planting
1. Care for the planting shall consist of keeping all plants in a healthy growing condition by watering, weeding, cultivating, pruning, spraying, tightening of guys, remulching and any other necessary operations as required until satisfactory completion of planting.
2. All plants shall be sprayed with an anti-desiccant. Apply anti-desiccant according to the manufacturers directions to thoroughly cover all above ground parts. The time of application shall be as follows, unless otherwise approved.
   a. Evergreen - Apply within ten (10) days following planting.
   b. Deciduous - Spring Planting - Apply when leaves have reached at least seventy-five (75) percent of mature size
   c. Fall Planting - Apply in October and November when the temperature is forty (40) degrees Fahrenheit or over.
3. All plants shall be watered at least once (1) per week between April 1st and October 1st unless otherwise directed by the Engineer, until satisfactory completion of planting. Each watering shall provide not less than five (5) gallons per square yard on plant pits and bed areas.
4. All dead and rejected plants shall be promptly removed from the contract site. In the event of the threat of serious damage from insects, diseases, or rodents, the plants shall be treated by preventive or remedial measures currently approved for good horticultural practice. In the event "heeled-in" material must be held over until a later planting season, such "heeled-in" material shall be lifted, replanted and maintained in a satisfactory condition in nursery rows. Such emergency storage and maintenance shall be at the entire risk of the Contractor and at no additional cost to the Owner. The land for such storage shall be provided for by the Contractor unless otherwise specified or approved.
5. Grass and weed growth shall be removed from all plant pits and planting beds as directed by the Engineer. Prior to final acceptance of the planting, the outer portions of tree pit saucers and all other disturbed areas, excluding planting beds, shall have acceptable evidence of grass growth unless otherwise directed by the Engineer. Seed used for this purpose shall be as specified under Section 329219, "Seeding and Sodding" or as approved by the Engineer.

B. Replacement Prior to Satisfactory Completion of Planting
1. At the conclusion of the essential portion of the planting work, all plants in an unhealthy or badly impaired condition in the opinion of the Engineer, shall be removed. All planting to be completed or replaced shall be planted not later than the next succeeding planting season.

C. Final Inspection
1. When, in the opinion of the Contractor, the planting is complete and ready for final inspection, notify the Engineer who will arrange to give the entire work a thorough inspection. Before

final payment will be made, any dead plants, defects or omissions noted on this inspections shall be rectified by the Contractor.

D. Care of Plants and Replacement During Period of Establishment
   1. Replace any damaged, destroyed or dead plant within the two (2) planting seasons during the "Period of Establishment" which may entail replacing the same plant twice after satisfactory completion of planting.
   2. The Contractor shall be responsible for all work required to care for the plants properly and make necessary replacements during the period of establishment, including watering, mulching, pruning, restaking and replanting. Maintain during this period a sufficient labor force at all times to care for the plants in a proper manner and perform all necessary operations efficiently and expeditiously.
   3. The Contractor shall be required to water all plant material a minimum of six (6) times during the period of establishment. Each plant shall receive five (5) gallons of water per watering for each square yard of pit area. Watering shall be performed when plants are in active vegetative growth. If in the opinion of the Engineer unseasonable dry conditions exist, additional watering may be required as directed by the Engineer.
   4. At the end of the "Period of Establishment" the Contractor shall remove and dispose of all stakes, wire, hose and tree trunk wrapping from all trees as directed by the Engineer. All holes left due to removal of stakes shall be filled with topsoil. All of the above work shall be performed at no additional cost to the Owner.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section provides for seeding and sodding for restoration of grass areas where the work is to pass through public and/or private lands and other areas along the line of the work where the Engineer deems it necessary or desirable to restore disturbed areas with seed or sod.

1.02 SUBMITTALS

A. The Contractor shall submit certificates of material compliance before delivery of material for the following items:
   1. Seed
   2. Sod
   3. Fertilizer (10-6-4)
   4. Limestone
   5. Superphosphate
   6. Mulch
   7. Insecticide

1.03 SAMPLES

A. Furnish and deliver to the Owner's testing facility for testing, representative samples of the following items planned to be used:
   1. Seed
   2. Sod
   3. Fertilizer (10-6-4)
   4. Limestone
   5. Superphosphate
   6. Wood Fiber Mulch
   7. Erosion Control Fabrics

B. None of the above items are to be delivered and used in the work until approval of the samples by the Engineer but such approval does not constitute final acceptance.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. Topsoil shall conform to Section 329000, "Planting".

B. Topsoil available on site which meets the specified requirements may be utilized with the permission of the Engineer. The Engineer may require that the Contractor, without additional compensation, add to the topsoil proposed for use, lime, particular fertilizer or particular humus, as directed in order to make the topsoil suitable.

2.02 SEED

A. General
   1. Grass seed shall be fresh, recleaned seed of latest crop. Material other than pure live seed shall comprise only non-viable seed, chaff, hulls, harmless inert matter and shall be free from noxious weeds. The mixture shall have less than one-quarter (1/4) of one (1) percent weed content. Seed shall be mixed before delivery and shall consist of the mixture specified and in conformity with the following proportions by weight and meeting with the following standards of seed content. The percentage of purity shown on the label will be acceptable. The percentage of germination shall not be less than the minimum specified.

B. Mixtures
   1. Mixture A to be seeded, in general, on areas not regularly mowed.

Mixture A	Mixture Tolerance	Germination

Tolerance Proportions of Mixture	Minus	Plus	Germination	Minus
50% Kentucky 31 Fescue	3%	5%	90%	6%
25% N.K. 100 Perennial Rye Grass	3%	5%	85%	7%
25% Penn Lawn Fescue	3%	5%	90%	6%

C. Mixture B to be seeded, in general, on areas regularly mowed and well-maintained.

Mixture B	**Mixture Tolerance**		**Germination**	
Tolerance Proportions of Mixture	Minus	Plus	Germination	Minus
50% Merion Blue Grass	3%	5%	80%	7%
30% Penn Lawn Fescue	3%	5%	90%	6%
20% NK106 Hybrid Rye Grass	3%	5%	85%	7%

1. The following brand name mixtures are approved: N.K. 200 or Norlea in the proper percentages of mixture or any other current approved brand name mixture.

D. Packaging
1. All grass seed shall be delivered in unopened standard size bags of the vendor showing weight, analysis and name of vendor. Seed shall be stored in such a manner that its effectiveness will not be impaired.

2.03 SOD

A. General
1. The sod shall be a good grade of sod, free from noxious weeds and broadleaf weeds and cut in fifteen (15) inch by forty-eight (48) inch pieces with a depth of one (1) inch minimum root growth. Sod shall be minimum two (2) years old, nursery grown, free of insects, grubs and fungus and with a minimum pH of 6.5. The sod shall be well irrigated and not cut or transported when dry.
2. Sods shall be composed of a vigorous dense growth of green turf and root development shall be capable of supporting the sod during handling, transporting and laying.

B. Analysis
1. The species and varieties from which the sod was grown shall consist of the following permanent grasses unless otherwise approved:
   a. 50% Merion Blue Grass
   b. 25% Penn Lawn Fescue
   c. 25% Fylking Kentucky Blue Grass

2.04 COMMERCIAL FERTILIZER

A. Composition
1. Commercial granular fertilizer shall have the following composition by weight: Nitrogen, ten (10) percent; Phosphoric Acid, six (6) percent; Potash, four (4) percent.

B. The Nitrogen shall be fifty (50) percent organic (from organic sources, e.g. fish meal, dried blood, dried manure, activated sewage sludge, castor pomace, cottonseed meal, etc.) and fifty (50) percent inorganic. The elements shall be available according to the methods adopted by the Association of Official Agricultural Chemists.

C. Packaging
   1. Fertilizers shall be packed in the manufacturer's standard containers weighing not over one-hundred (100) pounds each with the name of the material, net weight of contents and the manufacturer's name and guaranteed analysis appearing on each container.

2.05 GROUND LIMESTONE

A. Composition
   1. Ground Limestone (Calcium Carbonate) shall have the following analysis: At least fifty (50) percent shall pass a two-hundred (200) mesh sieve; at least seventy (70) percent shall pass a one-hundred (100) mesh sieve; and one-hundred (100) percent shall pass a ten (10) mesh sieve. Total carbonates shall not be less than eighty (80) percent or 44.8 percent calcium oxide equivalent; for purposes of calculation, total carbonates shall be considered as Calcium Carbonate.

B. Packaging
   1. Ground limestone packed in the manufacturer's standard containers shall weigh not over one-hundred (100) pounds each, with the name of the material, net weight of contents and the manufacturer's name and guaranteed analysis appearing on each container. Bulk shipments shall be accompanied by a certificate covering the names, weight and analysis as specified herewith for packaged material.

2.06 SUPERPHOSPHATE

A. Composition
   1. Superphosphate shall be an approximate 0-20-0 formulation with an acceptable minimum of eighteen (18) percent available phosphoric acid.

B. Packaging
   1. Superphosphate packed in the manufacturer's standard containers shall weigh not over one-hundred (100) pounds each, with the name of the material, net weight of contents and the manufacturer's name and guaranteed analysis appearing on each container.
   2. Bulk shipments shall be accompanied by a certificate covering the names, weight and analysis as specified for packaged material.

2.07 MULCH-WOOD FIBER

A. General
   1. Wood fiber suitable for use as a mulch for seeding shall be processed so that the fibers will remain in uniform suspension in water under agitation and will blend with grass seed, fertilizer, ground limestone and other additives to form a homogeneous slurry. It shall have the characteristics which, upon hydraulic application, shall form a blotter-like ground coating with moisture absorption and percolation properties and the ability to cover and hold grass seed in intimate contact with the soil. Wood fiber shall contain no growth or germination inhibiting factors and shall be dyed green.

B. Packaging
   1. Wood fibers shall be supplied in the manufacturer's unopened standard containers weighing not over one-hundred (100) pounds each, with the name of the material, net weight of contents, the manufacturer's name and the air dry weight of fiber (equivalent to ten (10) percent moisture) appearing on each container.

2.08 EROSION CONTROL FABRICS

A. General
   1. Erosion control fabrics for slope protection shall be knitted synthetic netting and/or jute mesh as follows:

a. The knitted synthetic netting shall consist of a combination of plastic netting interwoven with strips of paper. Paper fill shall be biodegradable of the type recommended by the manufacturer for the application required. Yarn shall be polypropylene. Knitted synthetic netting shall be furnished in firm rolls in widths of five (5) foot or ten (10) foot as required and in lengths of three-hundred-sixty (360) feet and weighing approximately twenty-eight (28) lbs. and fifty-six (56) lbs. respectively in relation to width.

2. Jute mesh shall be of a uniform open plain weave of undyed and unbleached single jute yarn averaging one-hundred-thirty (130) pounds per spindle of 14,400 yds. The yarn shall be of loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one-half (1/2) its normal diameter.
3. Jute mesh shall be woven as follows:
   a. Approximately sixty (60) warp ends per yard of width.
   b. Approximately forty (40) warp ends per linear yards.
   c. Weight of jute mesh shall average 0.9 pounds per square yard +/- (plus or minus) five (5) percent.
   d. Jute mesh shall be furnished in approximate lengths of seventy-five (75) yards and a width of forty-eight (48) inches +/- (plus or minus) one (1) inch or as otherwise approved.
   e. Jute mesh shall be "Soil Saver" as manufactured by Ludlow Corporation, or equal.

B. Shipments of erosion control fabric shall include instructions for installation and staples as required for anchoring fabrics as recommended by the manufacturers.

2.09 SOD STAKES

A. Stakes for pegging sod shall be approximately 1" by 2" and of sufficient length to penetrate the sod, the topsoil and to a minimum depth of two (2) inches of subsoil or shall be of a material and size as approved by the Engineer.

2.10 WATER

A. Water shall conform to Section 329000, "Planting".

2.11 SOURCE QUALITY CONTROL

A. The source of sod shall be made known to the Engineer at least five (5) days prior to delivery. Sod shall be inspected prior to delivery.

PART 3 - EXECUTION

3.01 GENERAL

A. When permitted by the Engineer, topsoil excavated under other Sections of this Specification shall be reused to provide a six (6) inch layer of topsoil over the top of sewer trenches and other areas required to be seeded and/or sodded. If after backfilling of excavation there are insufficient quantities of top soil conforming to the specified requirements, supply the necessary material to provide a six (6) inch layer of topsoil over the areas to be seeded and/or sodded. Where directed by the Engineer, the surface of the subsoil shall be scarified or tilled to a minimum depth of two (2) inches before topsoil or soil is placed to permit bonding of the upper soil layer with the subsoil.

B. When delays in seeding and/or sodding operations carry the work beyond the specified seasons or when conditions of high winds, excessive moisture or frost are such that satisfactory results are not likely to be obtained for any stage of the work, the Engineer will stop the work. The work shall be resumed with the Engineer's approval when the desired results are likely to be obtained or when approved corrective measures and procedures are adopted.

C. In general, all slopes exceeding a gradient of 1 on 3 shall be sodded. At the option of the Contractor, hydro-seeding with wood fiber mulch and/or seeding with erosion control fabrics may be approved by the Engineer, in lieu of sodding, for specific slope areas as designated by the Engineer.

D. At locations where sod must be installed adjacent to areas to be seeded, the sodding shall be done before the seed is sown and equipment used during seeding shall cause no damage to the sodded areas.

E. The Contractor shall be liable for any damage to property caused by seeding and sodding operations and all areas disturbed shall be restored to their original condition to the satisfaction of the Engineer.

F. One (1) inch of water per week shall be applied on seeded and sodded areas for adequate soil saturation as required by weather conditions and as ordered by the Engineer until final acceptance. Watering shall be continued until final payment. Watering shall be done in a manner which will not cause erosion or other damage to the finished surfaces. Any surfaces which become gullied or otherwise damaged shall be repaired to reestablish the grade and conditions of the soil prior to seeding and/or sodding. After the repairs have been made, the areas shall be reseeded and/or resodded as specified.

3.02 GRASS SEEDING

A. Time of Seeding
   1. Seeding shall be performed from March 1st to April 15th and from August 15th to October 15th unless otherwise approved. Notify the Engineer at least forty-eight (48) hours in advance of the time intended to begin seeding and do not proceed with such work until permission has been granted.

B. Preparation of Areas
   1. The areas to be seeded shall be cultivated and cleaned of all vegetative growth to a depth of six (6) inches except as otherwise directed by the Engineer on designated areas where topsoil has been furnished and placed to a depth of six (6) inches immediately prior to seeding. All weeds, roots, stumps, large stones and debris shall be removed. All washouts or other surface irregularities shall be repaired and additional topsoil shall be placed over the area as required until the entire area to be seeded is covered with a minimum of six (6) inches compacted layer of topsoil. The area to be seeded shall then be rough-graded to conform to the proper elevations as directed by the Engineer.

C. Final Preparations of Seed Bed
   1. The areas to be seeded shall be cultivated with a disc, rototiller or scarifier to a depth of four (4) inches. The areas shall be smoothly graded to the proper elevations, free from all unsightly ridges, depressions or undue irregularities. Areas to be seeded that cannot be cultivated by mechanical means shall be scarified by hand to attain the degree of smoothness and uniformity of adjacent lawn areas. Any soft areas shall be thoroughly compacted with an accepted roller weighing at least two-hundred (200) pounds.
   2. All topsoil not used is to be removed and disposed of.
   3. Ground limestone shall be evenly distributed at the rate of two-thousand (2,000) pounds per acre and worked into the top three (3) inches of the soil during the cultivation required for the final preparations of seed bed.
   4. Commercial fertilizer (10-6-4) as specified shall be evenly distributed at the rate of fifteen-hundred (1,500) pounds per acre using an approved mechanical spreader and shall be worked into the top one (1) inch of the soil.
   5. In the event that it rains between the time the soil on any area is prepared and before it is seeded by any specified method, the soil on all areas to be seeded shall be completely pulverized to a depth of one inch as determined, directed, and approved by the Engineer.

D. Sowing Seed
   1. Grass seed shall be sown evenly at the rate of one-hundred-fifty (150) pounds per acre. All seeding shall be done on dry or moderately dry soil and at time when the wind does not exceed a velocity of five (5) miles per hour.
   2. A mechanical seeder may be used such as a Brillion seeder or equal to distribute the seed. Rolling will not be necessary.

3. If the grass seed is to be sown by hand, the seed shall be evenly distributed and lightly raked into the top one-quarter (1/4) inch of soil. After seeding and raking, the soil surface is to be rolled with an accepted roller weighing at least two-hundred (200) pounds.

E. Hydro-Seeding
1. All requirements of "Seeding and Sodding" herein before specified shall apply except as modified herein.
2. Areas to be hydro-seeded shall be scarified sufficiently to break up the surface crust immediately before seeding except where the ground is loose and friable as immediately following grading or as otherwise approved.
3. The hydro-seeder slurry shall be a homogeneous mixture of seed, mulch, limestone and fertilizer which shall remain in suspension in water under agitation. The slurry shall be evenly distributed over the area to be seeded and shall be applied in accordance with the following application rates per acre of surface seeded.
   a. 6,000 gallons of water, 2,000 pounds of wood fiber mulch, 200 pounds of grass seed mixture, 1,200 pounds of ground limestone, 900 pounds of 10-6-4 fertilizer.
   b. The grass seed mixture used for Hydro-Seeding shall conform to Mixture "A" as specified in this Section.

F. Seeding with Erosion Control Fabrics
1. Erosion control fabrics shall be applied in accordance with the manufacturer's instructions as modified, directed, and approved by the Engineer.

3.03 SODDING

A. Time of Sodding
1. Sod may be laid at any time between August 15th and April 15th when the ground is not frozen. No sod shall be laid without the approval of the Engineer.

B. Care of Sod
1. Care shall be exercised at all times to retain the soil on the roots of the sod during the process of transplanting. Dumping from vehicles will not be permitted. The sod shall be planted within twenty-four (24) hours from the time it is harvested unless it is tightly rolled or stored roots-to-roots in a satisfactory manner. All sod in stacks shall be kept moist and shall be protected from exposure to the sun and from freezing. No storage longer than two (2) days will be permitted. Sod which becomes dried out or does not meet the Specifications will be rejected.

C. Preparation of Area
1. The areas to be sodded shall be cultivated and cleaned of all vegetative growth to a depth of six (6) inches except as otherwise directed by the Engineer or designated areas where topsoil has been furnished and placed to a depth of six (6) inches immediately prior to seeding. All weeds, roots, stumps, large stones and debris shall be removed. All washouts or other surface irregularities shall be repaired and additional topsoil shall be placed over the area as required until the entire area to be sodded is covered with a minimum of six (6) inch compacted layer of topsoil. The areas to be sodded shall then be rough graded to conform to the proper elevations as directed by the Engineer.

D. Final Preparation of Sod Bed
1. The areas to be sodded shall be cultivated with a disc, rototiller or scarifier to a depth of four (4) inches. The area shall be smoothly graded to the proper elevations, free from ridges, depressions or undue irregularities. Areas to be sodded that cannot be cultivated by mechanical means shall be scarified by hand to attain the degree of smoothness and uniformity of adjacent lawn areas. Any soft areas shall be thoroughly compacted with an accepted roller weighing at least two-hundred (200) pounds.
2. The subgrade of topsoil shall be graded so that after the sod is placed, the finished grade shall meet the existing grade or grades as specified by the Engineer.
3. All topsoil not used is to be removed and disposed of properly.

4. Before the sod is placed, zpply superphosphate to the subgraded topsoil at the rate of twenty (20) pounds per one-thousand (1,000) square feet and raked into a depth of one (1) inch.
5. Before installation of new sod, the edges of the existing sod shall be cut to form a true straight line so that new sod can be installed properly adjacent to it.

E. Placing Sod
1. In general, sod shall be placed in strips of 15" by 48" with staggered joints and rolled with at least a two-hundred (200) pound roller. No small pieces or strips of sod shall be laid adjacent to edges of sidewalks, curbs and driveways. After rolling, the finished grade shall conform evenly to the grades on the plan or according to grades given by the Engineer. On slop areas, sod shall be thoroughly tamped as approved by the Engineer.
2. If, in the opinion of the Engineer, the sod joints are not closely laid, open and/or loose joints shall be filled with a mixture of grass seed and screened topsoil at the rate of two (2) pounds of seed to one (1) cubic yard of topsoil. Sod shall be thoroughly tamped to a true even surface at the required finished grade and immediately watered.
3. Insecticide for grub proofing sod as approved by the Engineer shall be applied on sodded areas in accordance with the manufacturer's directions.

F. Pegging Sod
1. Sod shall be held in place by sod stakes on all slopes one (1) or two (2) percent or steeper and elsewhere as directed by the Engineer. Pegging shall be done immediately after tamping. At least one (1) stake shall be driven through each sod to be pegged and the stakes shall not be more than two (2) feet apart. Stakes shall have their flat sides against the slope and shall be driven flush.

3.04 MAINTENANCE

A. Maintain, mow and protect the seeded ares until a uniform stand of grass approximately two-and-one-half (2-1/2) inches high has been obtained. Any areas which have been damaged or fail to show a uniform stand of grass shall be scarified, refertilized and reseeded with the original seed mixture until all the designated areas are covered with grass.

B. Maintain, mow and protect sodded areas until the sod is established. The sod shall be considered satisfactorily established when it is knit into the soil. Should the sod not knit within a two (2) month period during the growing season (spring thaw to winter frost), the Contractor shall remove and then replace the sod in accordance with these Specifications. Sod so removed and replaced shall be established and maintained for a period of two months after the resodding operations have been completed.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes provisions for removing, preserving, and restoring of shrubs, small caliper trees, and hedges where necessary in the course of the work.

B. Plants that are removed and are not preserved in a healthy condition for any reason whatsoever, shall be replaced with plant material of equal value and/or quality.

C. Shrubs, small caliper trees or hedges shall not be removed without the approval of the Engineer.

D. Definitions
   1. Shrubbery shall mean all multi-stem flowering shrubs and evergreen shrubs.
   2. Small caliper trees are defined as all trees up to and including four (4) inch caliper.
   3. Hedges shall include rows of closely spaced shrubs, evergreen shrubs and/or small caliper trees forming a boundary or fence.

PART 2 - PRODUCTS

2.01 PLANTS

A. When it is necessary to replace existing plants with new plant material, replacement shall be of the species and varieties of plants as approved by the Engineer except that the sizes shall be as follows:
   1. Deciduous shade trees shall be 2-1/2" - 3" in caliper.
   2. Small upright and spreading trees shall be 10 - 12 foot (365.76 cm) height and shall be 2-1/2" - 3" in caliper.
   3. Evergreen trees shall be 10 - 12 foot (365.76 cm) height.
   4. Deciduous shrubs shall be 6 - 7 foot (213.36 cm) height.
   5. Evergreen shrubs shall not exceed 4-5 foot (152.4 cm) in spread or 10-12 foot (365.76 cm) height for upright growing types.
   6. Hedges comprised of trees and/or shrubs shall not exceed the above sizes.
   7. Plants shall be in conformity with Section 329000, "Planting". All plants shall be balled and burlapped. Deciduous shade trees shall be of Specimen Quality.

PART 3 - EXECUTION

3.01 GENERAL

A. Work shall be accomplished by qualified personnel trained and experienced in nursery work and as approved by the Engineer.

3.02 PREPARATION

A. Before removing any plants, notify the Engineer as to those plants and trees proposed to remove so that a record can be made of the location, size, species, variety and condition of each tree, shrub and hedge plant.

B. Plants shall be dug with care to obtain sufficient roots and to ensure the satisfactory condition and survival of the plants. Spreads of roots and root ball sizes shall be, at least, the size required for collected plants unless otherwise approved by the Engineer in locations where plants are closely spaced or due to other conditions.

C. Remove plants and trees shall be removed in accordance with Section 329000, "Planting", paragraph 2.01.D. "Digging and Handling:".

D. Temporarily establish all plants by transplanting to an area away from the field of construction operations and preferably where water is readily accessible.

E. Removed plants shall be planted, cared for and established in accordance with the Section 329000, "Planting".

F. Shrubs, small caliper trees, hedges or portions of hedges that have been removed shall be preserved until such time that they can be restored to their original location.

3.03 RESTORATION

A. As soon as conditions permit, after the construction work is completed, restore the plants to their original location. Plants which are not in satisfactory condition at the time of their restoration to their original location shall be replaced by the Contractor at no cost to the Owner. The size of the replacement plant or plants shall be as specified hereinbefore in "Materials", and they shall be of equal value and/or quality of the original plant.

B. All plants shall be planted in accordance with the Section 329000, "Planting".

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Television inspection of sewers prior to and post pipe cleaning; and prior to and post pipe rehabilitation.

1.02 SYSTEM DESCRIPTION

A. The segments of sewer to be cleaned are located primarily within the paved areas of the public right-of-way; however, there may be some sewer segments that are located within public easements on private property. The Contractor shall be responsible to coordinate and gain access to any and all sewer segments and will be responsible for any restoration.

B. Television camera used for inspection shall be a color pan and tilt camera or a side wall scanning (panoramic) camera specifically designed and constructed for sewer inspection. Lighting for the camera shall be suitable to allow an even distribution of the light around the sewer perimeter to provide a clear picture of the entire periphery of the existing sewer without the loss of contrast, flare out of picture, or shadowing. Televising system shall be capable of producing color picture and video quality acceptable to the Engineer. The optical system shall consist of a wide angle lens with appropriate optical angle and an externally controlled focus.
   1. Pan and tilt camera shall pause, pan, and visually inspect all service connections, pipe ends, and maintenance or structural defects. If utilizing a camera with side wall scanning capabilities, pausing and panning of each lateral is not necessary during the inspection if the image clearly depicts the inside of the lateral for post processing.
   2. Side wall scanning inspection systems are imaging cameras that are capable of a continuous 360 degree image capture of the wall of the pipeline being inspected. These systems shall have one or multiple cameras to capture the complete interior view of the pipeline. Once the pipeline inspections are completed, the captured images shall be linked with a companion software package that allows for identifying and coding defects and features in the pipeline. These systems shall provide a fold flat view and a perspective view of the pipeline.

C. Artificial Intelligence (AI) may be used as a data-processing tool to analyze CCTV inspection footage with the following provisions:
   1. All AI-generated PACP codes must be reviewed and digitally signed off by a certified human PACP operator
   2. The AI platform or underlyinf software must use an authorized, NASSCO-liscensed PACP format to ensure data exports properly to match the standard.
   3. Quality control benchmarks for allowable defect misidentification shall match NASSCO guidelines.
   4. Outputs shall match current NASSCO exchange formats to integrate directly into asset managment systems.

D. Video Images:
   1. Full color, 360-degree side view projected on a 13-inch minimum television monitor.
   2. Continuous logging action video shall be digitally recorded for permanent record.
   3. Record in the MPEG-4, or MP4, digital format. All MPEG codings shall be named using .mpg, or .mp4, as the file extension. The replay of the compressed video information, when reviewed on the latest version of Windows Media Player, shall be free of electrical interference and shall produce a clear, stable image. The audio portion of the composite digital coding shall be sufficiently free of electrical interference and background noise to produce an oral report that is clear and completely and easily discernible.

E. Radial-head Camera Requirements:

F. Scanning system: 525 line, 60 Hz NTSC.

G. TV line resolution: 350(H) x 360(V) minimum.

H. Focal Range: 1-inch to infinity.

I. Tilt Arc: at least 225 degrees.

J. Viewing Angle: 300-degree minimum.
   1. Minimum illumination: 10 lux or one footcandle (F=1.5)

K. Remote functions:
   1. Iris control (F1.4-F22)
   2. Motorized focus control.
   3. Automatic white balance.

L. Digital Inspection Equipment:
   1. Color: With the monitor adjusted for correct saturation, the six colors plus black and white shall be clearly resolved with the primary and complementary colors in order of decreasing luminance.
   2. Linearity: The background grid shall show squares of equal size, without convergence/divergence over the whole of picture. The center circle shall appear round and have the correct height/width relationship (±5%).

1.03 SUBMITTALS

A. Submit the following:
   1. Sample of television inspection log.
   2. Safety program and confined space entry program.
   3. Site specific safety plan.
   4. Weekly work schedule to outline the sequence in which the Contractor proposes to conduct operations. Use a time-scaled logic diagram format. The level of detail of activities shall provide clear, concise communication of the plan of work.
   5. NASCCO PACP certification for all camera operators, database, and software.
   6. Inspection data including video/scans, audio files of the operators' observations during the inspection, and logs. Inspection log shall indicate distance from manhole of infiltration points, building sewers, unusual conditions, roots, storm sewer connections, broken pipe, scale and corrosion and other discernible features
   7. PACP CCTV Reports, PACP database, and inspection logs noting important features encountered during the inspection.
   8. Descriptive literature on proposed television inspection system and CCTV software.

B. All Owner and NASSCO PACP required header information shall be fully and accurately entered on all CCTV reports.

C. Digital video deliverables may be sent through a readily accessible sharepoint, web transfer, or cloud-based storage site subject to the approval of the Engineer or on USB Flash Drive media. Label each USB Flash Drive, at a minimum, with the following information: Owner, Project Name, Date of Video Inspection, ID No., and Name of Contractor.

D. If using AI as a data-processing tool, submit in writing a plan for implementing AI into the CCTV footage analyzing process and clearly indicate adherance to the requirements of the contract specifications and NASSCO guidelines.

1.04 QUALITY ASSURANCE

A. The television inspection crew team leader shall have a minimum of ten (10) years work experience. The camera operator shall be certified by National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP).

B. Database shall be an NASSCO-PACP (Current Version) Certified Access Database.

C. CCTV software shall be PACP v7.0 or v8.0 certifed by NASSCO.

D. All television inspection work shall conform to current NASSCO PACP standards.

E. All audio-visual digital recordings and collected data made during the inspection shall become the property of the Owner within ten (10) business days upon completion of the inspection.

F. Use a suitable metering device that enables the cable length to be accurately measured, accurate to two tenths of a foot. Demonstrate that the tolerance is being achieved by wheel measurement

between manholes on the surface. This accuracy measurement shall be included on each computer generated digital assessment report.

G. Work not following these specifications may be rejected and the Contractor may be required to re-do the work at no additional cost to the Owner.

1.05 EXISTING CONDITIONS

A. Sanitary sewers to be televised are active within the wastewater collection system. The existing pipe material and the age of the sewers to be televised varies.

B. Obtain water necessary for cleaning.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 PREPARATION

A. Conduct preliminary due diligence assessment of the pipe to confirm there are no existing collapses or blockages that would prevent sage or complete cleaning of the pipeline.

B. Prior to televising any sewer line, clean the length of pipe under provisions of Section 330130.41.

C. A pre-inspection of pipelines shall be performed by lamping, or any other suitable method, which will give indication to the Contractor as to the appropriate equipment to be used for a particular line and the overall general condition of the line.

D. Clean pipelines in accordance with Section 330130.41- Cleaning of Sewers.

E. Provide flow bypass pumping if the flow in the pipe is excessive for existing conditions to be observed and described. Coordinate bypassing operation with the Engineer and Owner prior to its use. Supply all necessary pumping equipment and conveyance piping other than sanitary sewers. Actual flow rates vary.

F. Repair damage to sewer mains that occurs as a direct result of the work of televising operations.

G. Immediately investigate any and all reports of sewage backing up into fixtures served by the sewer section that is being televised.

H. Notify the Owner immediately if work causes any damage to private or public property caused by activities related to this contract. Make repairs and/or clean the property immediately in a timeframe that is acceptable to the Owner.

3.02 TELEVISION INSPECTION

A. Notify the Engineer 48 hours in advance, via email, of any TV inspection so that the Owner or Engineer may observe inspection operations.

B. Inspect sewer lines utilizing a self-propelled television camera through the sewer line between respective manholes. The camera used for television inspection shall be viewed on a viewer mounted in the mobile unit located on the work site. Mobile units shall be heated in winter months. Seating shall be provided for Owner and Engineer to view television monitor as work is being performed. The speed of travel shall be slow enough to inspect each pipe joint, tee connection, structural deterioration, infiltration and inflow sources, and deposits, but should not at a rate greater than 30 feet (914.4 cm) per minute. Stop when necessary to permit proper documentation of the sewer condition. The Contractor shall provide a recording of the televised sewer inspection, locating each sewer service connection entering the sewer.

C. The sewer lines may be plugged when the television inspection is being performed at the Contractor's sole risk and responsibility. Provide bypass pumping, if and when required. Work at off hours when flow is low or when extended periods of time may be available with no flow, subject to the prior approval of the Engineer and Owner. Under no circumstances, unless specifically instructed by the Engineer, shall the Contractor television inspect a sewer line which contains a flow depth of more than twenty percent of the pipe diameter, e.g., for a 10-inch diameter pipe, flow shall not exceed 2-inches.

D. The Contractor shall consider weather conditions to obtain the best video image of the sewer. This may require the Contractor to delay any video work after major rain events until the system can return to lower dry weather flow.

E. Provide a PACP certified operator on site at all times during the entire survey. If video is to be coded separately from the actual recording, both the onsite operator and the individual performing the PACP coding shall be PACP certified. Provide proof of certification prior to commencement of work, prior to a change in personnel involved in data collection, and as requested by the Owner.

F. Whenever conditions allow, position unit to reduce the risk of picture distortion. In circular sewers, the lens shall be positioned centrally at the spring-line (i.e. in prime position) within the sewer. In non-circular sewers, unit orientation shall be at mid-height, unless otherwise agreed, and centered horizontally. In all instances the lens shall be directed along the longitudinal axis of the sewer when in prime position. A positioning tolerance of ±10% of the vertical sewer dimension shall be allowed when the camera is in prime position.

G. The camera shall be centered in the pipe to provide accurate distance measurements to locations of features in the sewer and thee footage measurements shall be displayed and documented on the video. All PACP observations shall be identified by audio and on PACP log. All video shall be continuously metered from manhole.

H. Pause and rotate camera head to provide a view into each lateral as far into the lateral connection as possible. Pan the circumference of the tap, recording all defects found in the service connection. Where lateral flow is observed, observe flows from service connections for approximately two minutes to ascertain if the flow is sanitary or extraneous flow. The video recording may be paused during observation. Record results of the flow observed on video recording and inspection logs.

I. Rotate camera head vertically towards the cover to provide a view of the wall conditions and ladder/rungs in each manhole.

J. Perform all television inspections in accordance with NASSCO’s Pipeline Assessment Certification Program (PACP). Television inspection reports shall be delivered entirely in electronic format. The entire survey shall be recorded in an approved electronic format submitted with electronic links between the data and the video. All television inspection reports shall be within +/- two (2) feet of the measured linear footage between manholes along the existing sewer centerline from the start of pipe to end of pipe.

K. Should the picture quality be obscured from humidity or debris on the lens, remove camera and clean lens. To ensure that the unit shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure color consistency no variation in illumination shall take place during the inspection.

L. If the image quality is not adequate for post-inspection coding, the Contractor shall be required to repeat the survey at the Contractor’s expense.

M. If a blockage hampers the inspection of the sewer in one direction, then the Contractor shall attempt to complete the section by televising from the other manhole to complete the section. The Contractor shall immediately report the obstruction to the Owner. It shall be the Contractor's responsibility to remove materials and equipment that has been lodged in the sewer from television inspection.

N. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be aboveground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Engineer.

O. Inspection Record: At the start of each manhole length, a data generator shall electronically generate and clearly display on the viewing monitor and digital recording, a record of data in alphanumeric form containing the information entered into the work order.

P. Television inspection results shall be evaluated based on the PACP. Standard defect codes shall be preprogrammed in the software. In addition to noting the defects along the segment, assign each sewer segment with an internal condition grade of 1 to 5. The worst defect along the individual sewer length will be used to give a single condition grade. The condition grade will imply the following with regards to the visible structural condition of the pipe:
   1. Grade 5 Collapsed or collapse imminent
   2. Grade 4 Collapse likely in foreseeable future
   3. Grade 3 Collapse unlikely in the near future but further deterioration is likely
   4. Grade 2 Minimal collapse risk in short term but potential for further deterioration
   5. Grade 1 Acceptable structural condition

Q. Notify the Engineer immediately if a Grade 5 condition is encountered.

R. The computer-generated reports will include, but not be limited to, the following:
   1. Company and operator's name.
   2. Contract number and date and time of inspection.
   3. Purpose of inspection.
   4. Sewer location by street name.
   5. Starting and ending manhole numbers.
   6. Direction of camera travel.
   7. Pipe size and material.
   8. Locations and types of house or building service connections.
   9. Locations and types of defects in the pipe.
   10. Locations and nature of all leaks and infiltration. Note the estimated quantity of leakage.
   11. Locations and type of protrusions and obstructions.
   12. Locations of previous repairs.
   13. Digital photograph snap-shot of each defect, leak, infiltration, protrusion, obstruction, and previous repair. Photographs shall be located to the nearest 0.1 feet from the manhole wall of an adjacent manhole. Photographs shall be in JPEG format and shall have a minimum resolution of 5 megapixels.
   14. At the start of the inspection, display the work order long enough for the work order information to be read by any person reviewing the video files.
   15. Distance traveled on the specific run, in feet.
   16. GPS location of each manhole.

S. Create MPEG4, or MP4, files for each sewer line segment. In case of a reverse setup, such inspection shall be stored in a separate MPEG4 file. MPEG4 files and the data inspection files shall be electronically delivered to the Engineer as well as saved to two (2) USB storage devices which shall be delivered to the Engineer. Label each USB, at a minimum, with the following information: Owner, Engineering Firm, Project Name, Date of video inspection, and Contractor's Firm.

T. MPEG4 files shall be named according to the following file convention:
   1. UPSTREAM MANHOLE NUMBER.mp4.
   2. UPSTREAM MANHOLE NUMBER_A.mp4 for a reverse inspection.

3.03 FIELD QUALITY CONTROL

A. recording shall be of a quality sufficient for the Engineer to evaluate the condition of the pipe, locate the pipe service connections, and verify cleaning and joint testing. If the Engineer determines that the quality is not sufficient, re-televise the pipe segment and provide a new recording and report at no additional compensation. Payment for televised inspection will not be made until the Engineer approves of the recordings and reports.

B. Camera distortions, inadequate lighting, dirty lens, or blurred/hazy pictures will be cause for rejection by Owner.

C. Pipe stationing not shown on the video or in a font style or color that is unreadable will be cause for rejection by the Owner.

D. Digital recordings: Electronic recording file must allow snap scrolling to allow easy and quick access of the entire recording.

E. Check footage counter against 100-foot camera cable mark to record accuracy.

F. Measure the distance between the manholes (centerline to centerline) with a tape or wheel to accurately determine length, if any, of pipe that was not inspected.

G. Maintain a master copy of all recordings and Inspection Reports for five years after Final Completion.

3.04 SCHEDULE

A. Header Field Checklist

Field #	Header Field	Mandatory	Required for this Project
1	Surveyed By	X	
1a	Certificate No.	X	
2	Owner		X
3	Customer		
4	Drainage Area		
5	Sheet Number	X	
6	P/O Number		
7	Pipe Segment Ref.		X
8	Date	X	
9	Time		X
10	Street	X	
10a	City	X	
11	Location Details		X
12	Upstream MH No.	X	
13	Upstream MH Rim to Invert		
14	Upstream MH Grade to Invert		
15	Upstream MH Rim to Grade		
16	Downstream MH No.	X	
17	Downstream MH Rim to Invert		
18	Downstream MH Grade to Invert		
19	Downstream MH Rim to Grade		
20	Sewer Use		
21	Direction	X	
22	Flow Control		
23	Height	X	
24	Width	X	

25	Shape	X	
26	Material	X	
27	Lining Method		
28	Pipe Joint Length		
29	Total Length		X
30	Length Surveyed		
31	Year Laid		
32	Year Renewed		
33	Media Label		
34	Purpose		
35	Sewer Category		
36	Pre-Cleaning	X	
36a	Date Cleaned		X
37	Weather		X
38	Location		
39	Additional Info.		
40	W/O #		
41	Project		X
42	Pressure V		

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Furnish all labor, materials, equipment, and services required to perform NASSCO MACP Level 2 manhole inspections with 3D scanning and imagery for sanitary sewer manholes.

B. The objective is to determine which structures have reached the end of their useful service life and require rehabilitation and/or replacement.

C. All work shall conform to the requirements described herein and all applicable NASSCO standards.

1.02 REFERENCES

A. NASSCO – Manhole Assessment and Certification Program (MACP), Latest Version.

B. Wincan Sewer Inspection and Asset Management Software – Current Version.

1.03 SUBMITTALS

A. Equipment and technology:
   1. Submit a comprehensive list of all equipment and technology prior to commencement of work. At a minimum, include:
      a. Safety Equipment
      b. Inspection Equipment
      c. Traffic Control Equipment

B. Submit operator(s) NASSCO MACP certification.

C. Progress Submittals
   1. Provide weekly list of manholes inspected indicating:
      a. Manholes that require cleaning, pump out, or flow bypass for proper inspection
      b. Manholes that are unable to be inspected due to burial, inability to open, or inability to locate

D. Description of methods to be used during scanning operations.

E. Submit sample of inspection log.

F. Submit for record information only one (1) copy of project specific health and safety plan and confined space entry program.

1.04 QUALITY ASSURANCE

A. All personnel performing defect coding, QA/QC, or data review shall have current NASSCO MACP certification.

B. All collected data made during the inspection shall become the property of the Owner within ten (10) business days upon completion of an inspection.

C. Inspection data shall be entered into a NASSCO MACP-compliant application/database of the newest version.

D. Inspection data shall be Wincan or fully compatible with Wincan.

E. Immediately notify the Owner’s Representative of the following:
   1. Sanitary Sewer Overflow (SSO)
   2. Blockages that may cause backups or SSOs
   3. Imminent or catastrophic structural failure
   4. Evidence of cave-in on pipe or manhole
   5. Defects affecting system integrity

1.05 EXISTING CONDITIONS

A. Sanitary sewers in area to be scanned are active. The existing manhole material is primarily reinforced concrete and brick. The manholes to be scanned are more than 70 years old.

1.06 REGULATORY REQUIREMENTS

A. Obtain all permits required by the Owner, Collection system operator, and local agencies having jurisdiction for work in right-of-way.

PART 2 - PRODUCTS

2.01 PERFORMANCE / DESIGN CRITERIA

A. Provide all equipment and tools necessary to safely access and inspect manholes.

B. Provide traffic control.

C. Inspections shall be performed internally while the sewers remains in service.

D. Purpose of work is to provide the Owner with data to be used in a condition assessment to develop future inspection, rehabilitation and/or replacement needs for each manhole inspected.

E. Provide quality assurance prior to submission of data.

F. Utilize manhole identification noted on drawings for use in data collection.

G. Determine appropriate equipment and method to conduct survey in each manhole based on actual field conditions.

H. Inspection system requirements:
   1. Fully automated system capable of automatic lowering and retrieval to maintain image continuity.
   2. Capable of producing immediate scans for clarity and exposure review.
   3. Capable of being lowered up to 30-ft.
   4. The inspection equipment shall be sized to fit through a standard 24" cover frame opening.

I. Software
   1. Must support NASSCO MACP Level 2 data structure.
   2. Must be Wincan or fully compatible with Wincan.
   3. Must support 3D scan, video, and digital still imagery.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Locate and identify manholes using GIS/ArcMap applications or maps.

B. Access may require walking and hand carrying equipment through wooded areas, wetlands, fenced backyards, or sloped terrain.

C. Metal detectors and shovel excavation may be required to provide access to buried manholes.

D. Perform MACP Level 2 inspections with 3D scan and imagery.

E. Document all defects and conditions necessary to recommend corrective action.

F. Inspection reports shall include:
   a. 3D scan
   b. Video
   c. Digital stills of defects
   d. Condition and assessment report documents

G. Inspection data shall include, at a minimum:
   a. Asset and object ID
   b. Date of inspection
   c. GPS coordinates (sub-meter accuracy; horizontal ±3 ft)
   d. Depth
   e. Material
   f. Liner material
   g. Coded Defects

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cleaning of sewers in preparation for television inspection and pipe rehabilitation.

1.02 RELATED SECTIONS

A. Section 015134 - Temporary Sanitary Wastewater Conveyance System

B. Section 330130.11 - Inspection of Underground Pipelines

C. Section 330130.72 - Cured-in-Place Pipe Lining

D. Section 330130.73 – Cured-in-Place Point Repair

1.03 SYSTEM DESCRIPTION

A. The intent of sewer line cleaning is to remove foreign materials from the lines to allow conditions of pipe to be determined during television inspection. There are conditions which may be encountered such as broken pipes or blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued.

B. If cleaning an entire section between any two manholes cannot be successfully performed from one of the manholes, the equipment shall be set up at the other manhole and cleaning attempted from the other direction. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire distance between the two manholes, it will be assumed that a major blockage exists.

C. The segments of sewer to be cleaned are located primarily within the paved areas of the public right-of-way; however, there may be some sewer segments that are located within public easements on private property. Provide, coordinate, and gain access to any and all sewer.

1.04 QUALIFICATIONS

A. Provide an onsite field supervisor with a minimum of five (5) years of experience specializing in the cleaning and televising of sewers. Provide the names, titles, phone numbers and addresses of a minimum of two references that can be used to verify this experience. The references must be contract managers or persons of authority over cleaning and televising work performed by the Contractor.
   1. Provide 5 similar projects with cleaning and inspection equipment as proposed for this project.
   2. Team Leader or supervisors shall meet all pre-qualifications for the duration of the contract.

B. NASSCO PACP requirements for CCTV inspections in accordance with Section 330130.11.

1.05 SUBMITTALS

A. Submit the following:
   1. Site specific safety plan
   2. Submit proposed equipment and methods to be used during cleaning operations.
   3. Weekly work schedule to outline the sequence in which the Contractor proposes to conduct its operations.
   4. Contractor qualifications
   5. Proposed work schedule

B. Submit documentation of the work including any required permits and disposal documentation.

1.06 EXISTING CONDITIONS

A. Sanitary sewers in area to be cleaned are active within the Owner’s wastewater collection system. The existing pipe material includes asbestos cement, clay, PVC, ductile iron, and/or cast-iron pipe. The age of the sewers to be cleaned varies but is generally 50-75 years old.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. Water for cleaning may be available for purchase from a water utility. Potable water is not available from the Owner.

PART 3 - EXECUTION

3.01 PREPARATION

A. The primary objective of sewer cleaning shall be to prepare the sewer for subsequent televising or rehabilitation. Clean sewer to allow passage of self-propelled television camera.

B. A pre-cleaning inspection of pipelines shall be performed by lamping, or any other suitable method, which will give indication to the Contractor as to the appropriate equipment to be used for a particular line and the overall general condition of the line.
   a. The Contractor may choose to use color television inspection conforming to National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) standards as its method for pre-cleaning inspection. As this inspection is performed prior to cleaning it is understood that the video may not provide an “unobstructed view of the entire pipe”,
   b. The method of pre-cleaning inspection must be pre-approved by the Owner prior to inspection of the sewer interior

C. Provide flow bypass pumping prior to the start of sewer pipe cleaning in accordance with Section 015134. Coordinate bypassing operation with the Engineer and Owner prior to its use. Supply all necessary pumping equipment and conveyance piping other than sanitary sewers. Actual flow rates vary.

D. Utilize final cleaning tools that are as close as possible to the pipe size to obtain the necessary results preparatory to subsequent work.

E. Water shall be conserved and not be used unnecessarily.

3.02 CLEANING

A. The Contractor shall clean the sewer and associated manholes, including drop connections and benches, to remove all deposits settled, such that the sewer is ready for televising. This will require a minimum of two passes of a hydraulic flusher to remove all loose debris and collect it for removal in the downstream manhole. All debris shall be removed from the sewer, including any debris that may have been washed up into any service connections, drop connections or the bench wall of the manholes. This includes all grease, rocks, debris, sticks, etc. that will reduce the hydraulic capacity of the sewer and limit maintenance access of remote equipment.

B. Root Cut
   1. The Owner and Engineer shall determine if the sewer segment requires root cut cleaning. All roots shall be screened, collected, and removed from the sewer for proper disposal.
   2. The Contractor shall immediately notify the Engineer and Owner if they believe that the activities performed under this Section will cause a sewer collapse due to the existing deterioration of the host pipe. Owner's determination whether to continue or stop work is final.

C. Deposit Cut
   1. This work includes the removal of deposits attached encrustation (DAE) and deposits attached grease (DAG) that require a cutter to remove.
   2. If an adequate number of passes using high velocity hydro-cleaning equipment does not remove DAE or DAGS, a mechanical/hydraulic root, chain cutter, etc. may be used where necessary at no additional cost to the Owner. However, the Contractor shall be responsible for any damage to the sewer or any service connections.
   3. Compliance with this paragraph requires substantial effort towards cleaning, chipping, cutting, grinding, etc. to remove hardened deposits, grease, etc. Use remote CCTV equipment to monitor the progress of the work and ensure that the sewer is not damaged.

4. The Contractor shall immediately notify the Engineer and Owner if they believe that the activities performed under this Section will cause a sewer collapse due to the existing deterioration of the host pipe. Owner's determination whether to continue or stop work is final.

D. Lateral Cuts
   1. This work includes the removal of protruding laterals, excluding atypical lateral connection materials such as ductile iron pipe, steel pipe, and cast-iron pipe.
   2. The Engineer and Owner shall determine when break-in service connections will require grinding or cutting based on their review of the initial television inspection. Cut/grind the protruding service connection by using a remote grinding/cutting device capable of removing concrete, vitrified clay, PVC and other types of pipe material. The device shall be specifically designed to cut/grind protruding service connections. Use remote CCTV equipment to monitor the progress of the work and ensure that the service connection is not damaged.
   3. The protruding break-in service connection shall be cut/ground flush to the main sewer pipe without scouring or damaging the main sewer or service connection. All cuttings shall be screened, collected, and removed from the sewer for proper disposal.
   4. During the post-cleaning television inspection, slowly pan the entire circumference of the trimmed connection to verify the quality of the work.
   5. The Contractor shall immediately notify the Engineer and Owner if they believe that the activities performed under this paragraph will cause a sewer collapse due to the existing deterioration of the host pipe. Owner's determination whether to continue or stop work is final.
   6. If atypical lateral materials are encountered, notify the Owner and Engineer, and the Owner/Engineer and Contractor should discuss the ability, costs and risks associated with cutting/grinding the lateral. The Owner shall decide whether to cut/grind the lateral or to not cut/grind the lateral.

E. Utilize a CCTV camera in the sewer during Lateral Cut and Deposit Cut operations to verify that the cleaning equipment is not damaging the sewer.

F. The sewers shall be cleaned primarily by one of the following methods or any combination thereof:
   1. Hydraulically propelled, high velocity jet or mechanically powered equipment shall be used for the removal of sand and grit, grease, small debris and any other easily removable objects, obstructions or substances. Take the necessary precautions in using jetting equipment, especially in sandy soil where the sewer may be defective and the creation of voids may cause collapse of the pipe. A high velocity gun for washing and scouring manhole walls shall also be available. Equipment shall carry its own water tank, auxiliary engines, pumps and hydraulically driven hose reel with a minimum of 600 feet of hose. A selection of at least three nozzles shall be available for use. One of the nozzles shall be designed to penetrate stoppages.
   2. Rodding - Shall be used when large, firmly implanted obstructions such as roots, heavy conglomerates of grease, etc. are encountered. The Contractor shall have at its disposal for use, when required, an assortment of cleaning tools such as a stiff wire brush, swab, saw or auger type cutter, which may be attached to the rodding machine in order to clean light debris or cut through roots within the sewer lines.
   3. Bucketing - Shall be used if large quantities of materials such as grit, sand, and grease are encountered. Follow up this procedure with a stiff wire brush, swab or squeegee.

G. For procedures (2) and (3), make certain that sufficient amount of flushing water, with sufficient head, be available to scour and flush the pipe and propel the solids within the sewer line to the downstream manhole.

H. The use of hydraulically propelled cleaning tools which function in the manner in which a pressure head is allowed to build up behind the head of the tool by employing sewage in line or by filling a manhole and line with water will not be permitted.

I. Use the manufacturer's recommended size tools for the various size pipes. Equipment recommended by the manufacturer to protect the manhole and pipe, such as pull-in slant jack rollers and roller and yoke assembly, roller manhole jacks, etc. shall be utilized.

J. In order for the cleaning to be considered satisfactory, all grease, sand, grit, roots and foreign objects, shall be removed from joints and/or breaks.

K. Do not permit debris, sand, grit and accumulated materials to pass through the downstream manhole of the section being cleaned without being withdrawn. The cleaning operation shall proceed from manhole to manhole. A screen or plug shall be used to prevent debris, sand, grit and accumulated materials from entering the next run of sewer line. Remove debris that accumulates on manhole benches during cleaning process. Debris of every type from sewer cleaning operations shall be legally disposed of offsite.

L. Repair damage to sewer pipe that occurs as a direct result of the work of cleaning operations.

M. Keep records of types of debris removed from each segment of pipe and provide these records to Owner in the format requested by Owner.

N. Acceptance of sewer line cleaning will be made upon successful completion of the television inspection as determined by the Engineer and Owner. If TV inspection shows cleaning to be unsatisfactory, re-clean and re-televise sewer line until cleaning is shown to be satisfactory.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Short-term rehabilitation of defective pipe joints and internal surface area of manholes to reduce groundwater-induced infiltration into the pipeline/manhole by packer injection application of chemical grouting materials prior to pipe/manhole rehabilitation using other methods.

B. The various pipeline component items subject to these seal methods include:
   1. Main Line Joint (MLJ) - joints in mainline segment connected to a manhole at each end.
   2. Lateral Tap Connection (LTC) – Tap connection of lateral to mainline sewer, including a defined length of lateral from the tap and any annular space that might be present between a liner and the host pipe in situations where the main line has been lined.
   3. Cured in Place Pipe Liner Annular Space Tap (AST) – Annular space opening at tap cut between liner and host pipe in situations where the main line has been lined.
   4. Laterals Connected to Manholes (LCM) – Lateral pipe directly connected to and reached from manhole. LCM is defined within MACP.
   5. Outside Drop Connections (ODC) – Drop pipes connected to mainline sewer and manhole including a defined length of drop pipe from the main.
   6. Lateral Accessed from Cleanout (LACO) – Lateral pipe reached through a cleanout. LACO is defined within LACP as an Access Point observation.
   7. Longitudinal Fracture Defects (LFD) – Longitudinal or multiple fractures and crack within a pipe. LFD is defined within PACP/ LACP as a Structural observation.

1.02 RELATED SECTIONS

A. Section 015134 – Temporary Sanitary Wastewater Conveyance System

B. Section 330130.11 - Inspection of Underground Pipelines.

C. Section 330130.41 - Cleaning of Sewers

D. Section 330130.81 - Manhole Rehabilitation

E. Section 330130.72 – Cured In Place Pipe Lining

1.03 REFERENCES

A. ASTM F2304 - Standard Practice for Rehabilitation of Sewers Using Chemical Grouting.

B. National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) Reference Manual, latest version.

C. ASTM F2414 - Standard Practice for Sealing Sewer Manholes Using Chemical Grouting

1.04 SUBMITTALS

A. Submit product data and safety data sheets on grouting materials.

B. Documentation of required qualifications of personnel.

C. Documentation of grouting safety training of all field staff.

D. Equipment operating procedures and systems.

E. Grout information:
   1. Third party testing grout component chemical composition, including primary chemical percentages.
   2. Grout mixture ratio (including additives).
   3. Procedure for adjusting grout gel time during initial preparation.
   4. Procedures for adjusting grout gel time as temperature changes.
   5. Curves of grout gel time versus temperature.
   6. Instructions for addition of components.

F. Equipment operating procedures and systems to be used, including manufacturer’s literature on grout pumps (including pump curve demonstrating compliance with required pumping rates),

operating pressures, packers, skins, packer mounted gauges, pressure readings on screen, and lateral blockage clearing equipment.

G. Packer to pipe void volume between the packers and host pipe and maximum packer end element inflation pressure when new.

H. Documentation of Joint Testing Observations in accordance with Section 330130.11, Inspection of Underground Pipelines or in accordance with Grout and Seal codes and reporting per PACP Manual.

I. List and corresponding digital images, of lateral taps containing roots or other obstructive conditions.

J. Upon completion of grouting each segment, submit to Engineer a report showing the following data for each item tested, grouted, or attempted to be grouted.
   1. Location of the pipeline segment/lateral address in which the testing was done.
   2. Stationing.
   3. Location of any items not tested and the reason for not testing.
   4. Time, date, and temperature.
   5. Grout mixture formulation, including additives.
   6. End seal pipe-packer contact pressure and seal pressure.
   7. Test pressure achieved and the duration of test maintained for each item passing the air test.
   8. End-of-hoses pump rates.
   9. In situ packer pumping rate
   10. Gel time(s) from cup testing.
   11. Quantity of grout used to seal each item.
   12. Step grouting practice, including pump on and off cycle times and volumes, if applicable.
   13. Post-grout pressure test results.
   14. Regrouting and retesting giving above data as required.

K. Submit pump calibration information, field sealing records, certification of pressure sensing/monitoring equipment, current documentation of Contractor's compliance with product manufacturer's Safe Operating Practices Procedures (SOPP) as approved by the U.S. EPA

L. Submit proof of chemical supplier's product liability insurance.

M. Documentation of Post-Construction Inspection in accordance with Section 330130.11 Inspection of Underground Pipelines, Television Inspection of Sewers or in accordance with Grout and Seal codes and reporting per PACP Manual, latest version is a Television Inspection of Sewers specification is not included in the project manual.

1.05 GUARANTEE

A. Guarantee the sealing of the pipe joint by the grout for one full year from the date of acceptance of the Owner to the extent that the Contractor will repair and/or re-grout any defects including, but not limited to, root penetration, signs of infiltration, and cracks in the pipe or grouting material, which may appear in the structure because of faulty design, handiwork, or material furnished by him.

B. Prior to the expiration of the guaranty period, an initial retest area consisting of specific pipe sections between manholes shall be selected by the Engineer/Owner. Pipe sections to be retested shall be randomly selected throughout the project area and shall be representative of the majority of the sealing work originally performed. The initial test area shall consist of at least 5 percent, but not exceed 10 percent, of the linear feet contained in the original project.

C. Within the initial retest area, retest all previously sealed joints as specified (see Sewer Pipe Joint Testing). Joints failing the retest shall be resealed. If the failure rate of the retested joints is less than 5 percent of the joints retested, the work shall be considered satisfactory and no further retesting will be required. Payment for retesting the initial area shall be at the unit price bid for each item of work required (e.g.: cleaning, TV inspection, testing, etc.). No compensation will be provided for resealing (grouting) joints that fail.

D. If in the initial retest area, the failure rate of the retested joints exceeds 5 percent of the joints retested, an additional retest area of equivalent size shall be selected, and all previously sealed joints shall be retested.

E. This additional testing and sealing, if necessary, will continue until a failure rate of less than 5 percent is met. Any additional testing/sealing required beyond the initial retest area shall be at no cost to the Owner.

F. Should as much 25 percent of the original project be retested and fail to meet the 5 percent requirement, provide the same number of crews as utilized in the original project so that the retesting will proceed at a more rapid rate.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials: Chemical sealant shall have documented service of successful performance in similar usage, with a minimum of 10,000 joints grouted.

B. Handle, mix, and store grout components in accordance with the manufacturer's recommendations.

C. Provide appropriate protective measures to ensure that the grout components and the chemicals produced in mixing are under the control of the Contractor always and are not available to unauthorized personnel.

D. All grout materials used shall meet the following minimum application requirements:
   1. All component materials shall be transportable by common carriers.
   2. Packing of component materials shall be compatible with field storage requirements.
   3. Grout components shall be packed in such a fashion as to provide for maximum worker safety when handling the materials and minimize spillage when preparing for use.
   4. Gel initiation shall take place at the point of injection/repair.
   5. Cleanup shall be done in accordance with the manufacturer recommendations.

E. LTC and AST packers shall consist of inflatable mainline end elements and a lateral grouting sock and plug that creates a void area extending beyond the tap or drop connection. Use a lateral sock sized to match the diameter of the lateral being grouted. Effective sealing length shall be 6 feet, unless required by transition or pipe configuration less than this, otherwise indicated on the plans, or as directed by Engineer. Where the lateral or drop is capped, utilize alternate lateral grouting plug or equipment sized appropriately for the capped lateral. If the lateral transitions from 6" to 4" in diameter within the view of the mainline camera and less than 2 feet from the tap, use a 4" lateral grouting plug. Maintain a variety of lengths of lateral grouting plugs and adjust length of lateral grout plug as required.

F. LCM, LACO, ODC, and LFD packers shall consist of a flexible push-pull-type packer. LCM, LACO, and LFD packers shall be sized for the diameter and pipe joint spacing found in the field, have void spaces commensurate with their duty, and be acceptable to the Engineer. The packer shall be able to test the specified items and be able to negotiate fittings associated with the pipe construction. If the lateral contains a transition, change out diameters of push packer or grout using a smaller diameter packer but no relief for excess residual grout will be provided nor payment for the extra wasted grout.

G. Materials
   1. Acrylamide based grout shall have the following characteristics:
      a. A minimum of 10% acrylamide base material by weight in the total grout mix. A higher concentration of acrylamide base material may be used where needed to offset dilution during injection.
      b. The ability to tolerate some dilution and react in moving water during injection.
      c. A viscosity of approximately 2 centipoises, which can be increased with approved additives.
      d. A controllable reaction time from 10 seconds to 2 minutes.

e. A reaction (curing) that produces a homogenous, chemically stable, non- biodegradable, firm, flexible gel.
f. The ability to increase mix viscosity, density, and gel strength by increased concentrations of the mix constituents or by the use of approved additives.

2. Acrylate base grout shall have the following characteristics:
   a. A minimum of 10% acrylate base material by weight in the total grout mix.
   b. The ability to tolerate some dilution and react in moving water during injection.
   c. A viscosity of approximately 1-3 centipoise, which can be increased with approved additives.
   d. A controllable reaction time from 10 seconds to 2 minutes.
   e. A reaction (curing) that produces a homogenous, chemically stable, non- biodegradable, firm, flexible gel.
   f. The ability to increase mix viscosity, density, and gel strength by the use of approved additives.
3. Manufacturers - Avanti International or approved equal.
4. Chemical Root Inhibitor in accordance with Section 330130.44
5. Water: Potable.
6. Oakum: Avanti AV-219 Fibrotite, oil-free.
7. Add gel time extending agent in accordance with the manufacturer's recommendations to extend gel time as necessary.

2.02 EQUIPMENT

A. Provide equipment consisting of closed-circuit television systems, necessary chemical sealant containers/tanks, pumps, regulators, valves, hoses, etc. and joint sealing packers for appropriate sizes of pipe designated to receive chemical grouting. The packer shall be cylindrical and have a diameter less than the pipe size. The packer shall be constructed in a manner to allow restricted amounts of sewage to flow and shall be pneumatically operated. Hydraulically or mechanically expanded devices shall not be permitted. To test the accuracy, integrity, and performance capabilities of sealing equipment units, perform a demonstration test in a test cylinder constructed so that a minimum of two known leak sizes can be simulated.

B. The equipment shall be constructed in such a way as to provide means for introducing air under pressure into the void area created by the expanded ends of the packer and a means for continuously measuring the actual static pressure of the test medium and grout within the void area only. Packers shall be expanded by air pressure.

C. All packers shall be fitted with a void pressure sensor (either a transducer or gauge) mounted on the packer. If using a void gauge as the pressure sensor, the maximum top range shall be 15 psi (103.42 kPa) and readable using the television camera. There can be no check valve between the void space and the pressure sensor. Packer void pressure shall be shown either on-screen or captured on-video. The air test gauge in the control panel in the studio may not be used for air testing or post-grouting pressure confirmation because the length of hose and the presence of check valves render this technique unreliable and inaccurate at pressures below 12 psi (82.74 kPa).

D. Grout control panel shall have gauges for monitoring packer element pressure. Packer element pressure gauges shall have a range of 0-60 psi (0-413.69kPa).

E. Grouting equipment shall consist of the packer, hoses, and pumping systems capable of supplying an uninterrupted flow of sealing materials to completely fill the voids.

F. Use a tiger tail, boot, or downhole roller, manhole frame roller, and truck step grid plate or pavement tail or slide to protect hoses from chafing.

G. Equipment for cleaning lateral blockages shall be present on-site while any grouting work is being conducted.

PART 3 - EXECUTION

3.01 PREPARATION

A. Contractor shall be solely responsible for safety during the performance of all Work. Take satisfactory precautions to protect the sewer segments and appurtenances from damage that might be inflicted upon them by the use of grouting equipment.

B. Do not enter into any sewer segment where hazardous conditions may exist until such time as the source of those conditions is identified and eliminated by the Contractor. Perform all work in accordance with the latest OSHA confined space entry regulations. Coordinate work with local fire, police and emergency rescue units.

3.02 INSTALLATION

A. Conduct work in accordance with ASTM F2304 and ASTM F2414.

B. Any damage inflicted upon a sewer segment or other public or private property as a result of the Contractor's grouting operations, regardless of the grouting method used and regardless of any other circumstance which may contribute to the damage, shall be repaired by Contractor at own expense.

C. Cleaning
   1. Prior to application of chemical grouting materials, thoroughly clean the sewer designated to receive the chemical grouting in accordance with Section 330130.41.

D. Inspection of Pipelines: After cleaning and prior to application of chemical grouting materials, Provide video inspection of the sewer designated to receive the chemical grouting. Sewer line inspection requirements are in Section 330130.11 – Inspection of Underground Pipelines

E. Sewage Flow Control.
   1. Provide for maintenance of flow in accordance with Section 015134.
   2. Maximum Depth of Flow for Joint Testing/Sealing: Pipe less than 24 inch (609.6 mm) diameter: 25 percent of pipe diameter

F. For any segment, LTC, LCM, LFD, or LACO that Contractor, Owner, or Engineer believes has issues compromising the ability to cost-effectively grout or achieve the project’s longevity effectiveness goals, Engineer will review the Pre-Construction Inspection and direct Contractor as to which MLJs, LTCs, ODCs, LCMs, LFDs, and LACOs shall be (a) tested and grouted without further cleaning, (b) plugged, (c) otherwise repaired, (d) additionally cleaned, or (e) to receive no further rehabilitation.

G. Testing and grouting will not be required on pipe exhibiting the following conditions or characteristics. Provide Engineer with digital image and intention not to grout any such defect.
   1. Longitudinal, spiral, or multiple fractures, as classified by PACP, unless specifically shown or specified or directed by Engineer to be grouted via LFD grouting.
   2. Broken or partially collapsed pipe, as classified by PACP.
   3. Sections of the pipe without defects between joints.
   4. Any section of pipe that is scheduled for replacement or other work involving excavation or new connections.
   5. Any sections of pipe or joints that are in such poor structural condition that in the judgment of Engineer or Contractor, significant structural damage of the pipe would occur as a result of the pressure test.

H. Position packers over joints or defects by means of a closed-circuit television camera in the line.

I. For each joint/lateral/defect tested/grouted, record exact location and volume of grout placed in PACP Remarks field.

J. For each segment, record ambient temperature, grout tank temperature, gel set test time, and packer inflation pressure.

K. Specifically identify each tap and break location on the grout report to aid in properly locating joints during warranty testing.

L. Grout Preparation:
   1. Add gel time extending agent or cool the grout component tanks and/or hoses as necessary to compensate for changes in temperature in grout component tanks or hoses resulting from changes in ambient conditions. The addition of dilution water to extend gel times is only acceptable using the B (non-grout) tank so that the resulting grout still achieves minimum base material concentrations.
   2. During the grouting process, monitor the grout component tanks to make sure that proper ratios are being pumped. If unequal levels are noted in the tanks, repeat the pump test as described above and correct any defective equipment.
   3. Gel times shall be calculated using the following formula unless field conditions dictate otherwise. Any alterations of the gel time formula shall be approved by the ENGINEER.

$$Gel\ Time = \left(\frac{Volume\ of\ Pipe/Packer\ Void\ Space\ (gal)}{Pumping\ Rate\ (gpm)}\left(\frac{60\ sec}{1\ min}\right) + 20\ \text{sec}\ (\pm 5\ \text{sec})\right.$$

      a. Packer/Pipe void shall be defined as the volume between the inflated packer and the inside pipe wall when the packer is inflated per manufacturer recommendations.

$$Gel\ Time = \left(\frac{0.3\ (gal)}{3\ (gpm)}\left(\frac{60\ sec}{1\ min}\right) + 26\ \text{sec}\ (\pm 5\ \text{sec})\right.$$

3.03 FIELD QUALITY CONTROL

A. Provide test cylinders and pressure gauges. Perform the demonstration test for each chemical sealing unit prior to beginning work. This technique will establish test equipment performance capability in relationship to test criteria and ensure that there is no leakage of the test medium from the system or other equipment defects that could affect joint testing results. Tests may be required at any other time during joint testing work if the Owner suspects testing equipment is not functioning properly. All testing costs shall be borne by the Contractor.

3.04 PRE-INSTALLATION TESTING

A. Provide equipment such as pumps, gauges, regulators, and hoses, necessary to perform air tests of each joint in those sewer sections designated for grouting work. Equipment configuration shall be such that there are no valves on or along the air line between the measuring point at the joint and the pressure transducer or sensing device located in the control unit on the surface. Systems which incorporate bladders, hoses, or the like for monitoring the pressures and which have questionable accuracy shall not be allowed. The amount of pressure being exerted on the joint shall be readable above ground on a pressure gauge.

B. The accuracy and calibration of pressure sensing/monitoring system shall have been certified by an independent testing firm within a one-month period preceding the use of equipment. Proof of certification shall be submitted to the Owner.

C. Confirm that joint testing is not a more severe test than the pipe itself can withstand.

D. Packer Control Tests
   1. Conduct this test weekly. For pipe less than or equal to 18 inches (457.2 mm) in diameter, provide a straight pipe of appropriate diameters and ovality and sufficient length to test MLJ, LTC, LACO, LFD, and LCM packers. The test cylinder shall be equipped with a void release valve to exercise a controlled release of pressurized air to test the packer under both sound and leaking conditions. The test cylinder shall also be equipped with both a local pressure gauge (0-30 psi (206.84 kPa)) and a connection to the packer test control center/studio; these shall both indicate the pressure in the packer void space.
      a. With release valve sealed, inflate packer until it contacts the pipe; record this packer-pipe contact pressure. Inflated packer to 15 psi (103.42 kPa) greater than the packer-pipe contact pressure. Generate a void pressure of 10 psi (68.95 kPa). The equipment shall hold at this test pressure for a period of 60 seconds with a pressure drop of less than 1 psi (6.89 kPa).

b. If above test is passed, crack the release to simulate a very small leak. After 20 seconds, seal the release and confirm that a pressure drop has occurred and that the local gauge is within ±1.0 psi (6.89 kPa) of the reading in the control center/studio.

2. Conduct this test every segment for MLJ and LTC packers, and every 5th lateral for LCM and LACO packers. After entering each pipeline segment with the MLJ and LTC packer, but prior to the commencement of testing, position the packer on a section of sound sewer pipe between pipe joints, and perform a test. The equipment shall hold a 10-psi test pressure for a period of 30 seconds with a pressure drop of less than 1 psi (6.89 kPa). In the event of a failed test, repair any defective equipment and re-test to verify proper operation of all equipment at no additional compensation. Should it be found that the barrel of the sewer pipe will not allow valid in situ barrel test requirements due to corrosion or other barrel defects, then the performance testing shall be waived or modified as determined by the Engineer. LFD packers do not need to do this test.
3. If air testing equipment cannot be performed successfully, repair or otherwise modify air test equipment and repeat the tests until the results are satisfactory to the Engineer.
4. The in-situ barrel test may be required at any other time during the performance of testing work if the Engineer suspects the testing equipment is not functioning properly. Contractor shall perform the barrel test between joints in each pipeline to be tested to determine that the pipe barrel can pass the test criteria. If the pipe barrel will not pass decay rate limits, adjustment of maximum pressure levels will be evaluated jointly between Contractor and Owner. Owner shall render final written decisions on each such situation.

E. Pump Control Tests
1. At the start of the job and once monthly or every 1000 gallons of grout pumped, whichever is more frequent, pump grout in uninterrupted flow for full 5 minutes to demonstrate the pumping system can operate continuously at a minimum 3 gpm rate and deliver a minimum of 9 gallons within 3 minutes.
2. At the beginning of each day prior to application of grout, perform a pump test to determine if equal ratios are being pumped from the grout component tanks at the proper rates and to measure pump rates. Pump 1 gallon of grout from each tank into two separate volumetric measuring containers. Take corrective action if unequal quantities are being pumped. Repeat the pump test until equal quantities are pumped from the grout tanks. Record the amount of time required to pump the two gallons and, when using air pumps, count the pump strokes to confirm the number of pump strokes required to achieve the delivery rate.

F. In situ Pumping Capacity Tests – Once inside the pipe and pumping grout through the packer into the first defect of the segment, record the in-situ pumping rate delivered, and modify the grout gel time as appropriate. Check in situ pumping rate each time the packer is reconnected to the hoses.

G. Grout Gel Time Control Tests - Perform a grout gel test in the presence of the Engineer to determine the grout mixture gel time. If packer is not in the pipe, recycle into the respective tanks or properly dispose of any grout remaining in the hoses. Run mixers for a minimum of 1 minute, then allow entrained air to release from the grout tanks a minimum of 5 minutes before collecting grout samples in disposable cups. Ensure equal portions of Tank A and Tank B are collected prior to mixing. If foam is present on surface of tank, collect sample from below the foam.

H. Determine gel time by taking cup samples from each tank:
1. Prior to grouting each day.
2. Prior to grouting when a different gel time is required.
3. When new batches of grout are mixed.
4. When the temperature of the solutions in either of the tanks have changed by more than 5°F from the previous gel test.

I. Sewer Pipe Joint Testing
1. To determine if a joint needs grouting, test each joint by isolating the area to be tested within the testing device and applying positive pressure into the joint and void area created by the test device. Contractor shall then introduce pressurized air into the isolated void created by testing device. Apply pressure until the pressure cannot be built in the void or until the test

pressure of 1/2 psi per foot of depth plus four psi to a maximum of 10 psi (68.95 kPa) is reached as recorded by the void pressure monitor. When either of these conditions is reached, shut off the air supply. If the required pressure cannot be developed, the joint shall have failed the test. If the required test pressure in the void was increased to 1/2 psi per foot of depth plus four psi, rate of decay of this pressure shall not exceed 1 psi (6.89 kPa) in 30 seconds. The joint being tested will also have failed if the pressure drops more than 1 psi in 30 seconds.

2. Failure of the joint indicates the need for sealing. Sealing shall be accomplished by Contractor as specified elsewhere in these Specifications.
3. Test pipe joints upstream and downstream of locations indicated in the schedule. If the tested joint does not achieve the required test pressure, seal joint as specified elsewhere in these Specifications.

J. Individually test each MLJ, LACO, ODC, and LCM joints at the above-specified pressure (and retest after sealing) in accordance with the following procedure:
   1. The packer shall be positioned within the pipe in such a manner as to straddle the joint to be tested. If uncertain, pump small amount of grout to confirm the void space is properly located (spitting) before inflating the packer.
   2. The packer ends shall be expanded to isolate the joint from the remainder of the pipe and create a void area between the packer and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient inflation pressure to contain the air within the void without leakage past the expanded ends. Record end seal pipe-packer contact pressure and seal pressure used.
      a. Packer end seal pressures for visually sound VCP shall not be greater than 15 psi (103.42 kPa) more than the required packer-pipe contact pressure.
      b. Packer end seal pressures for VCP with joint defects shall use low pressure MLJ techniques such that the end element pressures shall not be greater than 8 psi (55.16 kPa) more than the required packer-pipe contact pressure.
      c. For rough surface pipes such as corroded concrete pipe, use grout to seal the leaks around the packer end if airtight seal cannot be achieved. Gel time may be reduced to half the normally specified time under these circumstances with the approval of Engineer. The Contractor shall be paid the unit price for grout to seal the packer unless Engineer determines that the sewer was inadequately cleaned, or the packer is not performing properly but will not be paid the unit price for joint grouting for this activity.

K. Lateral connection joint testing pressure shall be equal to 0.5 psi (3.45 kPa) per vertical foot of pipe depth plus 3 psi (20.68 kPa); however, test pressure shall not exceed 10 psi (68.95 kPa) nor lower than 6 psi (41.37 kPa) without approval of the Engineer.
   1. Air testing LTCs shall be accomplished by isolating the area to be tested with the packer and by applying positive pressure into the isolated void area. A pan and tilt camera shall be used to position the lateral packer. The bladder shall be inverted from the mainline assembly into the lateral pipe and inflated. The mainline elements shall then be inflated to isolate the lateral connection and the portion of the lateral to be tested. A sensing unit shall be located within the void area and will accurately and continuously transmit void pressure readout to the control panel or pressure gauge viewable with CCTV camera.
   2. The test procedure shall consist of applying air pressure into each isolated void area. A sensing unit shall be located within the void area and will accurately transmit continuous pressure readout to the control panel. Air shall then be slowly introduced into the void area until a pressure equal to the required test pressure is observed on the pressure monitoring equipment.
   3. After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the void pressure decays by more than 1.0 psi (6.89 kPa) within 20 seconds, the LTC will have failed the test and shall be sealed. If the void is over pressurized and the void pressure decays, the 20 second period shall begin once the test pressure is achieved.

4. After completing the air test for each individual LTC specified herein, deflate the packer, with the void pressure meter continuing to display void pressure. If the void pressure does not drop to ±1 psi (6.89 kPa), clean the test equipment of residual grout material or make the necessary equipment adjustments to provide for an accurate void pressure reading.
5. For laterals capped less than two feet from the main, use a mainline packer to test the lateral tap.
6. Test Records: During grout testing, keep records which include identification of the sewer section tested, test pressure used, location (footage) of each grouted defect tested and location of grouted defects not tested due to close proximity to building service connections and sanitary sewer manholes, a statement indicating test results (passed or failed) for each grouted defect tested, test pressure achieved and maintained for each grouted defect passing air test, weekly equipment pressure test results, sewer section barrel test results, daily gel check results, and air temperature at time of testing joints.

L. Mixing: Mixing and handling of chemical grout, which may be toxic under certain conditions, shall be in accordance with the recommendations of the manufacturer and in such a manner to minimize hazard to personnel. Provide appropriate protective measures to ensure that chemicals and gels are handled by authorized personnel in the proper manner. Only personnel thoroughly knowledgeable with the handling of the grout material and additives shall perform the grouting operations.

M. Chemical Grout Application for Sealing Joints: Repairs shall take place at joints, generally small circumferential cracks, small holes, or similar points of infiltration as identified. The repair shall be such that the original cross-sectional area and shape of the interior of sewer pipe shall not be permanently reduced or changed.

N. Placement of Chemical Grout:
1. Position the sealing packer over the area of infiltration by means of a metering device at the surface and closed-circuit television camera in the line. Accurate measurement of the location of the defect to be sealed shall be made, using the portion of sealing packer as "Datum" or measurement point or target. Such measurement to the target shall also be used to obtain necessary measurements for positioning the injection area of sealing packer over area to be sealed.
2. Expand the sealing packer sleeves using controlled pressures. Expanded sleeve shall seal against the inside periphery of pipe to form a void area at the point of infiltration, completely isolated from the remainder of the line. Pump sealant materials into this isolated area through hose systems at controlled pressures which are in excess of groundwater pressures. Pump as much grout field required to seal leaks and fill voids. Grout shall break away from the packer and stay in place when the packer is deflated and moved from the point of infiltration.
3. Upon completion of injection, retest the point of repair. If retesting shows the seal was not completely effective, repeat the sealing process until the defect successfully passes the pressure test. After sealing the entire sewer section, remove surplus grouting material from section at the immediate downstream manhole. If surplus grouting materials left in the sewer section by Contractor results in sewer surcharging and subsequent damage to public or private property, the Contractor shall be responsible for damage to property and expenses incurred by Owner.
4. Gel Checks: Make gel checks daily for each sealing vehicle to monitor both induction period and gel characteristics. Make checks for every mixed batch or at least twice per day if only one batch is used. Owner reserves the right to request adjustment of gel times or reject the entire batch if acceptable gel characteristics do not exist. Periodic gel checks shall also be made in the pipe (at request of Owner) by seating the sealing packer on the pipe barrel and filling the packer void with grout solutions. Pressure will then be monitored until a rise in pressure is observed, indicating that grout has gelled in the packer void. Contractor shall certify, for each of the sealing vehicles, results of required gel checks.

O. Contractor shall submit field records: Keep field records for each sewer section prior to, during, and after completion of the chemical grouting operation. Records shall include information such as accurate locations, gel times, grout volumes, grout pressures, air temperatures, and joints not sealed due to close proximity to building service connections and sanitary sewer manholes.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rehabilitation of defective pipe joints to reduce groundwater-induced infiltration into the pipeline and/or manhole by pressure injection application of chemical grouting materials.

1.02 RELATED SECTIONS

A. Section 015134 – Temporary Sanitary Wastewater Conveyance

B. Section 330130.11 – Inspection of Underground Pipelines

C. Section 330130.16 – Sanitary Sewer Manhole Inspection

D. Section 330130.41 - Cleaning of Sewers

E. Section 330130.81 - Manhole Rehabilitation

1.03 REFERENCES

A. ASTM F2304 - Standard Practice for Rehabilitation of Sewers Using Chemical Grouting.

B. ASTM F2414 - Standard Practice for Sealing Manholes Using Chemical Grouting.

C. National Association of Sewer Service Companies (NASSCO) prepared Pipeline Assessment and Certification Program (PACP) Reference Manual, latest version.

1.04 SUBMITTALS

A. Submit product data, installation data, and safety data sheets on grouting materials and water plugs.

B. Documentation of required qualifications of personnel.

C. Documentation of grouting safety training of all field staff.

D. Equipment operating procedures and systems.

E. Grout information:
   1. Third party testing grout component chemical composition, including primary chemical percentages.
   2. Grout mixture ratio (including additives).
   3. Procedure for adjusting grout gel time during initial preparation.
   4. Procedures for adjusting grout gel time as temperature changes.
   5. Curves of grout gel time versus temperature.
   6. Instructions for addition of components.

F. Equipment operating procedures and systems to be used, including manufacturer’s literature on grout pumps (including pump curve demonstrating compliance with required pumping rates), operating pressures, packers, skins, packer mounted gauges, pressure readings on screen, and lateral blockage clearing equipment.

G. Packer to pipe void volume between the packers and host pipe and maximum packer end element inflation pressure when new.

H. Documentation of Joint Testing Observations in accordance with Section 33 01 30.16, Television Inspection of Sewers or in accordance with Grout and Seal codes and reporting per PACP Manual.

I. List and corresponding digital images, of lateral taps containing roots or other obstructive conditions.

J. Upon completion of grouting each segment, submit to Engineer a report showing the following data for each item tested, grouted, or attempted to be grouted.
   1. Location of the pipeline segment/lateral address in which the testing was done.
   2. Stationing.
   3. Location of any items not tested and the reason for not testing.
   4. Time, date, and temperature.

5. Grout mixture formulation, including additives.
6. End seal pipe-packer contact pressure and seal pressure.
7. Test pressure achieved and the duration of test maintained for each item passing the air test.
8. End-of-hoses pump rates.
9. In situ packer pumping rate
10. Gel time(s) from cup testing.
11. Quantity of grout used to seal each item.
12. Step grouting practice, including pump on and off cycle times and volumes, if applicable.
13. Post-grout pressure test results.
14. Regrouting and retesting giving above data as required.

K. Submit pump calibration information, field sealing records, certification of pressure sensing/monitoring equipment, current documentation of Contractor's compliance with product manufacturer's Safe Operating Practices Procedures (SOPP) as approved by the U.S. EPA

L. Submit proof of chemical supplier's product liability insurance.

M. Documentation of Post-Construction Inspection in accordance with Section 330130.11, Inspection of Underground Pipelines or in accordance with Grout and Seal codes and reporting per PACP Manual.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials: Chemical sealant shall have documented service of successful performance in similar usage, with a minimum of 10,000 joints grouted.

B. Delivery, Storage and Handling: Deliver materials to job site in undamaged, unopened containers bearing manufacturer's original labels. Materials used as chemical grout shall be transported, stored, and placed in manner prescribed by manufacturer of those materials, as detailed in published data provided by manufacturer.

C. Handle, mix, and store grout components in accordance with the manufacturer’s recommendations.

D. Provide appropriate protective measures to ensure that the grout components and the chemicals produced in mixing are under the control of the Contractor always and are not available to unauthorized personnel.

E. All grout materials used shall meet the following minimum application requirements:
1. All component materials shall be transportable by common carriers.
2. Packing of component materials shall be compatible with field storage requirements.
3. Grout components shall be packed in such a fashion as to provide for maximum worker safety when handling the materials and minimize spillage when preparing for use.
4. Gel initiation shall take place at the point of injection/repair.
5. Cleanup shall be done in accordance with the manufacturer recommendations.

F. Materials
1. Acrylic or Acrylate based grout for non-structural infiltration control:
   a. Adhere to requirements of ASTM F2414
   b. Two-part chemical grout mixed at point of injection
   c. Minimum 25% acrylic or acrylate base material by volume
   d. Controllable reaction time: 30 seconds to 1 hour
   e. Viscosity: 1.5 centipoises water (May be increased to 2.5 as directed by Engineer)
   f. Tolerates dilution and reacts in moving water
   g. Final reaction:
      1) Produces chemically, continuous irreversible, non-biodegradable, flexible gel, impermeable to water at pressures up to 15 psi (103.42 kPa) in pure form.
      2) Produces stabilized soil in ground that will not become brittle or rigid.

h. Gel does not bleed water under stress
i. Dehydrated gel returns to 90% of its original volume and form after prolonged period of low ground water
j. Do not use catalyst containing dimethyl amino propionitrile (DMAPM)
k. Use root inhibitor (50% active dichlobenil) when roots are present in manholes, connecting pipes or laterals.
    1) Change dye color to confirm root inhibiting grout is being used
l. Use latex additive for increased tensile strength as required.
m. Tinted to allow detection of grout in drill holes or at leakage locations
n. Approved Manufacturers:
    1) Avanti International, Acrylic Gel AV-100
        (a) Additives: AV-101 Catalyst T+, AV-103 Catalyst SP, AC50W Root Inhibitor, AC-257 Icoset
    2) De Need, Inc, AC400 Acrylate Grout
        (a) Additives: TE 300 Triethanolamine, P200 Sodium Persulfate
    3) Or approved equal.

2. Urethane based grout for non-structural infiltration control:
    a. Ratio: One part urethane prepolymer to 10 parts water by volume (10 to 50 percent prepolymer).
    b. Liquid prepolymer:
        1) Solids content: 77 to 83 percent.
        2) Specific Gravity: 1.04
        3) Flash Point: 20 degrees Fahrenheit (-6.67 degrees Celsius).
        4) Viscosity: 200 to 1,200 centipoises water at 70 degrees Fahrenheit (21.11 degrees Celsius).
    c. Water for reacting prepolymer: pH of 5 to 9.
    d. Use manufacturer recommended gel control agent to control cure time as required.
    e. Final Reaction:
        1) Produces chemically continuous irreversible, non-biodegradable, flexible gel, impermeable to water at pressures up to 15 psi (103.42 kPa) in pure form.
        2) Produces stabilized soil in ground that will not become brittle or rigid.
    f. Dehydrated gel returns to 90 percent of its original volume and form after prolonged period of low ground water.
    g. Use root inhibitor (50% active dichlobenil) when roots are present in manholes, connecting pipes, or laterals.
    h. Use latex additive for increased tensile strength.
    i. Tinted to allow detection of grout in drill holes or at leakage locations.
    j. Approved Manufacturers:
        1) Warren Environmental, Inc, SG-201 Grout
        2) Avanti, Norosac AC 50W Root Inhibitor or AV-254 Gelset
            (a) Additives: AV-257 Icoset, AV-255G Grout Side Accelerator
        3) De Neef, Inc., Hydro Active Multigel NF
            (a) Additives: Flexgel Cat Water Side Accelerant, Reinforcing Agent

3. Provide a chemical sealant solution containing principal chemical sealant constituent, initiator (trigger) and catalyst specifically recommended for the purpose of sealing leaks in sanitary sewer lines and manholes. Chemical sealant constituent, initiator (trigger) and catalyst shall be compatible when mixed. Solution shall have ability to tolerate dilution and react in moving water. After final reaction, it shall be a stiff, impermeable, yet flexible gel. The grout proportions shall be such that dilute aqueous solutions - when properly catalyzed - will form stiff gels. Grout shall make true solution at concentrations as high as three pounds per gallon of water. Solutions shall have ability to accept dilution by groundwater of at least 50 percent by volume, without significantly changing sealing ability of the gel when at rest or in motion. Solutions shall gel in a predetermined time when exposed to normal groundwater pH ranges and be capable of formula adjustments to compensate for changing conditions.

Final reaction shall produce a continuous, irreversible, impermeable stiff gel at chemical concentrations as low as 0.4 lbs per gallon of water that is able to break away from the joint sealing packer when the packer is deflated. Gel shall not be rigid or brittle. Gel shall have negligible corrosion rate on mild steel plates.

4. Insoluble (Particulate) Additives: Inactive solids such as diatomaceous earth may be mixed with grout by Contractor as filler only upon written approval of Owner.
5. Water: Potable.
6. Oakum: Avanti AV-219 Fibrotite, oil-free.
7. Add gel time extending agent in accordance with the manufacturer's recommendations to extend gel time as necessary. Completely dissolve chemical crystals in water before introducing them to the grout tank.

2.02 EQUIPMENT

A. Provide equipment consisting of closed-circuit television systems, necessary chemical sealant containers/tanks, pumps, regulators, valves, hoses, etc. and joint sealing packers for appropriate sizes of pipe designated to receive chemical grouting. The packer shall be cylindrical and have a diameter less than the pipe size. The packer shall be constructed in a manner to allow restricted amounts of sewage to flow and shall be pneumatically operated. Hydraulically or mechanically expanded devices shall not be permitted. To test the accuracy, integrity, and performance capabilities of sealing equipment units, perform a demonstration test in a test cylinder constructed so that a minimum of two known leak sizes can be simulated.

B. The equipment shall be constructed in such a way as to provide means for introducing air under pressure into the void area created by the expanded ends of the packer and a means for continuously measuring the actual static pressure of the test medium and grout within the void area only. Packers shall be expanded by air pressure.

C. All packers shall be fitted with a void pressure sensor (either a transducer or gauge) mounted on the packer. If using a void gauge as the pressure sensor, the maximum top range shall be 15 psi (103.42 kPa) and readable using the television camera. There can be no check valve between the void space and the pressure sensor. Packer void pressure shall be shown either on-screen or captured on-video. The air test gauge in the control panel in the studio may not be used for air testing or post-grouting pressure confirmation because the length of hose and the presence of check valves renders this technique unreliable and inaccurate at pressures below 12 psi (82.74 kPa).

D. Grout control panel shall have gauges for monitoring packer element pressure. Packer element pressure gauges shall have a range of 0-60 psi (0-413.69 kPa).

E. Main line joint packers shall have a void volume less than 0.3 gallons for 4-inch packers, 0.3 gallons for 6-inch packers, 0.3 gallons for 8-inch packers, 0.4 gallons for 10-inch packers, 0.5 gallons for 12-inch packers, 0.8 gallons for 15-inch packers, 0.9 gallons for 15-inch packers, 1.0 gallons for 18-inch packers.

F. Grouting equipment shall consist of the packer, hoses, and pumping systems capable of supplying an uninterrupted flow of sealing materials to completely fill the voids. Pump systems shall be sized to deliver a minimum of 3 gpm during end-of-hose pumping tests and achieve at least a 3 gpm uninterrupted pumping rate over a 5-minute period.

1. Use a tiger tail, boot, or downhole roller, manhole frame roller, and truck step grid plate or pavement tail or slide are required to protect hoses from chafing.
2. Equipment for cleaning lateral blockages shall be present on-site while any grouting work is being conducted.
3. Provide at least one back up bladder or packer on-site for each packer scheduled for work on any given day

PART 3 - EXECUTION

3.01 PREPARATION

A. Contractor shall be solely responsible for safety during the performance of all Work. Take satisfactory precautions to protect the sewer segments and appurtenances from damage that might be inflicted upon them by the use of grouting equipment.

B. Do not enter any sewer segment where hazardous conditions may exist until such time as the source of those conditions is identified and eliminated by the Contractor. Perform all work in accordance with the latest OSHA confined space entry regulations. Coordinate work with local fire, police and emergency rescue units

3.02 INSTALLATION

A. Conduct work in accordance with ASTM F2304 and ASTM F2414.

B. Any damage inflicted upon a sewer segment or other public or private property as a result of the Contractor's grouting operations, regardless of the grouting method used and regardless of any other circumstance which may contribute to the damage, shall be repaired by Contractor at own expense.

C. Cleaning
   1. Prior to application of chemical grouting materials, thoroughly clean the sewer designated to receive the chemical grouting in accordance with Section 330130.41.

D. Inspection of Pipelines: After cleaning and prior to application of chemical grouting materials, provide video inspection of the sewer designated to receive the chemical grouting. Sewer line inspection requirements are in Section 330130.11 – Inspection of Underground Pipelines.

E. Sewage Flow Control.
   1. Provide for maintenance of flow in accordance with Section 015134.
   2. Maximum Depth of Flow for Joint Testing/Sealing: Pipe less than 24 inch (609.6 mm) diameter: 25 percent of pipe diameter

F. Testing and grouting will not be required on pipe exhibiting the following conditions or characteristics. Provide Engineer with digital image and intention not to grout any such defect.
   1. Longitudinal, spiral, or multiple fractures, as classified by PACP, unless specifically shown or specified or directed by Engineer to be grouted via LFD grouting.
   2. Broken or partially collapsed pipe, as classified by PACP.
   3. Sections of the pipe without defects between joints.
   4. Any section of pipe that is scheduled for replacement or other work involving excavation or new connections.
   5. Any sections of pipe or joints that are in such poor structural condition that in the judgment of Engineer or Contractor, significant structural damage of the pipe would occur as a result of the pressure test.
   6. Defects in cured in place liners.

G. Chemical Grouting prior to rehabilitation of manholes.
   1. Provide 48 hour notice to Engineer prior to start of work for equipment inspection and testing.
      a. Allow measurements to be taken.
      b. Demonstrate acceptable grout volumetric measuring technique.
   2. Adjust chemical mixing ratios required for specific application.
      a. Minimum gel time 30 seconds or as directed by Engineer.
   3. Do not block pipes entering/exiting manhole with grout.
      a. Use mirror or camera to confirm pipes are not blocked.
   4. Do not damage manhole structure during operations.
      a. Repair damage as directed by Engineer.
   5. Protect area of manhole below repair work.
      a. Do not allow solid material to enter sewage flow.
      b. Remove protective devices as soon as practical.
   6. Manhole Sealing: Follow ASTM F2414 and as specified herein.
      a. Brick manholes.

1) Drill only the amount of holes necessary to stop leakage following industry standards and chemical grout manufacturer's recommendations.
2) Do not use curtain of grout sealing method.
3) Proceed with manhole reconstruction using reconstruction processes specified herein.

b. Precast manholes.
1) Seal pipe connections as specified by drilling between pipe and manhole pipe penetration and injecting grout.
2) When specified, seal precast manhole base by drilling holes at leakage points along bench to wall, and in channel.
3) At precast joints inject grout through holes drilled at leaking joint.

7. Hydraulic Water Plugs: Follow approved submittals.
a. Provide mechanical key by undercutting or square cutting opening and removing loose materials.
b. Mix, handle, place and cure material.
c. Finish surface as required for other rehabilitation work.

8. Oil-Free Oakum Water Plugs: Follow approved submittals.
a. Saturate oakum with resin.
1) Use additives as required.
2) Place, pack and cure material.

H. For each joint/lateral/defect tested/grouted, record exact location and volume of grout placed in PACP Remarks field.

I. For each segment, record ambient temperature, grout tank temperature, gel set test time, and packer inflation pressure in PACP header in appropriate fields.

J. Specifically identify each tap and break location on the grout report to aid in properly locating joints during warranty testing.

K. Grout Volume Goal: Use the attached Grout Volume and Gel Time Calculator, which considers pipe material, bedding depth, bedding material, and joint spacing, to determine grout volume per defect goals.
1. Vitrified clay pipe (VCP), clay tile pipe (CT), asbestos cement pipe (AC) and unreinforced concrete pipe (CP) are more prone to break/fracture and therefore require bedding grouting as well as defect grouting to provide long-term seal stability. These pipes shall use the VCP/CP Grout Volume and Gel Time.
2. Polyvinyl chloride pipe (PVC), ductile iron pipe (DIP), reinforced concrete pipe (RCP), and other flexible pipes are less prone to break/fracture and therefore require less stabilization as well as defect grouting to provide long-term seal stability. These pipes shall use the PVC/RCP/DIP Grout Volume and Gel Time.
3. Bedding depth: Assume 3" unless otherwise shown or specified on plans or in specifications or field knowledge provides specific information.

L. Bedding material: Assume sand unless otherwise shown or specified on plans or in specifications or field knowledge provides specific information.

M. Gel Time: Gel times shall be within 10 seconds of the following unless field conditions dictate otherwise and with approval of Engineer.
1. Main line joint for VCP, CT, AC, and CP: Calculate gel time using the below formula.
2. Main line joint for PVC, RCP, and DIP: Calculate gel time using the below formula.

N. Preconstruction Testing
1. Provide equipment such as pumps, gauges, regulators, and hoses, necessary to perform air tests of each joint in those sewer sections designated for grouting work. Equipment configuration shall be such that there are no valves on or along the air line between the measuring point at the joint and the pressure transducer or sensing device located in the control unit on the surface. Systems which incorporate bladders, hoses, or the like for monitoring the pressures and which have questionable accuracy shall not be allowed. The

amount of pressure being exerted on the joint shall be readable above ground on a pressure gauge.

2. The accuracy and calibration of pressure sensing/monitoring system shall have been certified by an independent testing firm within a one-month period preceding the use of equipment. Proof of certification shall be submitted to the Owner.
3. To confirm that joint testing is not a more severe test than the pipe itself can pass, Contractor shall perform an on-job barrel test between joints in each pipeline to be tested to determine that the pipe barrel can pass the test criteria. If the pipe barrel will not pass decay rate limits, adjustment of maximum pressure levels will be evaluated jointly between Contractor and Owner. Owner shall make final written decisions on each such situation.

O. Pump Control Tests
1. At the start of the job and once monthly or every 1000 gallons of grout pumped, whichever is more frequent, pump grout in uninterrupted flow for full 5 minutes to demonstrate the pumping system can operate continuously at a minimum 3 gpm rate and deliver a minimum of 9 gallons within 3 minutes.
2. At the beginning of each day prior to application of grout, perform a pump test to determine if equal ratios are being pumped from the grout component tanks at the proper rates and to measure pump rates. Pump 1 gallon of grout from each tank into two separate volumetric measuring containers. Take corrective action if unequal quantities are being pumped. Repeat the pump test until equal quantities are pumped from the grout tanks. Record the amount of time required to pump the two gallons and, when using air pumps, count the pump strokes to confirm the number of pump strokes required to achieve the delivery rate.

P. Grout Gel Time Control Tests - Perform a grout gel test in the presence of the Engineer to determine the grout mixture gel time. If packer is not in the pipe, recycle into the respective tanks or properly dispose of any grout remaining in the hoses. Run mixers for a minimum of 1 minute, then allow entrained air to release from the grout tanks a minimum of 5 minutes before collecting grout samples in disposable cups. Ensure equal portions of Tank A and Tank B are collected prior to mixing. If foam is present on surface of tank, collect sample from below the foam.

Q. Determine gel time by taking cup samples from each tank:
1. Prior to grouting each day.
2. Prior to grouting when a different gel time is required.
3. When new batches of grout are mixed.
4. When the temperature of the solutions in either of the tanks have changed by more than 5°F from the previous gel test.

R. Grout Concentration Control Tests – When grout is not mixed under the observation of the Engineer, perform a grout concentration test using a Contractor-provided hydrometer or refractometer, temperature gauge, and a grout concentration: temperature chart on demand of the Engineer to determine the grout concentration.

S. Sewer Pipe Joint Testing
1. To determine if a joint needs grouting, test each joint by isolating the area to be tested within the testing device and applying positive pressure into the joint and void area created by the test device. Contractor shall then introduce pressurized air into the isolated void created by testing device. Apply pressure until the pressure cannot be built in the void or until the test pressure of 1/2 psi per foot of depth plus four psi to a maximum of 10 psi (68.95 kPa) is reached as recorded by the void pressure monitor. When either of these conditions is reached, shut off the air supply. If the required pressure cannot be developed, the joint shall have failed the test. If the required test pressure in the void was increased to 1/2 psi per foot of depth plus four psi, rate of decay of this pressure shall not exceed 1 psi (6.89 kPa) in 30 seconds. The joint being tested will also have failed if the pressure drops more than 1 psi in 30 seconds.
2. Failure of the joint indicates the need for sealing. Sealing shall be accomplished by Contractor as specified elsewhere in these Specifications.

3. Test pipe joints upstream and downstream of locations indicated in the schedule. If the tested joint does not achieve the required test pressure, seal joint as specified elsewhere in these Specifications.
4. Test Records: During grout testing, keep records which include identification of the sewer section tested, test pressure used, location (footage) of each grouted defect tested and location of grouted defects not tested due to close proximity to building service connections and sanitary sewer manholes, a statement indicating test results (passed or failed) for each grouted defect tested, test pressure achieved and maintained for each grouted defect passing air test, weekly equipment pressure test results, sewer section barrel test results, daily gel check results, and air temperature at time of testing joints.

T. Mixing: Mixing and handling of chemical grout, which may be toxic under certain conditions, shall be in accordance with the recommendations of the manufacturer and in such a way to minimize hazard to personnel. Provide appropriate protective measures to ensure that chemicals and gels are handled by authorized personnel in the proper manner. Only personnel thoroughly familiar with the handling of the grout material and additives shall perform the grouting operations.

U. Chemical Grout Application for Sealing Joints: Repairs shall take place at joints, generally small circumferential cracks, small holes, or similar points of infiltration as identified. The repair shall be such that the original cross-sectional area and shape of the interior of sewer pipe shall not be permanently reduced or changed.

V. Placement of Chemical Grout:
1. Position the sealing packer over the area of infiltration by means of a metering device at the surface and closed-circuit television camera in the line. Accurate measurement of the location of the defect to be sealed shall be made, using the portion of sealing packer as "Datum" or measurement point or target. Such measurement to the target shall also be used to obtain necessary measurements for positioning the injection area of sealing packer over area to be sealed.
2. Expand the sealing packer sleeves using controlled pressures. Expanded sleeve shall seal against the inside periphery of pipe to form a void area at the point of infiltration, completely isolated from the remainder of the line. Pump sealant materials into this isolated area through hose systems at controlled pressures which are in excess of groundwater pressures. Pump as much grout as is field required to seal any leaks and fill the voids. Grout shall break away from the packer and stay in place when the packer is deflated and moved from the point of infiltration.
3. Upon completion of injection, retest the point of repair. If retesting shows the seal was not completely effective, repeat the sealing process until the defect successfully passes the pressure test. After sealing the entire sewer section, remove surplus grouting material from section at the immediate downstream manhole. If surplus grouting materials left in the sewer section by Contractor results in sewer surcharge and subsequent damage to public or private property, the Contractor shall be responsible for damage to property and expenses incurred by Owner.

W. Gel Checks: Make gel checks daily for each sealing vehicle to monitor both induction period and gel characteristics. Contractor shall also make checks for every mixed batch or at least twice per day if only one batch is used. Owner reserves the right to request adjustment of gel times or reject the entire batch if acceptable gel characteristics do not exist. Periodic gel checks shall also be made in the pipe (at request of Owner) by seating the sealing packer on the pipe barrel and filling the packer void with grout solutions. Pressure will then be monitored until a rise in pressure is observed, indicating that grout has gelled in the packer void. Contractor shall certify, for each of the sealing vehicles, results of required gel checks.

X. Field Records: Keep field records for each sewer section prior to, during, and after completion of the chemical grouting operation. Records shall include information such as accurate locations, gel times, grout volumes, grout pressures, air temperatures, and joints not sealed due to close proximity to building service connections and sanitary sewer manholes.

3.03 FIELD QUALITY CONTROL

A. Provide test cylinders and pressure gauges. Perform the demonstration test for each chemical sealing unit prior to beginning work. This technique will establish test equipment performance capability in relationship to test criteria and insure that there is no leakage of the test medium from the system or other equipment defects that could affect joint testing results. Tests may be required at any other time during joint testing work if the Owner suspects testing equipment is not functioning properly. All testing costs shall be borne by the Contractor.

3.04 GUARANTEE

A. Guarantee the sealing of the pipe joint by the grout for one full year from the date of acceptance of the Owner to the extent that the Contractor will repair and/or re-grout any defects including, but not limited to, root penetration, signs of infiltration, and cracks in the pipe or grouting material, which may appear in the structure because of faulty design, handiwork, or material furnished by him.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The reconstruction of existing sewers by the installation of a resin-impregnated flexible tube that is inflated within the existing conduit to form a hard, impermeable, corrosion resistant pipe within a pipe. When cured, the cured-in-place-pipe (CIPP) shall be formed to the internal surface of the original conduit and provide a structurally sound, jointless and water-tight new pipe-within-a-pipe.

B. The Work of this Section consists of operations, equipment, methods, and materials necessary to clean, inspect by television, and rehabilitate underground sanitary sewer piping. Rehabilitation shall be by one of the following methods at the option of the Contractor:
   1. Use of a heat cured-in-place, full length, resin-impregnated flexible tube inserted into the host pipe by means of a hydraulic head. When cured, tube shall be continuous and tight-fitting throughout the entire length of the original pipe, and shall be jointless from manhole-to manhole or access point to access point.
   2. Use of a UV-cured resin impregnated glass fiber reinforced tube. When cured, tube shall be continuous and tight-fitting throughout the entire length of the original pipe, and shall be jointless from manhole-to manhole or access point to access point.

1.02 RELATED SECTIONS

A. Section 015134 - Temporary Sanitary Wastewater Conveyance System

B. Section 330130.11 - Inspection of Underground Pipelines

C. Section 330130.41 – Cleaning of Sewers

1.03 REFERENCES

A. ASCE MOP 145 - Design of Close-Fit Liners for the Rehabilitation of Gravity Pipes.

B. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.

C. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D. ASTM D 2990 - Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.

E. ASTM D 3681 - Standard Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.

F. ASTM D 5813 - Standard Specification for Cured-in Place Thermosetting Resin Sewer Piping Systems.

G. ASTM F 1057 - Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique.

H. ASTM F1216 - Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube. Appendices:
   1. X1 - Design Considerations.
   2. X2 - Chemical Resistance Tests.

I. ASTM F 1743 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe

J. ASTM F 2019 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled-in-Place Installation of Glass Reinforced Plastic Cured-in-Place (GRP-CIPP) Using the UV-Light Curing Method.

K. Guideline for the Safe Use and Handling of Styrene-Based Resins in Cured-in-Place Pipe, NASSCO.

1.04 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Performance Work Statement (PWS) which clearly defines the CIPP product delivery in conformance with the requirements of these contract documents. Unless otherwise directed by the Owner, the PWS shall, at a minimum, contain the following:
   1. Clearly indicate that the CIPP will conform to the project requirements as outlined in the Description of Work and as delineated in these specifications.
   2. A detailed product installation plan describing preparation work, cleaning operations, pre-CCTV inspections; installation procedure; method of curing and a detailed curing procedure, curing medium, method of application and monitoring requirements; service reconnection; quality control; testing to be performed; final CCTV inspection; and warrantees furnished necessary and appropriate for a complete CIPP installation.
   3. An installation schedule shall be prepared, submitted and conform to the requirements of this contract.
   4. A description of the proposed CIPP technology.
   5. A plan for identifying active service connections and maintaining service, during mainline CIPP installation, to each home connected to the section of pipe being rehabilitated, including temporary service for commercial, industrial and apartment complexes.
   6. Identify which tools and equipment will be redundant on the job site in the event of equipment breakdown along with detailed mitigation procedures to be implemented in the event of key equipment failure during installation process.
   7. A detailed curing procedure outlining the curing medium, the method of application and how the curing process will be monitored (e.g., temperatures, pressure, output of light, rate of travel of light train assembly).
   8. Repair and replacement procedures for common CIPP defects. Defects should be categorized as those that need no repair, those that can be repaired and those that must be removed and replaced. Repair/replacement procedures shall be as recommended by the CIPP system manufacturer.

C. Shop Drawings: Details of the lining procedure, lining elements, equipment depicting method of installation.
   1. Outline specific repair or replacement procedures for potential defects that may occur in the installed CIPP. Repair/replacement procedures shall be as recommended by the CIPP system manufacturer.
   2. Defects that will not affect the operation and long-term life of the product shall be identified and defined.
   3. Repairable defects shall be specifically defined by the Contractor based on manufacturer's recommendations, including a step-by-step repair procedure, resulting in a finished product meeting the requirements of these contract specifications.
   4. Unrepairable defects shall be clearly defined by the Contractor based on the manufacturer's recommendations, including a recommended procedure for the removal and replacement of the CIPP
   5. Provide the proposed method of grout placement, including pressures that will not collapse the CIPP and air release method to be employed.
   6. The bypass flow plan shall include the controlling (or maintaining) of flow, where necesary, for bypassing of active service connections and shall conform to Section 015134 - Temporary Sanitary Wastewater Conveyance System.

D. Product Data:
   1. Manufacturer's technical data, details, and specifications giving information on material composition, physical properties, and dimensions, including certification by the manufacturer that the materials are immune to corrosion from sewage and products resulting from the biological and chemical conversion of sewage constituents.
   2. Manufacturer's recommended procedures for shipping, handling, storing, and installation of the liner, including reinstatement of lateral service connections.
   3. Safety Data Sheets (SDS) for all materials to be furnished for the CIPP
   4. When UV-cured liners are used, submit the manufacturer's product specific data regarding the glass fiber tube, the resin and initiator cocktail system and the necessary manufacturer

installation reference material detailing the type of light source and the speed in which it will be advanced to insure proper curing.

5. Tube wet-out and cure method including:
   a. A description of the wet-out procedure for the proposed technology.
   b. The manufacturer's recommended cure method for each diameter and thickness of CIPP to be installed.
6. Submit certified information from the tube manufacturer on the nominal void volume in the felt fabric that will be filled with resin and the recommended saturation rates using the proposed resin, indicating the volume of resin require to poperly saturate each of the tube dimensions to be used on the project.
7. Design Calculations:
   a. For the rehabilitation of sewers by the inversion and curing of a resin-impregnated tube, submit structural design calculations and specification data sheets listing all parameters used in the liner design and thickness determinations based on:
   b. Heat Cured: Appendix X1 of ASTM F 1216.
   c. UV Cured: ASTM F2019
   d. Calculations shall be prepared under and stamped by a Professional Engineer registered in the State of New York.
8. Quality Control Submittals:
   a. Test Reports: Furnish certified test data issued by an independent testing laboratory, demonstrating that the products used comply with the required physical properties.
   b. Workers' Qualifications Data:
      1) Submit the names and addresses of three (3) previous trenchless sewer rehabilitation projects comparable to this project. Briefly describe the nature of each project.
      2) Submit a letter certifying that the supervisor and the workers doing the liner Work have at least two (2) years' experience each in installing sewer liners of the type specified.

E. Submit certification of compliance with specifications in this Section. Certified material test results shall be included that confirm that materials conform to these specifications. Materials not complying with these requirements will be rejected.

F. An Odor Control Plan to ensure that project specific odors will be minimized at the project site and surrounding area. Plan to include methods for removing odors from residents' homes, if required.

G. A Public Notification Plan that includes detailed staged notification to residences and bus affected by the CIPP installation.

H. A Safety Plan that includes a description of the daily safety program for the job site and all emergency procedures to be implemented in the event of a safety incident. The Safety Plan shall include safety recommendations for mitigating styrene emissions on heat-cure CIPP that have potential to pose health risks to workers.

I. A Quality Control Plan (QCP) that represents and conforms to the requirements of these specifications. At a minimum, the QCP shall include the following:
   1. A discussion of the proposed quality controls to be performed by the Contractor.
   2. Defined responsibilities of the Contractor's personnel for assuring that quality requirements for this contract are met. These shall be assigned by the Contractor to specific personnel.
   3. Proposed procedures for quality control, product sampling and testing shall be defined and submitted as part of the plan.
   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. Scheduled performance and product test result reviews between the Contractor and the Owner at a regularly scheduled job meeting.
   6. Inspection forms and guidelines for quality control inspections shall be prepared in accordance with the standards specified in this contract and submitted with the QCP.

1.05 QUALITY ASSURANCE

A. The Contractor shall be responsible for proper, accurate and complete installation of the CIPP using the system selected by the Contractor that meets the Owner requirements.

B. Neither the CIPP product, system, nor its installation, shall cause adverse effects to any of the Owner's processes or facilities. The installation pressure for the product shall not damage the system in any way, and the use of the product shall not result in the formation or production of detrimental compounds or by-products at the wastewater treatment plant. Notify the Owner and identify by-products produced as a result of the installation operations, test and monitor the levels, and comply with local waste discharge requirements. Clean up, restore existing surface conditions and structures, and repair the CIPP system determined to be defective.

C. The product furnished shall be a complete CIPP system including specific materials, applicable equipment and installation procedures. Other CIPP systems or multi-component products will be required to meet the submittal requirements as contained herein.

D. The installed liner shall comply with the chemical resistance requirements of the relevant ASTM standard(s) ASTM F1216, ASTM D5813, ASTM F1743 and/or ASTM F2019.

1.06 WARRANTY

A. The materials used for the project shall be certified by the manufacturer for the specified purpose. The Contractor shall warrant the CIPP material and installation for a period of one (1) year. During the Contractor warranty period, any defect which may materially affect the integrity, strength, function and/or operation of the pipe, shall be repaired at the Contractor's expense in accordance with procedures included in Paragraph 1.04.C of this Section and as recommended by the manufacturer.

B. For work completed by the Contractor that is defective and/or has been repaired, the Contractor shall warrant this work for (1) year in addition to the warranty required by the contract.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Characteristics: Designed to meet the following installation conditions:
   1. To match the configuration of the host pipe with a concave dimple appearing at each service connection.
   2. Able to negotiate pipeline bends of 90 degrees without splitting, rupturing, or wrinkling of the liner material.
   3. Able to be expanded 25 percent larger than the host pipe diameter without splitting or rupturing of the liner material.
   4. ASTM D1784 impact resistance equal to 5 or better.
   5. Manufactured with sufficient excess wall thickness to allow the liner to meet or exceed the DR requirements after being expanded during final installation.
   6. Continuously extruded or produced at the factory to effectively span the distance between manholes with no joints therebetween.
   7. Material Testing: Provide certification of inspection and testing at time of manufacture for defects in accordance with ASTM D2122, ASTM D 2152, and ASTM D 2444. Liners shall be homogeneous, uniform in color, free of cracks, holes, foreign material, and deleterious faults.

B. The Liner System shall meet the chemical resistance requirements of ASTM D543, F1216, and ASTM D5813.

C. Materials shipped to the project site shall be accompanied by test reports certifying that the material conforms to the appropriate ASTM standards listed herein.

2.02 TUBE

A. The tube shall consist of one or more layers of absorbent non-woven felt fabric, felt/fiberglass, felt/carbon fiber, carbon fiber or fiberglass and meet the material requirements of ASTM F1216, ASTM F1743, and/or ASTM F2019 and ASTM D5813 as applicable.

B. The tube shall be capable of absorbing and carrying resins, constructed to withstand installation pressures and curing temperatures and have sufficient strength to bridge missing pipe segments and stretch to fit irregular pipe sections.

C. The wet-out tube (“liner”) shall have a uniform thickness and excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.

D. The tube shall be manufactured to have a uniform thickness that, once properly saturated with resin, installed, and cured using the manufacturer's recommended methods and pressures, will meet the design requirements.

E. The tube shall be manufactured to a size, and length that, when installed, will tightly fit the internal circumference of the original pipe. Allowance shall be made for circumferential stretching during installation. The tube shall be properly sized to the diameter of the existing pipe and the length to be rehabilitated and be able to tolerate circumferential changes to fit irregular pipe sections and negotiate bends. Determine the minimum tube length necessary to effectively span the designated run between manholes. Verify the lengths in the field prior to ordering and prior to impregnation of the tube with resin to ensure that the tube will have sufficient length to extend the entire length of the run. Measure the inside diameter of the existing pipelines in the field prior to ordering tube so that the CIPP can be installed in a tight-fitting condition.

F. The outside and/or inside layer of the tube (before inversion/pull-in,) shall be coated or covered with an impermeable, flexible membrane that will contain the resin and facilitate, vacuum impregnation and monitoring of the resin saturation during the resin impregnation (wet-out) procedure.

G. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be acceptable upon visual inspection as evident by color contrast between the tube and the activated resin containing a colorant, if a colorant is utilized.

H. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made. The color contrast shall be sufficient to distinguish between the fully resin saturated tube and dry or resin lean areas.

I. Seams in the tube, if applicable, shall meet the requirements of section 7.1 of ASTM F1743.

J. The outside of the tube shall be marked at a maximum of every 5 feet (152.4 cm) with the name of the manufacturer or CIPP system, manufacturing lot and production footage.

K. The minimum length of the tube shall be that deemed necessary by the installer to effectively span the distance from the starting manhole to the terminating manhole or access point, plus that amount required to run-in and run-out for the installation process.

L. The nominal tube wall thickness shall be constructed, as a minimum, to a sufficient thickness that exceeds the required design thickness for that section of installed CIPP. Wall thickness transitions may be fabricated into the tube between installation entrance and exit access points. The volume of resin used in the impregnation shall be sufficient to fully saturate the tube.

2.03 RESIN

A. The resin shall be a corrosion resistant polyester or vinyl ester resin and catalyst system or epoxy resin and hardener system that, when properly cured within the tube composite, meets the requirements of ASTM F1216, ASTM F1743 or ASTM F2019, the chemical, physical, and mechanical properties herein, and those which are to be utilized in the design of the CIPP for this project. The resin shall produce a CIPP which will comply with or exceed the structural and chemical resistance requirements of this specification.

B. The resin-to-tube ratio, by volume, shall be furnished as recommended by the CIPP tube manufacturer.

2.04 DESIGN CRITERIA

A. Provide a CIPP system which meets or exceeds the minimum properties specified herein or as submitted in the PWS.

B. The CIPP shall be designed as per ASTM F1216 Appendix X1 or ASTM F2019 Appendix X1. The CIPP design shall assume no bonding to the original pipe wall.

C. The long-term (50 year extrapolated) Creep Retention Factor shall be set at 50% of the initial design flexural modulus as determined by ASTM D790 test method. This value shall be used unless the Contractor submits long-term test data (ASTM D2990) to substantiate a higher retention factor.

D. The cured pipe material ("CIPP") shall, at a minimum, meet or exceed the mechanical properties, as listed below.

2.05 PERFORMANCE REQUIREMENTS

A. The liner shall be continuous and jointless from manhole to manhole or access point to access point and shall be free of defects that will affect the long-term life and operation of the pipe.

B. The liner shall not leak at the manholes or through the wall of the installed pipe.

C. The liner shall be designed for a life of 50 years or greater and an equal service life unless specifically specified otherwise by the Owner.

D. The liner shall be designed for fully deteriorated conditions for a structural stand-alone pipe.

E. The required CIPP wall thickness shall be based, as a minimum, on the mechanical properties of the cured composite and per the design of the Professional Engineer (Paragraph 1.04.D) and in accordance with the design equations contained in Appendix X1 of ASTM F1216 or Appendix X1 of ASTM F2019 and the following design parameters:

Design Safety Factor	2.0 (1.5 for pipes 36" or larger)
Creep Retention Factor	50% or otherwise verified by test data
Ovality	3% or as measured by field inspection/observations from video inspection
Constrained Soil Modulus	Per AASHTO LRFD Section 12 and AWWA Manual M45
Groundwater Depth	As specified or indicated on the Plans
Soil Depth (above the crown)	As specified or indicated on the Plans
Live Load	Highway, railroad, airport or permanent structures as applicable
Soil Load (assumed)	120 lb./cu. ft. or as specified

F. The design soil modulus may be adjusted based on data, determined from project soil testing results.

2.06 CURED-IN-PLACE LINERS

A. Thermally cured, Resin-impregnated liner:
   1. Resin-Impregnated, flexible polyester felt thermally cured-in-place and meeting the following minimum physical properties:
      a. Flexural Modulus (ASTM D790): 300,000 psi (206842 kPa) initial; 150,000 psi (1034214 kPa) long-term.
      b. Flexural Strength (ASTM D790): 5000 psi (34473.80 kPa).
      c. Tensile Modulus (ASTM D638): 250,000 psi (1723690 kPa) initial; 152,000 psi (1048003.52 kPa)long-term.
      d. Tensile Strength (ASTM D638): 4,000 psi (27579 kPa)
         1) Custom designed by the manufacturer in accordance with ASTM F 1216 to meet the following conditions:
            (a) AASHTO H-20 live load with two trucks passing.
            (b) Soil weight 120lbs./cf.
            (c) Maximum ground water level at ground surface.

(d) Fully deteriorated pipe based on the video inspection following cleaning of the host pipe.
(e) 50-year service life.
(f) Maximum felt content of the liner: 25 percent.
(g) SDR of 50 or less dependent on deteriorated condition of host pipe. Wall thickness of the cured liner shall be determined by the design calculations required under Article 1.04 or this Section.

2) Resin shall be a polyester liquid thermosetting resin or photosetting resin with associated catalysts suitable for the design conditions and curing process.
3) When cured the liner shall form a continuous, tight fitting, hard, impermeable lining chemically immune to corrosion from sewage and by-products, combined with a maximum abrasion resistance.
4) Fabricate the liner to a size that when reformed will tightly fit the host pipe.
(a) Tube shall consist of one or more layers of flexible needled felt, or an equivalent non-woven material.
(b) Tube shall be capable of conforming to bends, offset joints, bells, and disfigured pipe sections.
(c) Allow for longitudinal and circumferential expansion when sizing to achieve proper installation of the liner.
(d) Verify dimensions in the field prior to delivery of the liner.
5) Verify length of liner prior to construction to effectively carry out installation and seal the liner at the inlet and outlet of each manhole.
6) Ensure that the correct liner is fabricated for the respective runs between each set of manholes.

B. UV-cured, glass resin liner:
1. UV-cured glass fiber tubing soaked in photo setting resin and meeting the following minimum physical properties:
a. Flexural Modulus (ASTM D790): 725,000 psi (4998701 kPa)
b. Flexural Strength (ASTM D790): 15,000 psi (103421.4 kPa)
1) Custom designed by the manufacturer in accordance with ASTM F 1216 to meet the following conditions:
(a) AASHTO H-20 live load with two trucks passing.
(b) Soil weight 120lbs./cf.
(c) Maximum ground water level at ground surface.
(d) Fully deteriorated pipe based on the video inspection following cleaning of the host pipe.
(e) 50-year service life.
(f) SDR of 50 or less dependent on deteriorated condition of host pipe. Wall thickness of the cured liner shall be determined by the design calculations.
2. Fabric tubes shall consist of the following:
a. Structural Layer: Resin saturated glass fiber with minimum thickness of 0.12 inch (3 mm)
b. Abrasion Layer: Minimum of 0.02 inch (0.5 mm)
c. Inner film: Shall be integral or capable of releasing from liner without damage.
d. External Protective film

C. Manufacturers:
1. iMPREG LLC (Richmond, VA)
2. Vortex Companies (Houston, TX)
3. Insituform, an Azuria Company (Chesterfield, MO)
4. Reline America (Saltville, VA)

PART 3 - EXECUTION

3.01 PREPARATION

A. Perform cleaning of existing sewers and manholes as required in Section 330130.41.

B. Furnish all labor, materials and equipment and perform all work necessary to remove and dispose of all debris, sediment, silt, refuse, timber, roots, and materials of all kinds which can be removed by conventional non-excavation type pipe cleaning equipment located in the existing sewers and manholes. Immediately notify the Engineer if such debris, etc., cannot be removed by conventional non-excavation type pipe cleaning equipment.

C. Remove foreign materials from the sewer piping as required to obtain tight seating of the new liner against a cleaned interior wall surface throughout the host pipe.
   1. Use hydraulically propelled, high velocity jet, or mechanically powered equipment as deemed necessary to satisfactorily remove dirt, grease, rocks, sand, and other foreign materials including obstructions.
   2. Remove roots in a manner assuring complete removal from the joints.
      a. Use mechanical equipment such as rodding machines, bucket machines, and winches in connection with root cutters and porcupines, plus other equipment such as high-velocity jet cleaners.
      b. Chemical root treatment with a herbicide approved by the Owner's Representative may be used at the Contractor's option to aid in the removal of roots. See Section 330130.44. Application shall be in accordance with the manufacturer's printed recommendations and instructions. Damaged vegetation as designated by the Owner's representative shall be replaced at no cost to the Owner.
         1) Obtain from the Owner's Representative written approval of the proposed equipment and methods to be used in the cleaning operations.
         2) If cleaning an entire section between any two manholes cannot be successfully performed from one of the manholes, the equipment shall be set up at the other manhole and cleaning attempted from the other direction. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire distance between the two manholes, it will be assumed that a major blockage exists requiring a point repair and the cleaning effort shall be abandoned until the blockage is removed by open-cut excavation.
         3) Debris of every name and nature from sewer cleaning operation shall be legally disposed of off Site.

D. Perform video inspection in accordance with Section 330130.11.

E. Pre-Rehabilitation Inspection: Following thorough cleaning, conduct a video survey, in the presence of the Owner's Representative, of each sewer section cleaned to verify adequacy of the cleaning in accordance with these specifications. Only PACP certified personnel trained in locating defects, obstacles and service connections by closed circuit television shall perform the inspection. Provide the Owner a copy of the pre-cleaning video and suitable log for review prior to installation of the CIPP.

F. Video Images:
   1. Upon completion of televising the existing sewer and prior to lining notify the Owner's Representative of all protruding service connections that will affect the Contractor's selected lining method. Upon approval from the Owner's Representative, remove or trim the protrusions. This shall be accomplished from the interior of the sewer by means of a television camera directed cutting device.
      a. Payment for removal of protruding service connections will be made at the unit price bid regardless of service connection material and size.

G. Prior to the start of work submit a bypass-pumping detail in accordance with Specification Section 015134. Provide for the diversion of flow of existing sewers at existing upstream manholes (if available) and pump the flow into an existing downstream manhole. The pumps and bypass lines shall be of adequate capacity and size to handle the flow. The proposed bypassing system shall

be submitted to the Owner's Representative for approval and no work shall commence until such approval is granted.

3.02 INSTALLATION

A. General:
   1. If a street needs to be closed to traffic because of the location of the sewer, furnish a detailed traffic control plan with necessary labor and equipment. The plan shall be in conformance with the requirements of the local agency having jurisdiction over traffic control.
   2. If significant groundwater infiltration is present in the existing sewer, install a preliner or perform chemical grouting in accordance with Specification Section 330130.61 Injection Grouting (Pre-Rehabilitation) to control resin loss and contamination, maintain CIPP thickness, prevent mechanical property reduction and prevent inadequate curing of the CIPP resulting from water or other contamination of the resin during installation. The preliner shall be a plastic tube to fit the existing pipeline and shall be continuous from manhole (access) to manhole (access). Preliners are not required when using pulled-in liners with exterior coatings or in the case of light cured liners (i.e. UV or LED) that contain an outer membrane.

B. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the CIPP system manufacturer to avoid damage. Damage includes, but is not limited to, gouging, abrasion, flattening, cutting, puncturing or ultra- violet (UV) degradation. On-site storage locations shall be approved by the Owner. Damaged materials shall be promptly removed from the project site at the Contractor's expense and disposed of in accordance with all current applicable agency regulations.

C. Designate a location where the uncured resin in the original containers and the un-impregnated liner will be impregnated prior to installation. Allow the Engineer and/or the Owner's representative to inspect the materials and chemical impregnation "wet out" procedure. A resin and catalyst system compatible with the requirement of this method shall be used. The quantities of the liquid thermosetting materials inserted into the lining tube shall be in accordance with the manufacturer's standards to fully saturate the liner material and provide the lining thickness specified. Protect, store and handle materials during transportation and delivery, while stored on-site and during installation following Manufacturer's recommendations. Liners impregnated with thermo-initiated resins shall be stored within the proper temperature range and liners impregnated with photo-initiated resins shall not be exposed to UV-light sources, to ensure no premature curing occurs.

D. Prior to installation verify length of required liner in field. Confirm the locations of all branch service connections prior to installing the CIPP.

E. Prior to installation of liner, the downstream sewer manhole adjacent to the sewer section to be lined shall be plugged.

F. The chemical impregnated liner material shall be inserted into the sewer line being reconstructed through the existing manhole by either the direct inversion method or by the pull-in-place method, as recommended by the manufacturer. The head used to extend the liner tube shall be sufficient to fully extend the tube both circumferentially and longitudinally. The head used must fall within the manufacturer's guidelines to ensure that a proper finished thickness is achieved and that the liner fits snug to the existing pipe wall producing dimples at service connections and flared ends at the entrance and exit manholes.

G. Winch cables shall be equipped with a tension gauge to measure tension during pull through.

H. Inflation of liners and heat/UV source method used shall be accomplished in accordance with manufacturer's standards and specifications.

I. Curing temperatures, times and pressures shall be monitored so as not to overstress the liner and cause damage or failure of the liner prior to cure.

J. The use of a lubricant is recommended, and such lubricant shall be compatible with liner and resin, not impact wastewater treatment, and not cause non-compliance with effluent limits.

K. Monitor and remove styrene to acceptable levels during the inflation and curing processes. An activated carbon filtration system shall be employed to remove styrene from both the process air flow and condensed steam, prior to release into the air or an adjacent or downstream sanitary or combined sewer manhole.

L. Adhere to the liner manufacturer's standard procedures for proper installation under specific conditions. Procedures for liner installation are specific to the method used and vary with liner material, liner thickness, pipe size, pipe shape, etc.

M. Cover irregular and sharp edges of the entrance to the host pipe to prevent damage to the liner during insertion.

N. Installation of Inverted, Resin-Impregnated Tube Liner:
   1. Resin-Impregnation (wet-out):
      a. Protect tube and resin areas from sunlight and moisture.
      b. Test operation of mixing and wet-out equipment prior to resin mixing to ensure that all components are in proper working order.
      c. Following resin mixing, verify that resin temperatures have been taken and gel tests (accelerated curing tests of the resin reactivity) have been performed for proper evaluation of the resin mixture.
      d. Pump the resin between the innermost layers of the tube.
      e. Do not allow air entrainment in the wet-out process.
      f. Pass the tube through a pair of rollers to uniformly distribute the resin. Gap spacing between the rollers shall be a minimum of twice the specified wall thickness of the cured-in-place liner. Verify the gap spacing with every 100 feet (3048 cm) of wet-out.
         1) Inversion:
            (a) Protect the tube from injurious impact and unclean soiling matter (dirt, mud, fine debris, etc.).
            (b) Use inversion heads sized according to manufacturer's recommendations.
            (c) Do not overstress the tube material or exceed 5 percent longitudinal stretch.
            (d) Place thermocouples at both ends of the tube and at intermediate stations as required to monitor the curing process.
            (e) Remove plastic films or coatings on the interior finish of the liner unless they are fully bonded to the absorbent tube material prior to installation.
   2. For Heat-Cured Resin:
      a. Prior to installation and as recommended by the manufacturer, remote temperature gauges or sensors shall be placed inside the host pipe to monitor the temperatures during the cure cycle. CIPP and/or host pipe interface temperature shall be monitored and logged during cure.
      b. To monitor the temperature of the CIPP wall and to verify correct curing, Provide temperature monitors between the host pipe and the CIPP in the bottom of the host pipe (invert) at manholes or access points and/or throughout its entire length (continuous) to monitor the temperature on the outside of the CIPP during the curing process.
      c. After inflation or inversion is completed, supply a suitable heat source. The equipment shall be capable of delivering steam or hot water to the far end of the liner to uniformly raise the temperature in the entire liner above the temperature required to initiate and effect curing of the resin system. The temperature shall be determined by the resin/catalyst system employed. The heat source shall be fitted with suitable monitors to gauge the temperature and pressure of the incoming and outgoing heat exchanger circulating heating medium.
      d. Full-Length Temperature Monitoring system shall consist of a wire probe with sensors no more than ten (10) feet apart running the length of the pipe section to be lined and a computer with vendor software for monitoring in real time and recording curing data. System shall have the ability to monitor the curing from a remote location accessible by Owner and Engineer. Monitoring systems shall be VeriCure, or approved equal.

e. Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner show it to be hard and sound; and when temperature reading(s) at the interface of the liner with the host pipe indicate sufficient heating has occurred. The cure period shall be of a duration recommended by the resin manufacturer; modified for the site-specific conditions at the time curing is affected. During this cure time, the temperature inside the liner shall be continuously maintained in the range required.

f. Once the cure is complete, cool the hardened liner to a temperature below one hundred degrees Fahrenheit (100°F) before relieving the internal pressure. Cool down shall be accomplished as recommended by the manufacturer. Care shall be taken in the release of the internal pressure so that a vacuum will not develop that could damage the newly installed liner.

g. If any temperature sensor or continuous sensor location does not reach the temperature as specified by the manufacturer to achieve proper curing or cooling, the Contractor shall make necessary adjustments to comply with the manufacturer's recommendations. For continuous temperature monitoring, the system computer should have an output report that specifically identifies stations along the length of pipe, indicates the maximum temperature achieved and the sustained temperature time at the stations. At each station along the length of the pipe, the computer shall record both the maximum temperature and the minimum cool down temperature and comply with the manufacturer's temperature recommendations.

3. For UV-light CIPP systems:

a. The intensity and duration of exposure to the photo-initiator's required UV-light wavelength shall be in accordance with the manufacturer's recommendations for the proposed size and thickness of tube, to ensure that the liner has been cured completely.

b. The UV-light source shall be fitted with multiple temperature sensors to ensure that reaction temperatures stay within the Manufacturer's acceptable range and do not blister the interior liner. All lamps shall be monitored to ensure that they are on and functioning properly. If a lamp fails, or the reaction temperatures fall below the Manufacturer's acceptable range during CIPP installation, reduce the speed of the light source (increasing the exposure duration) by the Manufacturer's specified amount.

c. The Manufacturer's recommended cooling phase shall be observed after the last lamp of the light source has been turned off.

d. The finished lining shall be continuous over the entire length and be free from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe.

4. If due to broken or misaligned pipe at the access manhole, the lining fails to make a tight seal, apply a seal of a resin mixture compatible with the liner.

5. After the curing has been completed, any residual water and condensation that adheres to the inner wall of the liner shall be removed.

O. The Contractor shall monitor and document installation and curing activities in accordance with the CIPP msystem manufacturer's recommendations. The data collected shall include, at a minimum: date, time, and location of wet out; the time of liner insertion into the host pipe; the pressures applied during insertion, curing, and cool down phase; curing information including method, temperature, duration, and cool down rate; rate of travel of the light curing assembly for dynamic curing processes; the power output of the light assembly; the entire length of the installed CIPP; and any additional parameters required by the specified installation or curing method or as recommended by the CIPP system manufacturer.

P. The Contractor shall cool the CIPP in accordance with the approved CIPP manufacturer's recommendations as described and outlined in the PWS.

Q. Temperatures and curing data shall be monitored and recorded by the Contractor throughout the installation process to ensure that each phase of the process is achieved as approved in accordance with the CIPP system manufacturer's recommendations.

R. Conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses and property owners or tenants and to provide an environmentally safe restored jobsite.

S. All liner installation work shall be carried out in full compliance with all City, State, and Federal laws, rules, and regulations regarding Air Quality and Safety. Take all necessary precautions to minimize the release of styrene or other VOC emissions and mitigate odors generated during set and the CIPP lining process. Take all necessary precautions to prevent such odors from entering structures, businesses, or other types of establishments, through service connections or other plumbing fixtures.

3.03 FIELD QUALITY CONTROL

A. Samples: Take samples as designated by the Owner's Representative at not less than 5 random line sections for the entire project.
   1. Take samples at intermediate manholes or at termination points initiated through like diameter pipe held in place by a suitable heat sink.
   2. Samples shall have been heated, pressurized, and formed or shaped in a manner identical to the liner installation.
   3. Samples shall be large enough to provide a minimum of 3 specimens and recommended 5 specimens for flexural and tensile testing, as applicable.
   4. Testing: Submit samples to an independent laboratory for analysis to assure physical properties of the cured samples follow the referenced applicable ASTM standards.
      a. Deliver test reports to the Owner's Representative for approval.
      b. Bear all testing costs.

B. The laboratory results shall identify the test sample location as referenced to the nearest manhole and station. Final payment shall be withheld pending receipt and approval of the test results. If properties tested do not meet the minimum mechanical and thickness requirements, the CIPP shall be repaired or replaced by the Contractor unless the actual mechanical properties and the thickness of the sample tested meet the design requirements as required in the contract.

C. Chemical resistance - The CIPP system installed shall meet the chemical resistance requirements of the relevant ASTM standard(s) F1216, or ASTM F1743, ASTM D5813 (section 6.4.1), or ASTM F2019. CIPP samples tested shall be of the tube and the specific resin proposed for actual construction. CIPP samples without plastic coating meet these chemical testing requirements. A certification shall be submitted, by the Contractor, from the manufacturer verifying that the chemical resistance of the CIPP meets the contract requirements.

D. The CIPP thickness shall be measured for each line section installed in accordance with the ASTM requirements specified. If the CIPP thickness does not meet that specified in the contract and submitted as the approved design by the Contractor, then the CIPP shall be repaired or removed unless the tested mechanical properties and the thickness of the sample tested meet the design requirements as required in the contract. The CIPP thickness shall have tolerance of minus 5%.

E. After a pipe section has been rehabilitated and for a period of time up to one (1) year following completion of the project, the Owner may inspect all or portions of the rehabilitated system. The specific locations will be selected at random by the Owner's inspector and should include all sizes of CIPP from this project. If it is found that any of the CIPP has developed abnormalities since the time of "Post Construction Television Inspection," the abnormalities shall be repaired and/or replaced as defined in Paragraph 1.04.C of this Section and as recommended by the manufacturer. If, after inspection of a portion of the rehabilitated system under the contract, problems are found, the Owner may televise all the CIPP installed on the contract. All verified defects shall be repaired and/or replaced by the Contractor and shall be performed in accordance with Paragraph 1.04.C of this Section and per the original specifications, all at no additional cost to the Owner.

3.04 SERVICE CONNECTION REINSTATEMENT

A. Determine which service connections are active and control (or maintaining) the flow for each active service connection along the line of the sewer to be rehabilitated. Where necessary, the

flow from an active service connection shall be bypassed to a manhole downstream of the proposed work by means of pumping from the trap located in the basement of the affected building. However, should such bypassing be judged unfeasible by the Owner's Representative, excavate to the service connection outside the building area (sidewalk or roadway as determined by the Owner's Representative) and bypass the connection from this point. The pump and bypass line for each service connection shall be of adequate capacity and size to handle the flow.

B. Prior to the commencement of any work, make all necessary investigations and prepare a plan for controlling (or maintaining) the flow and, where necessary, for bypassing of active service connections. This plan shall be submitted to the Owner's Representative for approval, and no work shall commence until such approval is granted.

C. After the liner has been installed, fully cured, and cooled down, re-open all existing active service connections and those inactive connections ordered by the Owner's Representative. It is the Contractor's responsibility to make sure that all active service connections are reopened.

D. Reinstate the existing service connections by using remotely controlled methods approved by the liner manufacturer and the Owner's Representative.
   1. Activate the connections from the interior of the lined sewer by means of a remotely directed cutting device that locates the covered service connection and cuts away the liner pipe in such a way that a smooth edge is established.
   2. The machined opening shall be at least 90 percent of the service connection opening area and the bottom of both openings shall match. The opening shall not be more than 100 percent of the service connection opening.
   3. Liner shall be tight to the existing sewer pipe with no evidence of an annular space between the service pipe and the liner.
   4. Coupons or fragments of CIPP material resulting from service tap cutting shall be collected at the next manhole downstream of the pipe rehabilitation operation prior to leaving the site. Do not allow coupons to pass through the system.
   5. All over-cut or under-cut service connections shall be properly repaired to meet the requirements of these specifications.

E. Provide a top hat sealing system for all reinstated laterals.

3.05 GROUTING OF VOID AREA

A. Grout known voids that remain after installation of CIPP. The material shall be of the flowable fill type and shall be injected into the void while removing all trapped air from the void.

3.06 MANHOLE SEALING AND BENCHES

A. Provide a watertight seal at the insertion and termination points in the manholes, in accordance with the manufacturer's recommendations.
   1. Neatly cut off the liner at least 2 inches from the manhole wall.
   2. Provide a mortar/concrete bench adjacent to the liner segment within the manhole to support the liner sidewalls and to provide smooth merging of flows from other pipelines.

B. Apply a seal, consisting of an epoxy resin mixture or hydrophilic seal compatible with the installed CIPP, at manhole/wall interface in accordance with the CIPP system manufacturer's recommendations.

3.07 SEWER LATERAL REHABILITATION

A. During cleaning and video inspection of the sewer mains, determine condition of each lateral connection showing evidence of infiltration. All sewer lateral rehabilitation will be performed at the discretion of the Engineer.

B. If infiltration is due to a minor crack, including a broken or open joint of an otherwise structurally sound pipe in the judgment of the Engineer within 10 feet of the connection, correct the condition by injection of chemical grout.
   1. Method of sealing by chemical grouting at the option of the Contractor and shall affect a watertight seal disallowing any infiltration.
   2. Remove excess grout from the pipe interior.

C. If structural integrity of lateral is deficient, and groundwater and/or root infiltration is significant, in the judgement of the Engineer, cured-in-place lateral rehabilitation is warranted. Seal connection between the lateral and the sewer main using “Top Hat” or approved alternative lateral liner. Liners shall extend a minimum of 2-ft into the lateral

3.08 FIELD TESTS AND INSPECTIONS

A. CIPP sample testing and repairs to the installed CIPP shall be completed before final acceptance, meeting the requirements of these specifications, and documented in written form.

B. Field acceptance of the sewer rehabilitation work shall be based on evaluation of the installation from post-installation TV video inspection, direct inspection where possible, and a review of the certified test data of the installed liner samples.
   1. Ground water infiltration of the liner shall be zero. Check by video inspection before doing service connection reinstatement.
   2. Chemically grouted pipe shall show no evidence of ground water infiltration during TV inspection.
   3. Service connections shall be open, clear, and watertight.
   4. Liners shall be free of visual defects including pinholes, dry spots, splits, cracks, lifts, kinks, delamination’s, and crazing. Remove and replace the CIPP full circumference, from manhole to manhole if these conditions are present.
   5. Interior surfaces of the liners shall have a smooth appearance, fitted tightly to the shape of the host pipe.

C. The installed CIPP shall be continuous over the entire length of a sewer line section and be free from visual defects such as foreign inclusions, dry spots, pinholes, major wrinkles and delamination. The CIPP shall be impervious and free of leakage through the CIPP wall.

D. Post-Rehabilitation Inspection: Conduct a video survey, in the presence of the Owner’s Representative, of each rehabilitated sewer section to verify adequacy of the liner installation and repairs in accordance with these specifications. Only PACP certified personnel trained in locating defects, obstacles and service connections by closed circuit television shall perform the inspection. The Contractor shall provide the Owner a copy of the post-cleaning video and suitable log.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Cured-in-place, resin impregnated, flexible tube installed by an inversion method and cured after installation to form a tight fitting, watertight pipe within a pipe.

1.02 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Provide technical data, engineering design calculations and descriptive literature to demonstrate compliance with this section.

C. Provide written record of temperature readings to demonstrate that temperature was sufficient during cure.

D. Provide written record of pressure while curing and under a positive head to demonstrate water tightness of lined pipe.

E. Workers' Qualifications Data:
   1. Submit the name, address and contact telephone number for three (3) previous comparable trenchless sewer rehabilitation projects. Provide a brief description of each project.
   2. Submit a letter certifying that the supervisor and the workers doing the liner Work have at least two (2) years experience each in installing sewer liners of the type specified.

1.03 SYSTEM DESCRIPTION

A. The existing piping system where spot liners are to be installed consists of 6-inch diameter to 18-inch diameter sewer pipe for sanitary wastewater. Potential pipe materials include vitrified clay pipe (VCP), asbestos cement pipe (ACP), cast/ductile iron pipes, and/or PVC pipe. The liner shall be custom designed to line the existing pipe between the limits of the work in a continuous operation. The design shall consider partial deterioration based on existing conditions observed during a video inspection following cleaning of the host pipe. The finished lined pipe line shall be capable of withstanding a pressure head of 40 feet.

B. Minimum Thickness: 0.24 inch (6 mm)

C. The point repair liner thickness design for each pipe size shall be in accordance with ASTM F1216. If conditions are encountered that require modification to the design assumptions, consult with the engineer/Owner prior to installing liner.

D. Design Parameters:
   1. Ovality 2% Minimum
   2. Existing Pipe Condition Fully Deteriorated
   3. Modulus of Soil Reaction 700-psi minimum
   4. Factor of Safety Against Buckling 2 Minimum
   5. Allowable Deflection 5% Maximum
   6. Ratio of Pipe to Soil Strength 10% Minimum
   7. Live Load H-20 (Roadways)
   8. E-80 (Railroads)
   9. Soil Unit Weight 120-pcf Minimum
   10. Creep Reduction Factor 50% Maximum
   11. Depth to Groundwater Full Pipe Depth

E. Service Life: 50 year minimum.

F. Fabricate installed liner from materials which when cured shall be chemically resistant to withstand internal exposure to municipal sanitary wastewater and by-products.

G. The cured-in-place pipe shall be sufficient to withstand hydraulic pressure without collapsing.

1.04 REFERENCES

A. ASTM C518 - Standard Practice for Determining Chemical Resistance of Thermosetting Resins

B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

C. ASTM D638 - Test Method for Tensile Properties of Plastics.

D. ASTM D696 - Test Method for Coefficient of Linear Expansion of Plastics.

E. ASTM D790 - Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

F. ASTM D2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

G. ASTM D2152 - Standard Test Method for Extrusion Quality using Acetone Emersion.

H. ASTM D2444 - Standard Test Method for Determination of Impact Resistance.

I. ASTM D2290 - Standard Test Method for Tensile, Compressive, Flexural Creep and Creep Rupture of Plastic.

J. ASTM D3681 - Standard Test Method for Chemical Resistance of Reinforced "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.

K. ASTM D5813 - Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems.

L. ASTM F1057 - Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique

M. ASTM F1216 - Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.

N. ASTM F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Insituform Technologies, Inc., CIPP.

B. Perma-Liner Industries, Inc., Perma-Main Lining System.

C. Easy Liner, LLC

2.02 MATERIALS

A. LINER – absorbent fibrous carrier material, polypropylene, polyester or urethane elastomer skin and polyester fiber fabric jacket.

B. THERMOSETTING RESIN - A thermosetting epoxy resin shall be injected into the tube assembly prior to installation. The Owner shall be allowed to inspect the materials and wet out procedure.

C. Fabricate the liner to a size that when reformed will tightly fit the host pipe.
   1. Tube shall consist of one or more layers capable of conforming to bends, offset joints, bells, and disfigured pipe sections.
   2. Allow for longitudinal and circumferential expansion when sizing to achieve proper installation of the liner.
   3. Verify dimensions in the field prior to delivery of the liner.

2.03 – SOURCE QUALITY CONTROL

A. The cured pipe liner shall conform to the minimum structural standards as listed below:

Cured Liner	Standard	Result
Tensile Stress	ASTM D638	3,000 psi
Flexural Strength,	ASTM D790	27,000 psi
Flexural Modulus of Elasticity, initial	ASTM D790	800,000 psi
Flexurl Modulus of Elasticity, long term	ASTM D790	400,000 psi
Coefficient of Expansion	ASTM D696	6.0×10^{-5} in/in/C

B. Wall thickness shall be based on fully deteriorated pipe to support hydraulic loads due to ground water since the soil and surcharge loads can be supported by the original pipe. No single layer of the felt system shall be less than 0.06 inch (1.5 mm) in thickness.

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide equipment, materials and labor to bypass wastewater flow and to isolate sanitary sewer during cleaning, lining and inspection of the sewer under provisions of Section 015134.

B. Clean existing piping as required prior to installation of the liner under provisions of Section 330130.41. Cleaning shall clear the line of obstructions that will prevent insertion of the liner. Inspect pipeline with closed circuit television prior to the work to determine location of any conditions which may prevent proper installation of liner. Furnish video files and typed logs to the Owner.

C. Designate a location where the felt tube will be impregnated. The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used, and a roller system shall be used to uniformly distribute the resin throughout the tube.

3.02 INSTALLATION

A. Resin-Impregnation (wet-out):
   1. Protect tube and resin areas from sunlight and moisture.
   2. Test operation of mixing and wet-out equipment prior to resin mixing to ensure that all components are in proper working order.
   3. Following resin mixing, verify that resin temperatures have been taken and gel tests (accelerated curing tests of the resin reactivity) have been performed for proper evaluation of the resin mixture.
   4. Pump the resin between the innermost layers of the tube.
   5. Do not allow air entrainment in the wet-out process.
   6. Pass the tube through a pair of rollers to uniformly distribute the resin. Gap spacing between the rollers shall be a minimum of twice the specified wall thickness of the cured-in-place liner. Verify the gap spacing with each tube wet-out.

B. The liner tube and bladder/packer shall be inserted into the pipe through the entrance pit by means of a winch. Inflate packer to hold the tube tight to the pipe wall, with no evidence of an annular space between the service pipe and the liner.

C. Inversion:
   1. Protect the tube from injurious impact and unclean soiling matter such as dirt, mud and fine debris.
   2. Use inversion heads sized according to manufacturer’s recommendations.
   3. Do not overstress the tube material or exceed 5 percent longitudinal stretch.
   4. Remove plastic films or coatings on the interior finish of the liner unless they are fully bonded to the absorbent tube material prior to installation.

D. Provide a watertight seal at the ends of the liner in accordance with the manufacturer’s recommendations.

E. Curing shall be accomplished by either heat or chemically through the use of accelerators, in accordance with the manufacturer’s instructions. Curing shall be of sufficient duration to carry overburden loads within a maximum of eight hours from the time of insertion inside the pipe. Care shall be taken during the elevated curing temperature so as not to over stress the liner. Heat source and recirculation equipment shall be suitable to uniformly raise the water temperature above the temperature required to effect a cure of the liner.

F. The heat source shall be fitted with suitable monitors to gauge the temperature. Temperature during the cure period shall not be less than 110 °F.

G. Cool the hardened CIPP to a temperature below 100 degrees Fahrenheit before relieving the pressure. Care shall be taken during release of pressure so that a vacuum will not be developed that could damage the newly installed CIPP.

3.03 FIELD QUALITY CONTROL

A. After completion of installation and curing, pull video camera through the lined pipe to inspect the installation for proper adherence of the liner to the existing pipe. Defects shall be repaired in accordance with the manufacturer's recommendations as agreed upon by the Engineer. Furnish video files and typed logs to the Owner under provision of Section 013300.

B. Wrinkles that exceed ½" in height or are between the 3 – 9 o'clock position will not be permitted and must be removed and CIPP repaired/replaced prior to acceptance.

3.04 TESTING

A. Provide written record of temperature readings to demonstrate that temperature was sufficient during cure.

B. Provide written record of pressure while curing and under a positive head to demonstrate water tightness of lined pipe.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewer manhole rehabilitation.

1.02 SYSTEM DESCRIPTION

A. Rehabilitation of manholes shall include the repair/replacement/rebuilding/sealing of the base, trough, bench, walls, top slab/cone and removal and disposal of unsound construction material by plugging, patching, grouting, and coating with mortars, coatings, grouts and sealers to improve structural condition; eliminate infiltration and provide corrosion protection. Work shall include surface preparation, sealing, and testing.

B. The lining system shall result in a monolithic structure to the shape and contour of the interior of the existing manhole. System shall be completely watertight and free of any joints or openings other than pipe inlets, pipe outlets and the rim opening. The junction of the manhole lining and the pipe material at the inlets and outlets shall be watertight.

C. The Manhole Rehabilitation System shall generally consist of the following steps:
   1. Pressure grout and/or plug active leaks.
   2. Repair cracks, joint, lift holes, and manhole step voids with cementitious repair mortar.
   3. Rebuild bench and trough as required.
   4. Provide structural rehabilitation by lining with cement mortar.
   5. Provide corrosion barrier by lining with epoxy coating.
   6. Install chimney seals where evidence of I&I is present.

1.03 REFERENCES

A. ACI 506.2 - Specifications for Materials, Proportioning, and Application Silica Chemical Resistant Mortars.

B. ASTM A48/A48M-03 Standard Specification for Gray Iron Castings Class 35B

C. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

D. ASTM C33 - Standard Specification for Concrete Aggregates

E. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

F. ASTM C78 - Standard Test Method for Flexural Strength of Concrete; Using Simple Beam with Third Point Loading

G. ASTM C94 - Standard Test Method for Ready-Mix Concrete

H. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)

I. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete

J. ASTM C150 - Standard Specification for Portland Cement Type

K. ASTM C157/C157M - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

L. ASTM C267 - Test Methods for Chemical Resistance of Mortars, Grouts and Monolithic Surfacings and Polymer Concretes

M. ASTM C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)

N. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings

O. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete

P. ASTM C321 - Standard Test Method for Bond Strength of Chemical-Resistant Mortars

Q. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars

R. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete

S. ASTM C496/C496M - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

T. ASTM C579 - Compressive Strength of Chemically Setting Silicate and of Shotcrete

U. ASTM C666/C666M - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

V. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear

W. ASTM C923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

X. ASTM D395 - Standard Test Methods for Rubber Property - Compression Set

Y. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension

Z. ASTM D543 - Resistance of Plastics to Chemical Reagents.

AA. ASTM D638 - Standard Test Method for Tensile Properties of Plastics

BB. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics

CC. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

DD. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

EE. ASTM D2240 - Standard Test Method for Rubber Property—Durometer Hardness

FF. ASTM D2344/D2344M Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

GG. ASTM D3039/D3039M Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials

HH. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrader

II. ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages

JJ. ASTM D4787 - Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

KK. ASTM D4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

LL. ASTM D7234 - Standard Test Method for Pull-off Strength of Coatings on Concrete Using a Portable Adhesion Tester.

MM. ASTM F2414 - Standard Practice for Sealing Sewer Manholes Using Chemical Grouting

NN. ASTM F2551 - Standard Practice for Installing a Protective Cementitious Liner System in Sanitary Sewer Manholes

OO. ASTM G210 - Severe Wastewater Analysis Test

PP. AASHTO M199 Standard Specification for Precast Reinforced Concrete Manhole Sections

QQ. AASHTO Standard Specifications for Highways and Bridges

RR. CIGMAT - Evaluation of Liner System for Wastewater Concrete and Clay Brick Facilities

SS. NACE SP0188 - For performing holiday detection

TT. NASSCO Manhole Assessment Certification Program (MACP).

UU. International Concrete Repair Institute (ICRI) Technical Guideline No. 310.1R – Surface Preparation Guidelines for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion

VV. SSPC-SP 13/NACE No.6 – Surface Preparation of Concrete

1.04 QUALITY ASSURANCE

A. The installed systems shall be free of all defects that will affect the service life and operation of the manhole.

B. The system furnished shall be completely integrated and compatible systems including all materials, manufacturer's recommended equipment and manufacturer's installation procedures. The system shall be designed against corrosion and typical chemicals found in wastewater. The manufacturer of the system shall provide testing data that supports their system's design and service life.

C. The rehabilitation system shall eliminate water leakage into the manhole and prevent water or vapors to leak out of the manhole through pinholes or other defects. If leakage occurs either in or out of the manhole, seal these areas to stop all leakage using a material compatible with the system applied and as specified by the manufacturer. If leakage occurs through any system applied to the manhole, the system shall be repaired or removed as recommended by the manufacturer. All repair materials shall have the same estimated life expectancy as the system installed. Final approval of the system installation will be based on meeting the acceptance test requirements for each system applied/installed.

D. Flow from existing active service connections entering the manhole shall be maintained or bypassed if the flow will affect proper system application/installation.

E. The manhole rehabilitation system shall cause no adverse effects to any of the Owner's processes or facilities either during or after application. The use of the product, shall not result in the formation or production of any detrimental compounds or byproducts at the wastewater treatment plant. Notify the Engineer and Owner to identify any by-products produced as a result of the installation operations, test and monitor the levels, and comply with any and all local waste discharge requirements.

F. For a manhole coating or lining product to be considered, a minimum of 1,000 vertical feet of documented manhole rehabilitation shall have been completed by the Contractor in the previous three (3) year period.

G. Cleanup, restore existing surface conditions and structures, and repair any of the manhole system's installed and determined to be defective. The Contractor shall conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses, and property owners or tenants.

1.05 SUBMITTALS

A. Submit the following:

1. Product data and safety data sheets (SDS). Material descriptions shall be sufficiently detailed in the submittals to verify conformance to these specifications.
2. Performance Work Statement (PWS) which clearly defines the proposed manhole rehabilitation system delivery in conformance with the requirements of these contract documents. Include information on the system and all tools and equipment required for a complete application/installation, catalog data sheets, ASTM references, material composition, manufacturers recommended specifications, component physical properties and chemical resistance, recommended material installation/application process including mixing, additives, set time, cure time (return to service) and all equipment required for quality product delivery, outline the mitigation procedure to be implemented in the event of key equipment failure during the installation process, proposed procedures for cleaning and preparing the manhole structure, detailed description on substrate testing to be performed to verify acceptability of the system material to be applied, and the name and experience of each lead individual performing work on this contract, for each component.

3. Detailed installation plan describing all preparation work, cleaning operations, pre-inspections, sewage flow maintenance, traffic control, installation procedure, method of curing, quality control, testing to be performed, final inspection, warranties furnished and all else necessary and appropriate for a complete system application/installation
4. Detailed installation schedule
5. Design calculations performed in accordance with the applicable ASTM or industry standard for each structural design component/system to be installed signed and sealed by a registered professional engineer as well as third party testing and documentation for structural design submittals including but not limited to the following:
    a. Manholes specified to be structurally replaced, being able to sustain all earth, hydrostatic and dynamic loading without support by the existing structure.
    b. Manholes specified to be structurally rebuilt, with build-back materials, or rehabilitated to sustain hydrostatic loading by groundwater.
    c. Manholes specified to receive a corrosion protective coating sufficiently thick to totally protect the existing host structure from further corrosion, deterioration and water vapor transmission.
6. Third party, independent, testing data on the rehabilitation component including but not limited to the following:
    a. Manholes specified to receive a corrosion protective coating sufficiently thick to totally protect the existing host structure from further corrosion, deterioration and water vapor transmission.
    b. Manholes specified to receive a coating to renew mortar or other deteriorated components of a manhole but has no specified longevity or corrosion resistance requirement
    c. Manholes specified to receive patch repair materials for portions of the manhole.
7. Certified statement from the manufacturer that the Contractor’s listed installer is an approved installer of the system with certificates of completed training for each crew member involved in each rehabilitation component
8. For each manhole rehabilitation, a complete and accurate record of all systems installed/applied shall be prepared. The record shall include identifying manhole number, location, and quantities of rehabilitation components installed.
9. For all system products, documentation for a minimum of three (3) year successful installation history.
10. A minimum of five (5) recent verifiable references of the Contractor’s work, indicating the successful application of the system products of the same material type as specified herein or to be furnished by the Contractor and applied in a similar project environment as included in these contract specifications.
11. Submittal of all quality assurance documentation and test reports for systems installed.

1.06 SEQUENCING AND SCHEDULING

A. Perform manhole rehabilitation after rehabilitation of upstream and downstream sewer pipe.

B. Obtain confined space entry permit prior to work in manhole. No entry to confined spaces will be permitted without the necessary certified training as required under applicable Federal, state, and local laws.

1.07 DELIVERY, STORAGE, AND HANDLING

A. All component materials furnished shall be marked with detailed product information, kept dry and protected from weather, and stored in a manner specified by the manufacturer.

B. Store polymer and Cementitious protective coating materials at temperatures as recommended by the manufacturer and handled according to their material safety data sheets. Do not store near flame, heat, or strong oxidants.

C. Deliver materials to job site in undamaged, unopened containers bearing manufacturer's original labels. Materials used as chemical grout shall be transported, stored, mixed and applied in

manner prescribed by the manufacturer of the specified materials, as detailed in published data provided by manufacturer.

1.08 FIELD SERVICES

A. Provide the services of a manufacturer's approved trainer for training the Owner's representatives on the specific product being installed. The Owner's representatives training shall include sufficient amount of classroom or virtual session time to instruct the Owner's representatives on the basic concepts of the technology and what aspects are important to review and inspect in the field while the system is being installed by the Contractor. The Owner's representatives training shall also include a sufficient amount of time to instruct the Owner's representatives on what needs to be inspected in the field, what needs to be inspected for each system and what documentation is needed to verify that the system has been installed in accordance with the contract documents.

B. At a minimum provide two (2) 8-hour days for manufacturer's authorized representative. One (1) day for pre-installation conference and training and one (1) day during installation to certify that the installation follows all manufacturer recommendations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The systems defined herein include those identified as commercially accepted methods for manhole rehabilitation. Methods or products not defined under these specifications shall be submitted to the Engineer for review before use on this project.

2.02 EPOXY POLYMER LINER

A. Manufacturers:
   1. APM Permaform, Cor+Guard, Johnston, IA
   2. PPG Protective and Marine Coatings, PPG Raven 405, Epoxy Liner, Concord, Ontario
   3. VORTEX (QUADEX, LLC), Structure Guard, Houston, TX
   4. Sauereisen SewerGard, Pittsburg, PA
   5. Or approved equal.

B. Epoxy mortar:
   1. 100 percent solids system consisting of epoxy resins and chemical resistant fillers.
   2. Unaffected by freeze/thaw attack.
   3. Chemically resistant to sanitary sewer environment.
   4. Coating shall be colored such that full coverage can be confirmed via visual inspection
   5. Minimum coating thickness shall be 125 mils (3.18 mm) or as required by calculations.
   6. Minimum Structural Standards:
      a. Compressive Strength (ASTM D695) 13,000 psi (89632 kPa)
      b. Flexural Strength (ASTM D790)) 13,000 psi (89632 kPa)
      c. Tensile Strength (ASTM D638) 7000 psi (48263 kPa)
      d. Flexural Modulus (ASTM D790) 500,000 psi (3447380 kPa)

2.03 CHEMICAL GROUTS

A. Provide chemical grout in accordance with Specification 036400 – Injection Grouting (Long-Term).

2.04 CEMENTITIOUS MANHOLE REPAIR MATERIALS

A. Manhole Repair Materials
   1. Cementitious restoration materials shall provide for structural build-back, Inflow & Infiltration abatement, corrosion resistance, and repairing inverts. All materials applied to a structure shall be compatible, as specified by the manufacturer.
   2. Quick setting (20 minutes or less), high strength, sulfide resistant, calcium aluminate-based or Portland cement material.
   3. Suitable for troweling or rotary spray application.
   4. Minimum Properties:

Density	135 lb/cf
Compressive Strength (ASTM C109) at 1 day	2,000 psi
Compressive Strength (ASTM C109) at 28 days	5,500 psi
Bond Strength	1,640 psi
Flexural Strength	1,500 psi
Shrinkage	0%

5. Manufacturers
    a. APM Permaform, Permacast CR-9000
    b. Vortex (Quadex, LLC), Aluminaliner
    c. The Strong company, Inc., Strong-Seal High Performance
    d. PPG Marine and Protective Coatings, Raven 705CA Repair Mortar
    e. Or approved equal

B. Hydraulic Water Plugs (Non-Structural Infiltration Control)
1. Rapid setting to plug active leaks prior to rehabilitation work.
2. Initial Set 70 degrees Fahrenheit (21 degrees Celsius): 60-90 seconds
3. Final Set Time 70 degrees Fahrenheit (21 degrees Celsius): One Hour
4. Minimum Properties:
    a. Compressive Strength (ASTM C109) at 28 days 4,000 psi (27579.04 kPa)
    b. Length Change (ASTM C157) 0%
5. Manufacturers
    a. APM Permaform, Permacast-Plug
    b. Vortex (Quadex, LLC), Quad-Plug
    c. The Strong company, Inc., Strong-Seal QSR or Strong-Plug
    d. Or approved equal

C. Oakum Water Plugs (Non-Structural Infiltration Control)
1. Rapid setting, oil free oakum and hydrophilic grout to seal active water leaks prior to other rehabilitation work.
2. Oil-free oakum meeting Federal Specification HH-P-117
3. Two-part urethane resin hydrophilic grout. Initial Set Time: 5 -10 seconds
4. Manufacturers:
    a. Avanti International, AV-219 or AC-202
    b. DeNeed, Inc, Oil-Free Oakum or Hydro Active Sealfoam
    c. Or approved equal.

2.05 MANHOLE CHIMNEY SEALS

A. General
1. Manhole frame sealing includes the sealing of the joint between the manhole frame and the opening through the top of the manhole structure with either a manufactured or applied internal flexible seal.
2. The seal shall be designed to prevent leakage of water into the manhole.

B. Mechanical Frame Seal Material
1. The flexible sleeve portion of the seal shall be extruded or molded from a high quality rubber compound, which conforms to the resilient material properties prescribed in ASTM C 923 Table 1.
2. The sleeve shall have an unexpanded vertical height sufficient to seal the entire grade adjustment area and be corrugated or pleated to allow for vertical and horizontal movement.
3. The upper and lower sections of the sleeve that compress against the frame casting, and manhole chimney or cone shall have an expansion band recess capable of restraining the band during expansion and after installation.

4. Any extension used in conjunction with the sleeve to increase chimney coverage shall be manufactured of the same material in conformance with ASTM C923, Table 1 and be designed with an extension flap which fits into or behind the expansion band recess allowing for joining the components with an expansion band.
5. The expansion bands used for compressing the sleeve and extensions against the manhole shall be fabricated stainless steel, conforming to section 4.2 of ASTM C 923. The manufacturers mechanism used to expand the bands shall have the capacity to develop sufficient pressure to create a watertight seal. The bands shall be permanently held in the expanded position with a positive locking mechanism that conforms to section 4.2 of ASTM C 923.
6. The installed internal seal or its appurtenances shall not extend far enough into the manhole opening to prevent or unduly restrict manhole entry. If the seal is constructed of another flexible material, the seal shall have both tensile and tear strength equal to or greater than that of the natural or synthetic rubber when tested in accordance with the applicable ASTM procedures.
7. Physical Properties
    a. Extruded or molded from a high grade rubber compound as per ASTM C923.
8. The installed seal shall remain flexible, to allow for repeated vertical movements of the frame due to frost lift, ground movement, or other causes and/or repeated horizontal movement of the frame due to thermal movement of pavement or other causes.
9. Manufacturers:
    a. Cretex Specialty Products - LSS
    b. Trelleborg FlexRib
    c. Sealing Systems, Inc. - Internal Uni-Band
    d. Or approved equal

C. Polymer Chimney Seal
1. Polymer manhole chimney seals shall be designed to prevent leakage of water into the manhole through the sealing of the joint between the manhole frame and the opening through the top of the manhole structure including all extensions to the chimney area. Extensions shall include but are not limited to lifting rings, brick and/or block material that may have been used to achieve grade.
2. The polymer chimney seal material shall be corrosion resistant.
3. Mil thickness shall be determined by the manufacturer.
4. The polymer chimney seal may require a primer resin applied to the entire surface before application. The sealing system shall line the interior of the adjustment area from the cone/top of the manhole and onto the inside of the casting. If the manhole has been relined prior to the seal installation, the seal shall cover a minimum of 6 vertical inches to cover casting cone interface.
5. Manufacturers:
    a. Vortex (Quadec, LLC) – Chimney Guard
    b. PPG Marine and Protective Coatings, Raven 581
    c. Or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. General
1. Maintain all flow in the manhole throughout duration of the work.
2. Provide 48 hour notice to the Engineer and Owner prior to start of work for Owner’s representatives to review and document materials and equipment to be used, for Quality Assurance and testing requirements.
3. Bypass sewage as required.
4. Clean interior surfaces of manhole of debris, dirt, oil, grease, remains of old coating materials, and any other extraneous materials.

5. Pressure wash manhole walls to remove loose mortar, concrete and debris. Pressure washing levels, used for cleaning, shall be as recommended by the manufacturer.
6. Repair irregularities in manhole using materials, compatible with proposed resurfacing material, as recommended by the manufacturer.
7. Repair leakage in manhole using materials, compatible with proposed resurfacing material, specified in these contract specifications.
8. Trim and grout incoming laterals and pipes as required.
9. Remove debris from manhole and incoming sewer connections.
    a. Handle cleaning water to prevent water and residue from causing damage.
    b. Do not discharge debris downstream through the sanitary sewer system.
    c. Filter solids-laden water through a de-silting device.
    d. Properly dispose of debris and residue from cleaning and other construction operations in a manner satisfactory to Owner and authority having jurisdiction over area where work site is located.

B. All manhole steps shall be removed and disposed of prior to a coating or lining application.

3.02 EPOXY LINER

A. Installation
1. Thoroughly clean to remove all loose material and surface contaminants. Cleaning shall be by waterblasting, sandblasting, applying a 10 percent solution of muriatic or hydrochloric acid over all surfaces or other approved method. If an acid solution is used, the surface shall be thoroughly rinsed and neutralized prior to the application of mortar and coatings.
2. Collect loose materials/debris and remove from manhole.
3. Install and mix epoxy mortar in accordance with manufacturer's instructions.
4. Apply epoxy coating onto interior surfaces of the manhole to produce a smooth coating at the required minimum thickness. A gauge shall be used during application to verify thickness at various locations.
5. Epoxy putty or other surfacer shall be used as necessary to repair any surface irregularities prior to applying epoxy as recommended by selected epoxy manufacturer.
6. Sagging of epoxy coatings not permitted.
7. Cure in accordance with manufacturer recommendations.
8. Sloped surface of the manhole bench shall be made non-skid by broadcasting aluminum oxide or sand into the surface prior to gelatin/set.

3.03 CHEMICAL GROUT

A. Provide in accordance with Section 330130.63 – Injection Grouting (Long-Term).

3.04 CEMINTITIOUS RESTORATION

A. GENERAL
1. Before starting any patch work or liner application install a perforated device, catch bucket, or other straining device to prevent construction debris from entering down-stream pipes.
2. Provide all materials, labor, equipment, etc. required to perform the work as recommended by the manufacturer and as required by the contract documents.
3. Inspect each manhole to determine methods of stopping leaks and applying patch repairs.
4. Promptly inform Owner of errors or discrepancies between the contract documents and the field conditions found, in order that changed conditions can be evaluated and revised directives issued in a timely manner.
5. Install all products in accordance with manufacturer's instructions regarding surface preparation, product application and curing.
6. Confirm that all material to be used, for the rehabilitation of the manhole are compatible with each other. Do not use any materials that have not been verified for compatibility.

B. Sealing Active Leaks
1. The work consists of hand applying a dry quick-setting cementitious mix designed to instantly stop running water or seepage in all types of concrete and masonry structures. Apply

material in accordance with manufacturer's recommendations in accordance with the following minimum requirements:

a. The area to be repaired shall be clean and free of all debris per the guidelines set forth elsewhere in these specifications.
b. Once cleaned, prepare crack or hole by chipping out loose material to a minimum depth recommended.
c. As recommended by the manufacturer, place a generous amount of the dry quick-setting cementitious material to the active leak, with a smooth fast motion, maintaining external pressure for 30 seconds, repeat until leak is stopped.
d. Proper application should not require any special mixing of product or special curing requirements after application.
e. Use of Oil-free Oakum Water Plugs.
    1) Saturate oakum with resin following approved submittals.
    2) Use additives as required.
    3) Place and cure following manufacturer's recommendations.

C. Invert Repair
1. The work consists of hand mixing and applying a rapid setting, high early strength, non-shrink patching material to fill all large voids and repair manhole channels prior to spray lining of the manhole. For invert repairs, flow must be temporarily restricted by inflatable or mechanical plugs prior to cleaning.
2. The area to be repaired shall be cleaned and free of all debris.
3. Mix water shall be clean potable water and require no additives or admixtures for use with cementitious patching materials.
4. Cementitious material shall be mixed in a mortar tub or 5 gallon pail with water per manufacturer's specifications. Material should be mixed in small quantities, to avoid setting prior to placement in voids or channels.
5. Once mixed to proper consistency, apply materials to the invert or void areas by hand and trowel. In invert applications, care should be taken to not apply excessive material in the channel, which could restrict flow. Once applied, materials should be smoothed either by hand or trowel in order to facilitate flow.
6. Flows in channels shall be re-established when material has cured enough to withstand the flow as determined by the manufacturer.

D. Application of Cemintitious Manhole Liner
1. Trowel, spray apply and/or centrifugally spin-cast a cementitious based liner to the inside of the existing manhole. The equipment and application methods to apply the cementitious based liner materials shall be as recommended and approved by the material manufacturer.
2. Material shall be mixed with water in accordance with manufacturer's specifications. Once mixed to proper consistency, the materials shall be pumped via a rotor-stator style progressive cavity pump through a material plaster hose for delivery to the appropriate selected application device. The equipment shall be as recommended by the manufacturer, matched for the material being applied.
3. If a chimney seal is required in conjunction with the lining technology, contact the chimney seal manufacturer to determine the proper preparation required for effectively installing the chimney seal after the coating has been applied and cured.

E. Spray Application of the Cemintitious Material
1. Apply and finish materialusing equipment specified by the manufacturer.
2. Material hose shall be coupled to a low-velocity spray application nozzle. Pumping of the material shall commence and the mortar shall be atomized by the introduction of air at the nozzle, creating a low-velocity spray pattern for material application.
3. Spraying shall be performed by starting at the manhole invert and progressing up the wall to the corbel and chimney areas.

4. Apply material to a specified uniform minimum thickness as required by the manufacturer and as necessary for proper curing and application. Apply material to the bench area in such a manner as to provide for proper drainage.
5. Material shall be troweled smooth to compact material into voids. A brush or broom finish may be applied when a top coating is desired.

F. Sping Casting Application of the Cemintitous Material
1. Apply and finish material using equipment specified by the manufacturer.
2. Material hose shall be coupled to a high-speed rotating applicator device. The rotating casting applicator shall then be positioned within the center of the manhole at either the top of the manhole chimney or the lowest point elevation corresponding to the junction of the manhole bench and walls.
3. The high-speed rotating applicator shall then be initialized and pumping of the material shall commence. As the mortar begins to be centrifugally cast evenly around the interior of the manhole, the rotating applicator head shall be raised and / or lowered at a controlled retrieval speed conducive to providing a uniform material thickness on the manhole walls.
4. Controlled multiple passes must then made until the specified minimum finished thickness is attained. If the procedure is interrupted for any reason, stop the retrieval of the applicator head until flows are recommenced.
5. Material thickness shall be verified at any point with a depth gauge and shall be no less than a uniform ½-inch. If additional material is required at any level, the rotating applicator head shall be placed at that level and application shall recommence until that area is thickened.
6. Material shall be applied only when manhole is in a saturated surface dry (SSD) state, with no visible water dripping or running over the manhole walls.
7. The low-velocity spray nozzle and the centrifugal spin casting head may be used in conjunction to facilitate uniform application of the mortar material to irregularities in the contour of the manhole walls and bench areas.
8. Troweling of materials shall begin immediately following the spray application. Initial troweling shall be in an upward motion, to compress the material into voids and solidify manhole wall. A brush or broom finish may be applied if top coating is desired.
9. Curing will take place once the manhole cover has been reinstalled. It is important that the manhole cover is replaced no more than 10-20 minutes after troweling is complete to avoid moisture loss in the material due to sunlight and winds.
10. Do not apply during freezing weather conditions. Material shall not be placed when the ambient temperature is 37 degrees Fahrenheit and falling or when the temperature is anticipated to fall below 32 degrees Fahrenheit during 24 hours.

G. Testing and Acceptance
1. Visual inspection – verify no infiltration, cracks, or loose material.
2. Vacuum Testing, as required in the contract documents.
3. Cementitious Material Physical Property Testing.

3.05 MANHOLE CHIMNEY SEALS

A. Mechanical Frame Seal
1. The contact surfaces for the sleeve and/or extensions shall be reasonably clean and smooth, circular and free from excessive voids or defects. If the masonry surface is rough or irregular and will not provide an effective sealing surface, it shall be smoothed with a single component non-shrink quick set repair mortar designed for vertical and overhead use. Realign manhole frame and cover if offset is greater than three (3) inches between the frame and top of the manhole structure.
2. After surface preparation is completed and the rubber sleeve has been placed in the proper position, the lower band is positioned in the band recess and expanded as required to provide a water tight seal. If an extension or extensions are being used, place the extension in the proper position, insert the band into the lower band recess and expand as required to provide a watertight seal.

3. Extension flap shall be placed into or behind the expansion band recess to allow for the compression of both the extension flap and sleeve against the manhole surface by the expansion band. Continue by placing the upper band or bands in the recess, insuring the seal is properly placed on the manhole cone, chimney and frame and expand as required to provide an effective seal.
4. Installation procedures shall be in accordance with the manufacturer's recommended instructions.
5. Testing and Acceptance
    a. Visual Inspection - Verify no infiltration, cracks, or loose material.
    b. Leakage test - Following the expansion of the lower band a quality assurance test shall be performed to insure effective sealing by pulling the upper section of the seal or extension inward to create a recess behind the seal where water can be poured. Pour the water behind the seal and observe the lower sealing area for any visible leaks. The sealing shall be considered effective if no water leaks from behind the seal at the lower sealing area.

B. Polymer Chimney Seal
1. All loose and protruding mortar and brick that would interfere with the polymer chimney seal's performance shall be removed. Any lips for gravel pan supports shall be cut off flush with the manhole casting. All loose material or excessive voids shall be repaired using patching cement, as recommended by the manufacturer. Obtain from the polymer chimney seal manufacture, in writing, the material compatibility and the recommended time required for the patching cement to properly cure prior to installing the polymer chimney seal.
2. Preparation of the chimney surface and casting may include using high pressure water, sandblasting, wire brushing, or other methods as described by the manufacturer, to ensure a clean surface. Active leaks (infiltration) shall be sealed by a method as recommended by the polymer chimney seal manufacturer prior to installing the chimney seal. After water or sandblasting, pressure wash the entire area remove any loose sand that may have been deposited. The substrate surface shall be free of sand, loose debris, latencies, dust, oil, grease or chemical contamination. A blower may be required to completely dry the substrate surface or as recommended by manufacturer.
3. The polymer chimney seal shall require the proper mixing of several components, as recommended by the manufacturer. If a primer is required, ensure that all surfaces are clean and dry before applying. After proper curing of the primer, the polymer chimney seal may be applied evenly by brush over the entire chimney area, including the frame joint area and the area above the manhole cone including all extensions to the chimney area.
4. Installation procedures shall be in accordance with the manufacturer's recommended instructions.

C. Testing and Acceptance
1. Visual Inspection - Final liner system shall be completely free of pinholes or voids
2. Holiday Detection Test
3. Adhesion Testing

3.06 FIELD QUALITY CONTROL

A. Visual Inspection
1. All manholes shall be visually inspected. Any leakage into the manhole in areas where system's were installed by the Contractor shall be identified.
2. Provide samples for testing to the Owner from the actual installed system. Samples shall be provided, at a minimum from one location per every ten (10) system's installed.

B. Cementitious Material Property Testing
1. One 2 X 2 X 2 inch sample cube shall be taken for every 50 bags of material used. Samples shall be sprayed from nozzle, identified in the presence of the Owner's representative and sent by the Owner's representative, to an independent test laboratory for compression strength testing as described in ASTM C 109.

C. Film thickness Measurements

1. Where applicable and specified, during application a wet film thickness gauge, meeting ASTM D4414, shall be used. Measurements shall be taken, in the presence of the Owner's representative, documented and attested to by Contractor for submission to Owner.

D. Holiday Detection Test
1. Where specified, holiday detection shall be performed for all coating systems installed in corrosive environments.
2. After the epoxy coating product have set in accordance with manufacturer instructions, all surfaces shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection.
3. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating can be hand applied to the repair area.
4. All touch-up/repair procedures shall follow the coating manufacturer's recommendations.
5. Documentation on areas tested, results and repairs made shall be provided to the Owner, in writing, by Contractor.

E. Adhesion Testing
1. Where specified, a minimum of 10% of the manholes coated shall be tested for adhesion/bond of the coating to the substrate. Testing shall be conducted in accordance with ASTM D4541, ASTM D7234, or NACE SP018. Owner's representative shall select the manholes to be tested.
2. A minimum of three (3) - 1.97 inch (50 mm) dollies shall be affixed to the coated surface at the cone area, mid section and at the bottom of the structure or in areas suspect from non-destructive evaluation and testing The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of the coating product and permitted to cure in accordance with manufacturer recommendations. The coating and dollies shall be adequately prepared to receive the adhesive.
3. Failure of the dolly adhesive shall be deemed a non-test and require retesting. Prior to performing the pull test, the coating shall be scored to the substrate by mechanical means without disturbing the dolly or bond within the test area.
4. Two of the three adhesion pulls shall exceed 300 psi (2068 kPa) or concrete failure with more than 50% of the subsurface adhered to the coating.
5. Should a coasting fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Owner. Any areas detected to have inadequate bond strength shall be evaluated by the Owner.
6. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section covers the provisions for furnishing and installing all ferrous and nonferrous castings.

1.02 QUALITY ASSURANCE

A. All castings shall be inspected prior to the delivery to the job site by an authorized representative of the Owner. Castings shall be measured and weighed for accuracy. Castings arriving at the job site without a stamp of approval will be rejected.

1.03 SUBMITTALS

A. Shop Drawings shall be submitted showing all pertinent information for approval prior to the delivery of the castings to the job site.

PART 2 - PRODUCTS

2.01 GENERAL

A. All sewer castings shall conform to the Standard Details for the Construction of Sanitary Sewers.

B. All metal castings shall conform to the requirements specified herein and to the following standards:

Gray Iron	ASTM A48
Malleable Iron	ASTM A47
Carbon Steel	ASTM A27
Alloy Steel	ASTM A148
Low Alloy Steel	ASTM A242

C. All castings shall be free from pouring faults, cracks, blow holes, or other defects affecting their strength and value for the service intended.

D. Unless otherwise specified, gray iron shall be Class 30, malleable iron shall be Grade 32510, and carbon steel shall be Grade 65-35. Castings shall be manufactured using tough, close grained material without the admixture of cinder iron or metal of inferior quality.
   1. Angles shall be boldly filleted and the arises kept sharp.

E. No plugging of defective castings will be permitted.

F. The dimensions of all castings shall have a tolerance of plus or minus one-sixteenth (1/16) of an inch and an additional tolerance of plus or minimum one-sixteenth (1/16) of an inch per foot of dimension. The weight deviation tolerance shall not exceed five (5) percent. Notwithstanding the above tolerances, all manhole rings and covers of the same nominal size shall assemble interchangeable. All horizontal bearing surfaces between frames, filler rings and covers shall be machined.

G. Covers shall have a raised rectangular surface design and shall be lettered as shown on the Standard Details for the Construction of Sanitary Sewers.

2.02 MANHOLE CASTINGS

A. Adjustable Castings
   1. Adjustable manhole castings shall consist of an outer frame, inner frame, cover, and a one-piece adjustment or filler ring. Filler rings may have a single slot cut into the circumference. Filler rings consisting of more than one piece are not acceptable. Castings shall be as manufactured by Richard Foundry Corp., Norfolk, Virginia; E. L. LeBaron Foundry Co., Brockton, Massachusetts; Campbell Foundry, Harrison, N.Y., or equal. The flat exposed surface of the inner frame shall have a recessed pocket with the letters "ADJ.". The top of the lettering shall be flush with the top of the frame.

B. Watertight Castings
   1. Watertight castings shall be of the non-adjustable type, and shall be as manufactured by Richard Foundry Corp., E.L. LeBaron Foundry Co., or equal.

2. Each watertight casting shall consist of a frame, cover, steel pan, steel locking bar, brass bolt, and rubber gasket.

2.03 CLEAN OUT CASTINGS

A. The cast iron clean-out frames and covers shall conform to ASTM A48 and shall be as manufactured by E.L. LeBaron Co., Richard Foundry Corp., or equal.

B. The iron body ferrules and brass screw plugs installed in connection with a clean-out assemblies shall conform to the applicable sections of ASTM A74.

PART 3 - EXECUTION

3.01 PREPARATION

A. All castings shall have a full, firm, and even bearing on the supporting surface. Manhole castings shall be set on a mortar bed.

B. Castings shall be erected to accurate grades and alignment, and when placed in concrete, shall be carefully supported to prevent movement.

3.02 INSTALLATION

A. Manhole Castings

1. Before placing an adjustable manhole casting, the filler ring shall be removed. Castings shall be placed on brickwork as specified in Section 042000, "Brick and Block Masonry". Adjustable castings shall be set flush with the base pavement, and shall be raised to grade immediately before placing the wearing course. Only the castings in the area that can be paved in one (1) day shall be raised. All other castings shall be set flush with the finished grade.

B. Clean-Out Castings

1. The frame and cover shall be set on a compacted subgrade, true to required line and grade. The clean-out casting shall be placed in the sidewalk where possible. Where no sidewalk exists, the casting shall be placed in a concrete slab as shown on the Standard Details for the Construction of Sanitary Sewers. The concrete shall conform to the requirements of the Section 033000, "Concrete" of these Specifications.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe and fittings for gravity sanitary sewers and gravity drain lines.

B. Comply with the requirements contained in Section 330130.11 - Inspection of Underground Pipelines for requirements pertaining to the submission of underground pipeline documentation that shall be provided as work of this section.

1.02 RELATED SECTIONS

A. Section 312316 - Earth Excavation

B. Section 312333 – Backfill

C. Section 314100 - Shoring of Excavation

D. Section 321200 - Roadway Paving

E. Section 321313 - Cement Pavement Repairs

1.03 REFERENCES

A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

B. ANSI/AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.

C. ACI 308 - Standard Practice for Curing Concrete.

D. ANSI/AWWA C150/A21.50 - American National Standard for Thickness Design of Ductile Iron Pipe.

E. ASTM A1064 - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

F. ANSI/AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings

G. ANSI/AWWA C600 - Installation of Ductile Iron Water Mains and Appurtenances.

H. ANSI B18.2.1 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

I. ANSI B18.2.2 - Square and Hex Nuts (Inch Series).

J. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

K. ASTM F714, ASTM D3261, ASTM D3350 for High Molecular Weight, High Density PE 3408 Polyethylene Pipe

L. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.

M. ANSI/ASTM D698 - Test Methods for Moisture - Density Relations of Soils and Soil Aggregate Mixtures. Using 5.5 lb. rammer and 12-inch drop.

N. ASTM C827 - Test Method for Early Volume Changes of Cementitious Mixtures.

O. ASTM C923 - Resilient Connectors between Reinforced Concrete Manhole Structures and Pipe.

P. ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

Q. ASTM D3034 - Type PDM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

R. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

S. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.

T. Great Lakes-Upper Mississippi River Board of State Sanitary Engineers - Recommended Standards for Sewage Works (Ten State Standards).

U. UNI-B-5-89 - Recommended Practice for the Installation of Polyvinyl Chloride Sewer Pipe.

1.04 SUBMITTALS

A. Submit under provisions of Section 013300.
   1. Submit underground pipeline documentation as required in Section 017839.
   2. Product Data: Provide data on pipe materials, pipe fittings, accessories and marking tape.
   3. Manufacturer's Installation Instructions: Indicate procedures required to install products specified.
   4. Manufacturers' Certificate: Certify that products meet or exceed specified requirements.
   5. Foundry Records and Tests: Written transcripts of the test results shall be delivered directly to the Engineer within one week of the shipment of pipe with the date of the tests as close to the date of manufacture as practical. For ductile iron pipe, written transcripts shall be furnished directly to the Engineer in accordance with applicable sections of AWWA C151 and ANSI A21.51:
      a. Transcripts & Certification: 51-5.2
      b. Group Tests Required:
         1) Hydrostatic Test (51-9)
         2) Tensile Test (51-12.1)
         3) Impact Test (51-12.2)
         4) Low Temperature Impact Test (51-13).
      c. Number of Specific Group Tests
      d. Required in Addition to General
   6. Certification: One (1) per pipe size per 2,000 linear feet of pipe.

1.05 MANUFACTURER'S TESTING

A. General
   1. Each manufacturer furnishing pipe under this Section shall be equipped with testing facilities of approved type and capacity and shall furnish the required number of specimens for each size or lot of pipe without cost to the Owner.
   2. A lot as used herein is defined for pipe smaller than thirty (30) inches in diameter as two hundred (200) lengths of pipe or less, of identical type, class, and size manufactured on one machine. For pipe thirty (30) inches in diameter and larger, a lot is defined as one-hundred (100) lengths of pipe or less, of identical type, class, and size.
   3. At least one full length of pipe shall be selected from each lot of pipe for each test specified. No less than two (2) specimens shall be tested for each type, class, and size of pipe. A greater number of specimens shall be tested if required by ASTM Specifications or specified herein. When allowed by ASTM Specifications, the same length of pipe may be used for different tests.
   4. Should any specimen fail to meet any of the required tests, then two additional test specimens shall be selected for each specimen that failed, from the lot represented by the specimen that failed. The additional specimens shall be tested, and should any one of these fail to meet the requirements specified, the entire lot represented by these tests shall be rejected.
   5. Certified copies of the results of all tests shall accompany each shipment of pipe and shall be furnished to the Owner for each shipment of pipe.

B. Polyvinyl Chloride Pipe (PVC)
   1. Polyvinyl Chloride Pipe, fittings, and specials shall be tested in accordance with ASTM D3034, D2444, and D2412.
   2. Pipe flattening, impact resistance, and pipe stiffness tests shall be made for each size of PVC pipe furnished. The minimum "pipe stiffness" at five (5) percent deflection shall be forty-six (46) for all sizes when tested in accordance with ASTM D2412.

1.06 QUALITY ASSURANCE

A. Ductile iron pipe manufacturer shall be a member of the Ductile Iron Pipe Research Association.

B. Pipe shall be marked with the manufacturer's name, classification, or nominal thickness and "DI" or "Ductile Iron".

C. Perform work in accordance with Nassau County DPW Standards and Ten State Standards

D. PVC pipe shall be marked with the following:
   1. Nominal size in inches and O.D, base
   2. PVC
   3. Dimension Ratio (i.e. DR 18)
   4. Pressure Class in PSI
   5. Hydrostatic integrity test pressure
   6. AWWA designation
   7. Manufacturer’s name/trademark and production run record/lot code
   8. Mark of certifying agency for pipe intended for potable use
   9. Maximum allowable axial joint deflection in degrees
   10. Additional markings as required by ASTM Specifications for each pipe shall also be included.

E. Each coupling, fitting, and special shall be similarly marked by the manufacturer and also marked with the size and class of pipe with which it is to be used.

F. Omission of the above information may be cause for rejection of the pipe.

G. Factory Inspection
   1. The Ownershall have the right at all times to have its representative inspect the materials, the processes of manufacture, the records of analysis and tests, observe the manufacturing, witness all tests and select the test specimens at the place of pipe manufacture.
   2. Ten (10) working days notice plus travel time is required prior to the commencement of any manufacturing process or testing of pipe.

1.07 TESTING

A. Sampling
   1. Furnish and deliver to Owner testing facilities for testing, standard lengths of pipe, fittings, and specials of each type, size, and strength class from each shipment of VCP, PVC, and PVCP. Specimens for testing will be selected by the Engineer from each shipment of pipe. Furnish these selected specimens at the rate of one (1) standard length of pipe from each one-hundred (100) lengths of pipe in each size and strength class and also one (1) fitting and special from each one-hundred (100) fittings and specials of each size and class except that in no case shall less than two (2) specimens from each type, size, and class of pipe be furnished.
   2. The tests performed by the Owner and the methods and procedures for those tests will be the same as the tests specified under "Manufacturer's Testing" of this Section.
   3. Should any specimen fail to meet any of the required tests, then two (2) additional test specimens shall be furnished and delivered to the Owner testing facilities for each specimen that failed, from the shipment represented by the specimen that failed. The additional specimens will be tested, and should any one of these fail to meet the requirements specified, the entire lot represented by these specimens shall be rejected.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products in accordance with manufacturer's instructions to prevent soiling, disfigurement, or damage.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of work and isolating parts of completed systems.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

B. Do not mix or place mortar and non-shrink grout if ambient temperature is below 40 degrees F.

C. Do not backfill over or with frozen materials.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. PVC Pipe: Certaineed, JM, Carlon

B. Ductile Iron Pipe: US Pipe & Foundry, Co., American Ductile Iron Pipe Company, or equal.

2.02 MATERIALS

A. Pressure-Rated PVC Pipe – ANSI/AWWA C900, Polyvinyl Chloride (PVC) material; Or Pressure Rated PVCO Pipe - AWWA C909, Polyvinyl Chloride Oriented (PVCO) material; inside nominal diameter as indicated, integral bell and spigot end joints, Class DR 18 or as indicated on plans
   1. Pipe Compound: ASTM D1784 Cell Class 12454
   2. Integral Bell Joints: ASTM D3139
   3. Gaskets: ASTM F477

B. PVC - ANSI/ASTM D3034, Type PSM, Polyvinyl Chloride (PVC) material; inside nominal diameter as indicated, integral bell and spigot end joints, Class DR 18 as indicated on plans. Joints meet or exceed ASTM D3212. All fittings for C-900 pipe shall be manufactured in one piece of injection molded PVC compound meeting ASTM D1784. Fittings shall be designed to withstand a minimum of 755 psi quick burst pressure at 73°F tested in accordance with ASTMD1599. Bells shall be gasketed joint conforming to ASTMC3139 with gaskets conforming to ASTM1477. Ductile Iron or Cast Iron Push-on joint or MJ will be allowed as alternative when PVC sizes are not available.
   1. Color: Green

C. Ductile Iron - Pipe shall be centrifugally cast with primary graphite in modular form or spherulitic and conform to AWWA C150, Class 54, bell and spigot ends. All buried and exposed pipe and fittings shall be cement lined per AWWA C104, double thickness, minimum 3/16 inch for pipe and standard thickness for fittings. All buried pipe and fittings shall be provided with bituminous seal coat per AWWA C106, inside and out. Ductile iron fittings shall comply with AWWA C110. Nuts and bolts shall be alloy steel conforming to the physical properties of ASTM A563 and ANSI B18.2.1 for bolts and ANSI B18.2.2 for nuts. Joints meet or exceed AWWA C111.

2.03 ACCESSORIES

A. Pipe Connectors: Elastomeric PVC with Series 300 stainless steel bands by FERNCO, Davison, MI.

B. Gaskets: Plain Rubber (Styrene Butadiene Copolymer) with stainless steel locking segments for push-on joint restraint. Field Lok 350 by US Pipe, or Amarillo Fast-Grip by American.

C. Detectable Marking Tape: Solid plastic tape with a minimum total thickness of 4.5-mil with aluminum backing. Tape resistant to alkalis, acids, and other destructive elements. Green in color, minimum 3 inches wide with the words "Caution - Sanitary Sewer" repeated every 16-36 inches, conforming to APWA uniform color code.

D. Flexible Couplings:: Elastomeric PVC in accordance with ASTM D5926 and ASTM C1173 with shear bands and Series 300 stainless steel bands by FERNCO, Davison, MI.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry and not over excavated. Comply with the requirements contained in Section 312316 - Earth Excavation and Section 312333 - Backfilling.

3.02 PREPARATION

A. Remove scale and dirt, on inside and outside, before assembly.

B. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.

C. All encountered obstructions in the line of the work shall be carefully taken-up and stored for subsequent replacement. If damaged, full and new replacement will be required at no additional expense to the Owner. Comply with Section 321200 - Roadway Pavement and Section 321313 - Cement Pavement Repairs.

D. Remove and dispose of all other obstructions which will affect the work or which are specifically designated to be removed.

E. Hand trim excavations to required elevations. Correct over excavation with Type C fill as defined in Section 312316 - Earth Excavation.

3.03 INSTALLATION

A. Maintain separation of sanitary sewer from water piping in accordance with regulations of Nassau County Department of Health, New York State Department of Health, and the Recommended Standards for Wastewater Facilities.

B. Parallel Water and Sewer Lines - Pipelines carrying sewage, sludge or other wastewater, whether treated or not, shall not be located any closer than 10 feet horizontally from a potable water pipeline. If it is not possible to maintain horizontal separation, the lines may be located at least 3 feet horizontally from each other, provided that there is at least 18 inches of clear vertical separation, with the sewer line being below the water line.

C. Water and Sewer Line Crossings - Whenever water and sewer lines must cross, the sewer shall be situated below the water line with at least an 18 inches of clear vertical separation. In no case shall a water line pass under a sewer.

D. Special Conditions - Parallel Lines - When it is impossible to achieve the requirements of paragraph 3.03 (B), immediately notify Engineer. If Engineer concurs, they will order the construction of the sewer with ductile mechanical joint pipe and may order the reconstruction of the existing water line. Regardless, sewer shall be installed at a lower elevation than the water line and the reconstructed water line shall be pressure tested for leakage in accordance with Section 017550 - Process Pipe and Tank Testing.

E. Unusual Conditions - Immediately notify Engineer when it is impossible to achieve any of the above conditions. The Engineer will prescribe the procedures to be followed.

F. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321 and manufacturer's instructions. Seal joints watertight. Select pipe and fittings so that there will be as small a deviation as possible at the joints and so those inverts present a smooth surface. Pipe and fittings that do not fit together to form a tight fitting joint are not permitted.

G. Install ductile iron pipe in accordance with AWWA and ANSI standards and manufacturer’s instructions. Seal joints watertight. Select pipe and fittings so that there will be as small a deviation as possible at the joints and so those inverts present a smooth surface. Pipe and fittings that do not fit together to form a tight fitting joint are not permitted.

H. Install pipe to allow for expansion and contraction without stressing pipe or joints.

I. Lay pipe to slope gradients noted on drawings with maximum variation from the slope of 1/8 inch in 10 feet.

J. Backfill and compact trench in accordance with Division 31 requirements.

K. Plug or close every open pipe end before leaving work at night, and when pipe installation is not in progress.

L. After partially backfilling, install marking tape 18 to 24 inches above crown of pipe. Place as straight as possible. Hold tape in position by adding backfill with hand shovels before using mechanical equipment to finish the backfill.

M. Adjust lock joint flexible sleeve or install non-shrink grout to provide water-tight pipe penetration. Mount lid and frame level in grout, secured to top section to elevation indicated.

N. Perform all mixing, surface preparation and grouting in accordance with manufacturer's recommendations.

O. In each stretch of underground pipe, light shall be visible from one end to the other and the pipe shall be true to line and grade. All deposits found in the pipes, protruding cement or packing shall be removed and the sewer bore left clean and free through its entire length. There shall be no visible leakage into any stretch of sewer. All manholes and other appurtenance shall be of the specified size and form and of neat appearance, and their tops shall be set to the proper grade. If the Work is found to be in any condition other than in accordance with these specifications, it

shall be brought to proper condition by cleaning, pointing, or if necessary, excavating and rebuilding.

P. Install pipes to the lines and grades as given on the drawings. Engineer reserves the right to disapprove a method of control, including those previously accepted, if, in the Engineer's opinion, the method of control is not providing the accuracy required under the Contract.

Q. Drainage of construction excavations through sanitary sewers is not permitted.

R. Maintain the excavation free of water during the progress of the Work. No pipe shall be laid in water nor shall there be any joints made up in water. No separate allowance for pumping or otherwise removing water will be made. All slides or cave-ins of the trenches or cuts shall be remedied at the expense of the Contractor, and to the satisfaction of the Engineer.

S. Make connections between pipes of different materials with approved adapters. The encasement of adapter made connections with concrete is not permitted. Commence pipe laying at the lowest point, with the spigot ends pointing in the direction of flow.

T. All adjustments to the line and grade of pipe laid on earth foundation shall be done by scraping away or filling in the earth under the barrel of the pipe, and not be blocking or wedging. Where excavation has been carried too deep but not in excess of six (6) inches, the Contractor may replace with suitable earth and hand tamp same to provide a firm foundation. Wherever the contractor has excavated to a depth in excess of six (6) inches, the Engineer may order broken stone or gravel fill without additional compensation to the Contractor. In all cases the trench under the joint shall be excavated to permit an even bearing for the barrel of the pipe.

U. When unsuitable materials and/or conditions are encountered, the Engineer may direct the excavation to continue below grade and the trench filled with gravel or crushed stone foundation, or the Engineer may order other corrective measures.

V. Where required, holes and spaces to be used for joints shall be sufficiently large enough to leave the joint of each pipe free and not resting on the ground at any point. Every joint shall be made up in the trench.

3.04 PIPE INSTALLATION

A. Excavate and shape the trench to conform to the details shown on the Drawings. If accidental or intentional over excavation of the trench occurs, in depth or width, corrective measures shall be taken by the Contractor. No additional compensation will be made therefore. This requirement applies equally in the case of cave-in of the trench walls, by failure to apply necessary sheeting measures.

B. Place and compact embedment materials in accordance with Paragraph 5.10.2, "Methods of Placing Embedment Materials", of Recommended Standard UNI-B-5 of the Uni-Bell Plastic Pipe Association, subject to the conditions of the Plans and these Specifications. Pipe haunching and initial backfill shall be brought up and compacted equally on either side of the pipe, to preclude disturbance of the pipe, in layers not to exceed four inches in height, by use of hand tamping supplemented by mechanical compacting using hand-operated compactors, similar to "Whacker" or equal. Flooding, puddling and jetting of initial backfill are prohibited for PVC pipe installations.

C. Place final backfill in accordance with Section 312333, as modified herein. "Hydrohammers" and similar compacting equipment, which, in the opinion of the Engineer, may cause disturbance to the pipe and/or the materials in the pipe zone (bedding, haunching, and initial backfill) shall not be utilized within four feet (4') of the pipe. This shall not be construed to preclude the use of mechanical compactors, "hoe-packers", and the like, which may be demonstrated, by the Contractor, to produce no deleterious effects on the embedment materials. Such demonstration shall be the responsibility of the Contractor. The use of mechanical compaction equipment shall be in accordance with the pipe manufacturer's recommendations, and as approved by the Engineer.

D. The Contractor's specific attention is directed towards the critical nature of effecting and maintaining the specified compaction of the embedment materials in the pipe zone. Lower limit for sheeting driven and pulled shall be one foot (1') above the top of the pipe. All sheeting placed

below this level shall be cut off at said point and left in place. Compensation therefore will be made only if ordered to drive below this level, by the Engineer.

E. Use of a moveable “trench box” when moved, may cause disturbance to the materials in the pipe zone. Usage of a trench box, for protection of personnel in accordance with OSHA requirements, will be permitted only under one of the following conditions, which shall be the Contractor’s responsibility to propose and employ:
   1. Position the moveable trench box on a shelf above the pipe springline, with the pipe installed in a narrow, vertical walled subditch. The width of the subditch shall not exceed the O.D. of the pipe plus 9 inches on each side; or
   2. Increase the overall trench width to produce a minimum clearance of 2-1/2 pipe diameters between the pipe barrel and the trench box on each side of the pipe after embedment has been placed and compacted. In utilizing this option, all voids left in the embedment material as the result of trench box removal shall be filled and compacted. Disturbance to the loss of compaction density in the pipe zones is not permitted.
   3. Submit proposed method of meeting the above-specified conditions to the Engineer. No additional compensation will be made for meeting these conditions, or for additional excavation, backfill, repaving, or similar items.

F. Compaction of embedment materials, including bedding, haunching, and initial backfill shall be as shown on the Drawings, and initial backfill shall be as shown on the Drawings, but in no case shall the density attained be less than that required for the final backfill above. The Contractor’s attention is directed toward compaction requirements for pavement sub-base material, specified elsewhere in the specifications.

3.05 MECHANICAL JOINT PIPE/FITTING INSTALLATION

A. Clean the socket and plain end. All surfaces with which the gasket comes in contact shall be thoroughly wired brushed just prior to assembly. All loose rust, mud, frozen material, sand, gravel, and other foreign material shall be removed.

B. Wipe the gasket clean and install the gasket. Take care that no gasket loops or bulges protrude into the path of the entering pipe spigot. In temperatures below 32 deg. F, the gaskets shall be warmed before installation.

C. Using a clean brush, apply a liberal amount of lubricant supplied by the pipe manufacturer completely over the end of the pipe, the spigot radius, and the outer surface of the pipe up to the assembly stripe. Lubricant shall have no deteriorating effects on gasket and pipe material. Also, apply lubricant completely over the exposed surface of the gasket.

D. Install the bevel end of the pipe into the socket. Take care that the plain end is centrally located in the socket and push the pipe home. The joint deflection may then be set.

E. When tightening bolts on mechanical joint fittings, the gland shall be brought up to the fitting flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around. This shall be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, and then the remaining bolts. Repeat this process until the proper joint tightness is achieved. Overstressing the bolts to compensate for the poor installation will not be permitted.

3.06 CONNECTIONS TO EXISTING MANHOLES AND STRUCTURES

A. The use of excessive force or blunt instruments is prohibited in installing the pipe into the walls of existing manholes and structures. Neatly core drill a hole through the exiting wall, to achieve the minimum diameter hole required to install the pipe true to line and grade. The structure shall be maintained in good repair. Provide flexible and watertight connection at the wall.

B. In making the connection to an existing manhole or structure, pump out each structure in order to make this connection.

C. Where drop inlets are required for connections to existing manholes, install in accordance with the details and configurations indicated in the Contract Documents.

3.07 SITE TOLERANCES

A. Maximum variation from proposed rim elevation shall be 1/4 inch.

B. Maximum variation from established pipe grade shall not exceed the following, given that such variance does not result in a slope less than the minimum slope identified in 10 State Standards.

Diameter (Inches)	Tolerance (Feet)
8 – 12	0.03
14 – 16	0.04
Greater to or equal to 18	0.05

3.08 FIELD QUALITY CONTROL

A. Request inspection prior to and immediately after placing backfill.

B. Compaction testing shall be performed in accordance with ASTM D2922.

C. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.

3.09 PROTECTION

A. Protect pipes, structures, and appurtenances from damage or displacement during backfilling.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the provisions for the installation of all house connections, risers and clean-out assemblies of the types and sizes as shown on the Plans and as specified.

1.02 SUBMITTALS

A. Shop Drawings
   1. Shop drawings shall be submitted for all pipes, pipe fittings, riser, and clean out assemblies.

PART 2 - PRODUCTS

2.01 GENERAL

A. All house connection pipes shall be a minimum six (6) inch diameter.
   1. In general, all house connection pipe, riser pipe, and all fittings shall be manufactured of the same material and class as the mainline sewer pipe.
   2. Where the sewer pipe is of reinforced concrete, the house connection pipe shall be connected to a six (6) inch diameter cored opening. The house connection pipe, riser pipe, and fittings shall be either VCP, PVC, or DIP.
   3. Where pressure pipe is specified or ordered by the Engineer, the Contractor shall have the option, unless a specific type of pipe is required, of furnishing and installing either DIP or PVCP pipe.
   4. All pipe and fittings for clean out assemblies in commercial and traffic areas shall be Extra Heavy Cast Iron. In all other areas, the Contractor has the option of using Extra Heavy Cast Iron or PVCP.
   5. Where the depth of cover over the pipe is less than four (4) feet all pipe shall be DIP or PVCP unless otherwise specified or shown on the drawings.

B. All pipe, fittings, joints, and incidentals shall conform to the requirements of Section 333100, "Sewer and Pressure Pipe".
   1. Clean-out castings, iron body ferrules, and brass screw plugs for clean-out assemblies shall conform to the requirements of Section 330561.05, "Castings".
   2. Saddles for sewer connections to existing sewers and all reinforced concrete pipe shall be cast iron. Saddles for all riser connections and the horizontal connections to reinforced concrete pipe shall be Sealtite Model "US" or equal. Horizontal connections to sewers 8 through 24 inch (609.6 mm) diameter shall be made with Sealtite Model "ES" saddles or equal.
   3. Concrete for connections shall be 3300 psi (22752.71 kPa) conforming to the requirements of Section 033000, "Concrete".

PART 3 - EXECUTION

3.01 PREPARATION

A. All requirements for preparation shall conform to the requirements of Section 333100, "Sewer and Pressure Pipe".

B. The location and depth of house connections shall be as directed in the field by the Engineer to best suit, in location and depth, the property to be served.

3.02 INSTALLATION

A. General
   1. The installation of all pipe, fittings, assemblies, concrete encasement and incidentals necessary to complete the various items of work shall be as shown in the Standard Details for the Construction of Sanitary Sewers.
   2. The open ends of all pipe stubs or lines installed for future connection shall be capped or plugged watertight. The use of solvent cemented caps or plugs will not be permitted.

3.03 HOUSE CONNECTION ASSEMBLIES

A. For 8 to 24 inch (609.6 mm) diameter sewers, fittings for house connection assemblies shall be reducing "Y" fittings. The straight run of the "Y" fitting shall be the same size as the sewer line in which it is installed, and the reducing leg shall be the same size as the house connection pipe.

B. The "Y" fittings shall be installed in a rotated position at an angle of approximately twenty (20) degrees to the horizontal. The elbow shall be installed that it will best suit the run and slope of the house connection piping. The degree of rotation of the "Y" fitting shall be limited so that the joints of connecting pipes and fittings are not impaired by excessive deflection.

C. For reinforced concrete pipe, a six inch cast iron saddle, pipe coupling and fitting, shall be installed over a six (6) inch cored opening in conformance with the details shown in the Standard Details for the Construction of Sanitary Sewers.

3.04 HOUSE CONNECTIONS TAPPED TO EXISTING SANITARY SEWERS OR INTERCEPTORS

A. Where noted on the drawings or where directed by the Engineer, make connections to existing lateral sewers and interceptors in conformance with the details shown in the Standard Details for the Construction of Sanitary Sewers.

B. Existing sewer lines may be active or filled with liquid. Maintain flow in active lines while making the connection. Any sewer connections made to active lines shall be done during low flow periods. Sewer lines filled with water shall be drained prior to making the connection.

3.05 RISER ASSEMBLIES

A. A riser assembly shall be made with a reducing "T" fitting and elbows of the same kind and strength class as the pipe installed in the sewer line. The straight run of the "T" shall be the same size as the sewer line in which it is installed and the leg of the "T" fitting shall be the same size as the riser and house connection pipe.

B. When a riser assembly is to be installed on a section of reinforced concrete pipe or an existing sewer, a cast iron saddle and coupling shall be placed over a cored opening and the joint shall be constructed as shown on the Standard Details.

3.06 ADDITIONAL RISER HEIGHT

A. The additional length of straight pipe required to increase the height of a standard riser assembly for a house connection shall be as ordered by the Engineer and shall be installed in a vertical position as shown on the Standard Details.

B. Ensure that the riser pipe and fittings are properly braced. Riser pipe and fittings shall be held rigidly in place during backfilling and shall be maintained in a vertical position.

3.07 HOUSE CONNECTION PIPE

A. House connection pipe shall be installed from the connection assembly or the riser assembly to a point one (1) foot inside the curb except as listed below:
   1. Where storm water drains or utilities are located in the sidewalk area, the house connections shall be installed to a point beyond the back edge of the drain or utility.
   2. In State highways, the house connections shall be installed to the property line.
   3. House connection tunnelled close to poles or trees shall be extended to a point as determined by the Engineer.
   4. Deep house connections (depth nine (9) feet or greater) shall be extended to a point five (5) feet beyond the edge of pavement and/or as directed by the Engineer.

B. Where the house connection pipe cannot be placed on undisturbed soil, the trench shall be backfilled, and compacted to the invert of the house connection, prior to the installation of any horizontal part of a house connection pipe.

C. If in the opinion of the Engineer it is necessary to install a house connection under or close to a pole or tree, the house connection will be tunnelled.

D. An electronic marker shall be set six to twelve inches above to the last foot of a house connection pipe in a level position. For house connection locations which require marker placements at a

depth greater than six (6) feet, a "dummy" plastic marker of the same color and size as the electronic marker shall be placed six to twelve inches above the end of the house connection pipe and the electronic marker set directly above at its maximum operational depth. Any damaged or defective electronic marker shall be replaced by the Contractor at no cost to the Owner.

E. Accurately mark the location of the house connection at the curbline. This will be accomplished by means of two parallel chisel marks approximately two (2) inches apart, one-quarter (1/4) inch deep, and four (4) inches in length perpendicular to the curbline. These marks shall be painted green with durable paint approved by the Engineer. If no curb exists at the house connection location, these marks will be chiseled and painted on the sidewalk. If no sidewalk or curb exists at this location, a 2 inch (50.8 mm) x 2 inch x 18 inch (457.2 mm) hardwood stake shall be driven flush with the soil. The top of this stake shall be painted green with a permanent paint.

F. Should subsequent replacement of the curb and/or sidewalk be ordered by the Engineer, these marks shall be replaced at no additional cost to the Owner.

3.08 CLEAN-OUT ASSEMBLIES

A. Clean-out assemblies shall be installed in locations as determined by the Engineer. In general, clean-out assemblies shall be installed on house connections that exceed thirty-five (35) feet in length from centerline of sewer to curb and in locations where the total length of house connection pipe from centerline of sewer to outlets at the residence or building exceeds seventy-five (75) feet. The distance between clean-out assemblies shall not exceed seventy-five (75) feet on house connections longer than one-hundred-fifty (150) feet.

B. All pipe and fittings shall be properly braced, supported and protected to avoid displacement or damage to the assembly and joints during the placement and compaction of the backfill, and they shall be maintained in a vertical position. The upper portion of the six (6) inch vertical pipe with the frame and cover shall be installed prior to the completion of the finished grade. Concrete and pea gravel shall be provided as shown in the Standard Details.

END OF SECTION