Five Towns Drainage Study







Appendix D: Community Assessments

Nassau County, New York
Department of Public Works

AECOM

Cameron Engineering & Associates, LLP

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1.0 INTRODUCTION

Nassau County's "Five Towns" region is comprised of nine jurisdictions on the south shore of western Long Island, at the head of the Far Rockaway Peninsula. Despite its name, the region is not comprised of five towns; rather, the full area lies within the Town of Hempstead, in southwestern Nassau County. The "Five Towns" designation dates back to the year 1931 when local fundraising organizations in Inwood, Lawrence, Cedarhurst, Woodmere, and Hewlett formed a joint entity dubbed the "Five Towns Community Chest". In the decades thereafter, the general public began referring to this geography of Nassau County as the "Five Towns". Today, the term encompasses the incorporated Villages of Cedarhurst, Lawrence, Hewlett Harbor, Hewlett Bay Park, Hewlett Neck and Woodsburgh; and the unincorporated Hamlets of Hewlett, Inwood, and Woodmere. The Five Towns region is largely surrounded by water including Jamaica Bay and Hewlett Bay, Reynolds Channel, and numerous tidal creeks and navigable canals. More than 49,000 people reside within the Five Towns. Land use is predominantly single-family residential. Other uses include commercial, retail, light industrial, and parkland/open space.

Flooding has historically occurred in the Five Towns during severe rainfall events, astronomical high tides, nor'easters, and tropical storms. The region's vulnerability to both tidal and stormwater flooding was highlighted during Superstorm Sandy in October of 2012 when significant tidal storm surge inundation combined with backwater flooding of municipal stormwater drainage systems to cause catastrophic inland flooding even in areas that were beyond the extent of the storm surge.

The Five Towns' flood vulnerability directly affects the quality of life of its residents. Stormwater flooding occurs frequently and coastal storm surges have become more frequent, and are expected to continue and get more severe.

1.1 Purpose and Scope of the Drainage Study

Municipal drainage improvement projects originated as a concept in the Five Towns Community Reconstruction Plan (CRP) under the Governor's Office of Storm Recovery's (GOSR) New York Rising Program to address areas that have been identified as historically vulnerable to localized flooding due to tidal backflow, limited drainage capacity/overflow, topographic low points or a combination thereof. Numerous drainage problem or focus areas were identified in the CRP as well as through meetings with community officials which warranted additional study before potential improvements could be proposed and implemented. The primary purpose of the Five Towns Drainage Study was to first, document existing municipal stormwater drainage conditions and then, to identify potential drainage improvements or flood mitigation projects. The Drainage Study Report documents the evaluation of potential drainage improvements within the Five Towns Area.

The Villages of Woodsburgh and Hewlett Bay Park were not included in the original Five Towns CRP due to minimal damages as a result of Hurricane Sandy; however, they are included as part of this study for completeness in evaluating the region. Storm surges and stormwater impacts occur regardless of municipal boundaries.

Following the evaluation of existing conditions, drainage improvement plans were developed to limit stormwater flooding at higher frequency events (*i.e.*, 1" rainfall, 2" rainfalls, etc.) – often categorized as

"nuisance flooding" – rather than larger, low frequency rainfall events such as the 25-year rainfall, 50-year rainfall, etc.

1.2 Project History

Between August of 2011 and October 2012, communities across New York State suffered significant impacts as a result of Hurricane Irene, Tropical Storm Lee, and Superstorm Sandy. As communities began to pick up the pieces and rebuild their communities, many were in need of technical expertise to meet their goals of mitigating risk and increasing resiliency. In response to this need, the State developed the New York Rising Community Reconstruction Program (NYRCRP) in April of 2013. This program dedicated more than $650 million to affected communities to provide rebuilding and resiliency assistance. Nassau County's Five Towns was one of the communities selected to participate in this program.

As a NYRCRP community, the local leaders, community organizations, residents, business owners, and civic leaders from the Five Towns developed a Community Reconstruction Plan with technical support provided by staff from GOSR, planners from New York State (NYS) Department of State, NYS Department of Transportation, and consultants from firms specializing in planning, engineering, flood mitigation solutions, green infrastructure, and more.

The Five Towns NYRCRP Plan:

- defines the scopes of the planning area, assesses storm damage, and identifies critical assets;
- inventories critical assets and assesses the assets' exposure to risk;
- describes recovery and resiliency needs and identifies opportunities;
- develops a series of comprehensive reconstruction and resiliency strategies; and
- identifies projects and implementation actions to fulfill these strategies.

One of three key strategies that emerged from the NYRCR process was a desire to:

> *"Increase the resilience to extreme weather in high risk coastal areas by addressing coastal protections and stormwater infrastructure."*

Plans for each of the Five Towns communities in the NYRCR included a stormwater infrastructure upgrade project to improve overall system capacity and/or system efficiency, which served as the basis for this drainage study.

2.0 EXISTING CONDITIONS

2.1 Description of the Study Area

The Five Towns area is largely surrounded by water, including Jamaica Bay and Hewlett Bay. The western boundary of the community is the border between Nassau County, Long Island, Queens County and New York City. This boundary includes Far Rockaway to the south and Head of Bay to the north, which flows into Jamaica Bay between Inwood and JFK Airport. To the north, the Five Towns area is bounded by the Villages of Valley Stream and Lynbrook. Portions of both Motts Creek and Hook Creek are included in the community near the northern boundary. Both of these tidal creeks extend from Head of Bay northeast into Cedarhurst, North Woodmere, and Woodmere. The eastern boundary of the Five Towns includes the Village of East Rockaway and Brosewere Bay. The southern boundary is Reynolds Channel, which separates the Village of Lawrence from Atlantic Beach.

Jurisdictions in the Five Towns include the incorporated Villages of Cedarhurst, Hewlett Bay Park, Hewlett Harbor, Hewlett Neck, Lawrence, and Woodsburgh; and the unincorporated Hamlets of Hewlett, Inwood, and Woodmere. The Five Towns project area is shown in Figure 1.

Land use in the study area is largely single-family residential, but also consists of commercial/retail, light industrial, and parkland/open space.

2.2 Overview of the Problem

Stormwater infrastructure in the Five Towns consists of separate municipal storm sewer systems (MS4) under the jurisdiction and maintenance responsibility of the respective municipality (County, Village, or Town). In some cases, the individual systems are interconnected and mutually contribute stormwater to a single outfall. Private properties are required to maintain stormwater onsite and retention volume is governed by a local municipal ordinance and, in some cases, by the Nassau County Department of Public Works. Older commercial and industrial properties are generally brought into compliance with onsite drainage requirements during the design review process triggered by an expansion or redevelopment building permit application.

Flooding in the Five Towns Project Area occurs frequently during high tide events such as during tropical storms, nor'easters, and spring tides. Existing stormwater infrastructure is often considered inadequate to accommodate increased flows during periods of heavy rainfall, and flooding is exacerbated when stormwater outfalls, of varying condition and often absent of check valves, become submerged by high tides and experience backwater surcharging.

Many areas are built upon wetland areas that were filled in the late 1800's to accommodate development demands after the railroad opened up the region for a year-round, commuter population. These lands in particular are generally quite low and are naturally flood-prone.

Tropical Storm Irene in 2011 was primarily a rainfall event for the Five Towns area, with storm totals ranging from five to nine inches causing extreme stormwater flooding. The following year, in 2012, Superstorm Sandy brought with it a storm surge up to 10 feet NAVD88. As stormwater drainage system outfalls and areas along the coastline were submerged by tidal waters, widespread drainage system backups occurred causing extreme flooding well inland of coastal area.

Approximately 216 stormwater outfalls lie within the Five Towns project area. Most of these either lack backflow prevention devices altogether or currently have improperly functioning backflow prevention devices. Locations with improperly functioning devices are indicative of drainage system backups when outfalls become submerged, stormwater system surcharging and flooding of low lying areas. Outfall locations are depicted in Figure 2.

When existing drainage systems are at capacity - whether due to tidal backflow, stormwater inflow, or a combination of both – flooding occurs at drainage system inlets (manholes and catch basins). Figures in each assessment section show key problem locations reported by public officials and/or the public. These locations were investigated as part of this drainage study to evaluate potential system upgrades and improvements.

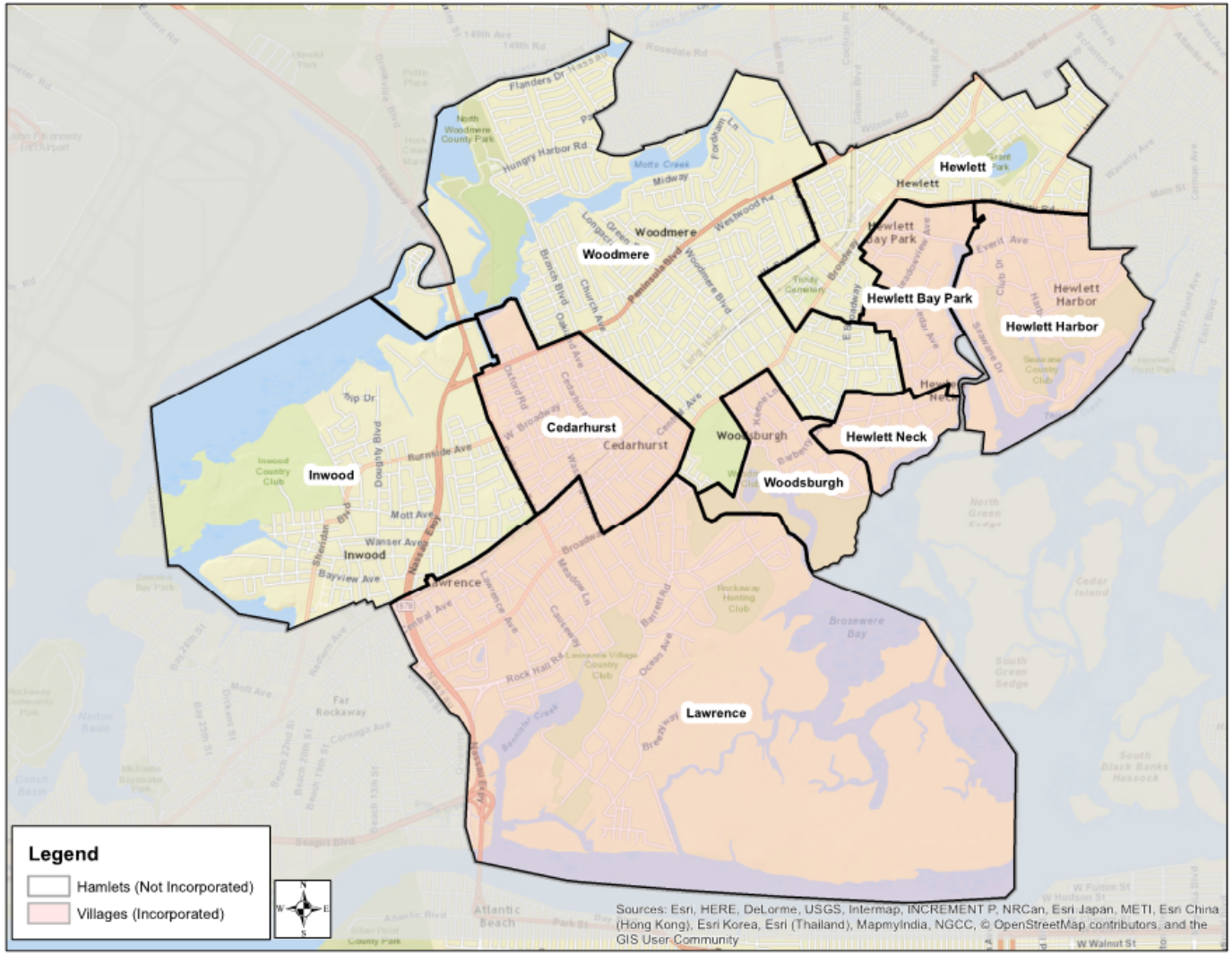


Figure 1: Five Towns Study Area

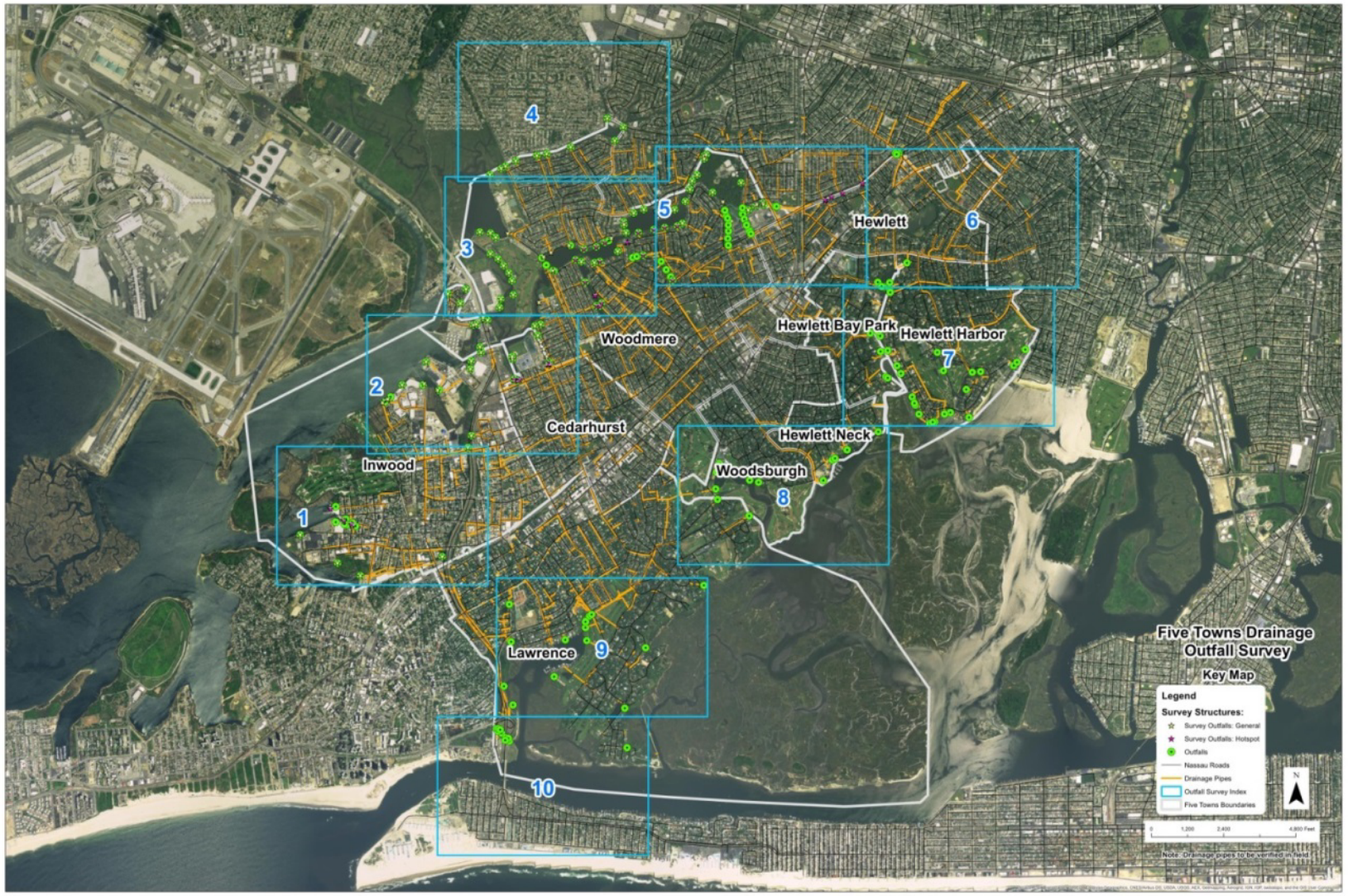


Figure 2: Five Towns Outfalls

2.3 Community Drainage Assessments

The sections below detail the assessment of the drainage and flooding issues in each community and a summary of the results of the drainage analyses. Costs for the proposed projects are detailed in the Main Report and Appendix E.

3.0 VILLAGE OF CEDARHURST DRAINAGE ASSESSMENT

3.1 Stormwater Drainage Problems

Backwater flooding occurs frequently in the Cedarhurst stormwater drainage system when stormwater outfalls along the Head of Bay become submerged, allowing bay water to enter the system via the outfalls. This was identified in the Cedarhurst Stormwater Infrastructure Upgrades project in the March 2014 Five Towns Community Reconstruction Plan (CRP) (Figure 3). This condition results in flooding along Peninsula Boulevard at the intersections of the cross streets, such as Albermarle Road, Arlington Road, and Cedarhurst Avenue. This flooding occurs routinely at high tide and is most severe during the spring tide, as shown in Figures 4 and 5. The flooding is exacerbated when rainfall occurs during high tide events, as shown in Figure 6. A broader view of the extent of flooding during a severe high tide event is shown in Figure 7. It is this flooding extent that the drainage system analysis hoped to address.

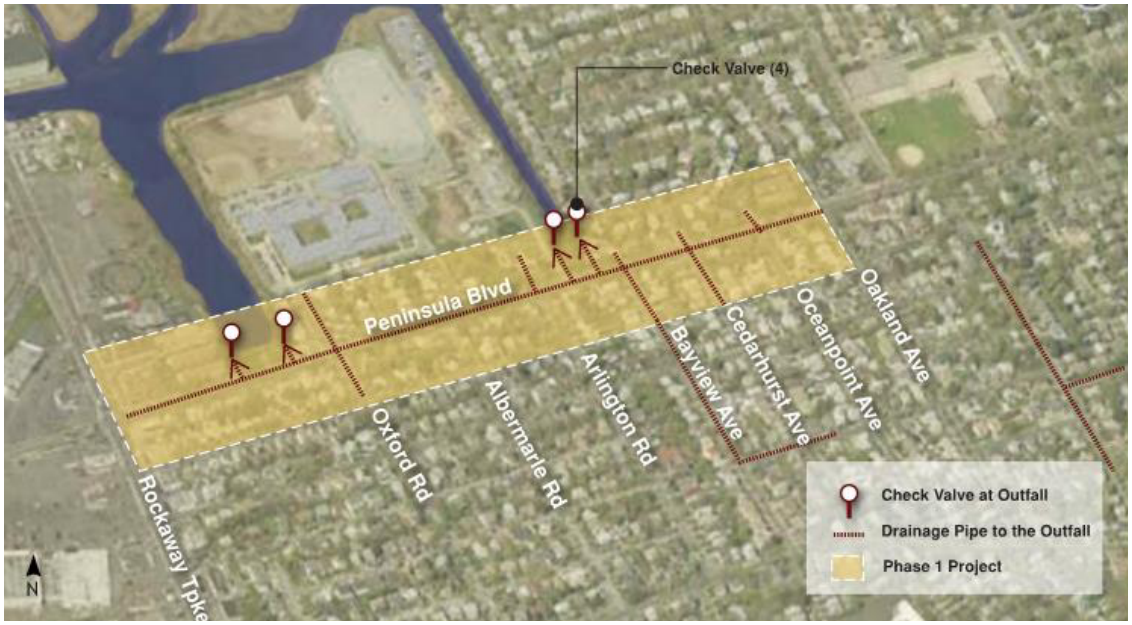


Figure 3: CRP - Cedarhurst Stormwater Infrastructure Project Plan



Figure 4: Tidal Flooding along Cedarhurst Rd.

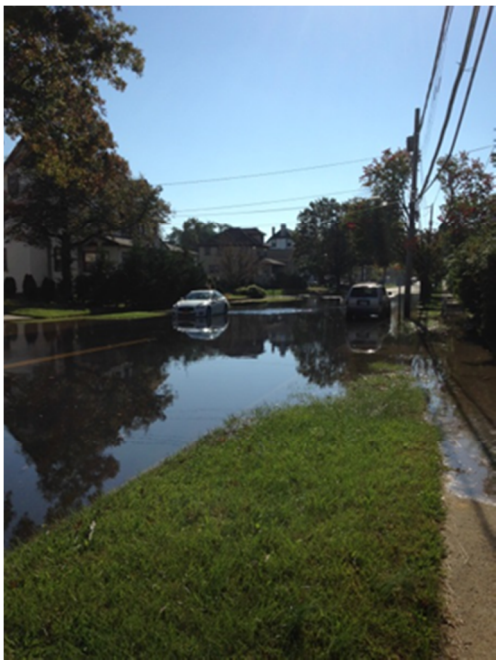


Figure 5: Tidal Flooding along Albermarle Rd.



Figure 6: Flooding along Arlington Road Following a Rainfall at High Tide



Figure 7: Cedarhurst – Extent of Typical Tidal Flooding, Peninsula Boulevard

Backflow prevention flap gates are in place at the canal at the head of Bayview Avenue; however, the gates installed are old style flap gates, as shown in Figure 8. During a recent visit, the largest gate was draining water at low tide although it had not rained for several weeks. This was most likely the release of bay water that had surcharged the system through leaky backflow prevention devices. As shown in the figures above, flooding occurred from tidal surcharging despite the presence of backflow prevention devices.



Figure 8: Flap Gates Village of Cedarhurst, Bayview Ave. Canal

The improvement concept presented in the Five Towns CRP included the installation of updated backflow prevention devices, stormwater system upgrades, and potential utilization of the existing pump station and

wet well at the decommissioned water pollution control plant for a new stormwater pumping station. Community officials have indicated that they prefer not to utilize the existing wet well and pump station as those are centrally located within the plant property and will limit reutilization of the property following demolition of the plant facilities.

3.2 Modeling and Results

Hydraulic drainage models were developed from the outfalls landward until pipe sizes were below 24 inches in diameter. The Cedarhurst model extent, shown in Figure 9, includes three primary drainage networks: the west side near Rockaway Boulevard, central Cedarhurst along Peninsula Boulevard, and an eastern network, which primarily feeds the County's 42-inch trunk line along Peninsula Boulevard. Figure 9 shows the current conditions model; the model was revised to reflect a pump station for the appropriate plan.



Figure 9: Cedarhurst Drainage Model Schematic

Potential improvements evaluated for the Cedarhurst drainage systems include the installation of new backflow prevention devices; larger pipes; a 50 cubic feet per second (cfs) pump station; and a smaller, dual pump station (5 cfs and 25 cfs). The results are presented in Table 1. Because the plan with improved pipe sizes did not show any measurable changes in flood elevations, the results are not presented in Table 1.

Table 1: Cedarhurst Modeling Results

Albermarle Road					Alternative 1	Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Coincidental Rain/Tide 50 CFS Pump	Flood?	Coincidental Rain/Tide 5 & 25 CFS Pump	Flood?
1 Inch	4	1.6	5.4	5.4	2.6	1	No	2	No
2 Inch	4	3.6	5.4	5.4	4.3	4	No	5.5	Yes
1 Year	4	4.5	5.4	5.4	5.2	4	No	6	Yes
10 Year	4	5.1	5.4	5.4	5.4	4	No	6.2	Yes

Arlington Road (Small Line)					Alternative 1	Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Coincidental Rain/Tide 50 CFS	Flood?	Coincidental Rain/Tide 5 & 25	Flood?
1 Inch	4.3	0.5	5.4	5.8	0.5	0.5	No	1.9	No
2 Inch	4.3	0.6	5.4	5.8	4.9	4.2	No	5.4	Yes
1 Year	4.3	0.8	5.4	5.8	5.6	4.1	No	6	Yes
10 Year	4.3	4.8	5.4	5.8	5.5	4.2	No	6	Yes

Broadway, Carlyle, and Arbuckle Avenue					Alternative 1	Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Coincidental Rain/Tide 50 CFS	Flood?	Coincidental Rain/Tide 5 & 25	Flood?
1 Inch	4.5	1.2	5.4	5.4	2.8	1	No	2	No
2 Inch	4.5	2.9	5.4	5.6	5.5	4.3	No	6	Yes
1 Year	4.5	3.4	5.4	5.8	5.6	4.1	No	6.2	Yes
10 Year	4.5	5	5.4	5.8	5.9	4.5	No	6.3	Yes

Bayview Avenue					Alternative 1	Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Coincidental Rain/Tide 50 CFS	Flood?	Coincidental Rain/Tide 5 & 25	Flood?
1 Inch	4.9	1.8	5.4	5.4	1.7	2	No	2	No
2 Inch	4.9	2	5.4	5.4	4.5	4.1	No	5.5	Yes
1 Year	4.9	2.2	5.4	5.4	5.1	4.1	No	6	Yes
10 Year	4.9	2.7	5.4	5.8	5.5	4.1	No	6.2	Yes

Cedarhurst Avenue					Alternative 1	Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Coincidental Rain/Tide 50 CFS	Flood?	Coincidental Rain/Tide 5 & 25	Flood?
1 Inch	4.7	0.3	5.4	5.4	1.1	1	No	2	No
2 Inch	4.7	0.7	5.4	5.4	4	4.1	No	5.5	Yes
1 Year	4.7	0.9	5.4	5.4	4.8	4.1	No	6	Yes
10 Year	4.7	1.4	5.4	5.4	4.2	4.1	No	6	Yes

Oxford Road					Alternative 1	Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Coincidental Rain/Tide 50 CFS	Flood?	Coincidental Rain/Tide 5 & 25	Flood?
1 Inch	4.4	1.5	5.4	5.4	2.7	1.5	No	1.9	No
2 Inch	4.4	2.7	5.4	5.4	5.3	2.4	No	5.6	Yes
1 Year	4.4	3.7	5.4	5.4	5.3	3.5	No	6.2	Yes
10 Year	4.4	4.1	5.4	5.4	5.4	4.3	No	6.2	Yes

Rockaway Tpke					Alternative 1	Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Coincidental Rain/Tide 50 CFS	Flood?	Coincidental Rain/Tide 5 & 25	Flood?
1 Inch	4.8	1.4	5.4	5.4	3.6	3.8	No	4.2	No
2 Inch	4.8	4.5	5.4	5.4	5.2	3.8	No	5.8	Yes
1 Year	4.8	5	5.4	5.4	5.3	3.9	No	5.7	Yes
10 Year	4.8	5.5	5.4	5.4	5.4	4	No	6	Yes

Peninsula Boulavard					Alternative 1	Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Coincidental Rain/Tide 50 CFS	Flood?	Coincidental Rain/Tide 5 & 25	Flood?
1 Inch	4.6	1.1	5.4	5.4	1.1	1.6	No	5.4	Yes
2 Inch	4.6	1.3	5.4	5.4	5	2.4	No	5.4	Yes
1 Year	4.6	1.6	5.4	5.4	5.4	4.4	No	5.4	Yes
10 Year	4.6	4.1	5.4	5.6	5.6	5	Yes	5.5	Yes

Notes: (1) Elevations in Feet NAVD88.
(2) Tidal cycle and coincidental flooding based on 5.39 ft NAVD (estimated) spring tide.
(3) Colored cells represent improvements in flooded conditions.

3.3 Proposed Cedarhurst Improvements

3.3.1 Overview

Based on model results, the following improvements are proposed to limit recurring flooding within the Village:

1) **Backflow Prevention:** The backflow prevention devices at the outfalls at Johnny Jack Park are located upstream from the outfalls near the swirl separators. These devices appear to be functioning properly as upstream flooding during high tide in this area is negligible. However, the drainage networks leading to the outfalls near the old water pollution control plant (head of Bayview Avenue) are subject to frequent tidal surcharge. The four outfalls would be retrofitted with new, more effective backflow prevention devices to limit tidal surcharging and tidal flooding.

   The intersection of Peninsula Boulevard and Rockaway Boulevard is also subject to frequent flooding as the outfall to the canal at Plaza Road has a treatment system but is apparently not protected by a backflow prevention device (see Figure 10). A backflow prevention device would also be installed here.



Figure 10: Plaza Road Outfall

2) **Pipe Improvements:** Pipe size improvements were evaluated for the Cedarhurst networks; however, they did not result in measurable changes in flooding conditions.

3) **Pump Stations:** The dense development and large drainage area of the Cedarhurst stormwater drainage network contributes a large amount of runoff that quickly surpasses the capacity of the drainage system during large rainfall events, especially during surcharged or blocked conditions. The most effective way to convey the runoff in those conditions is with a pump station. Several pump station configurations were evaluated with a goal of minimizing costs. The smallest pump station which provided measurable flood relief at events larger than a 1-year event (2.8" rainfall) was a 50 cfs pump. The proposed pump station location is shown in Figure 11.

4) **Additional Improvements:** Officials indicated that catch basins along Peninsula Boulevard had a large amount of silt or sediment, potentially limiting the conveyance of the basins. These should be cleaned through coordination between the County and the Village. As this type of maintenance is outside the purview of this analysis, cost estimates for basin and manhole cleaning were not included as a possible drainage improvement plan.

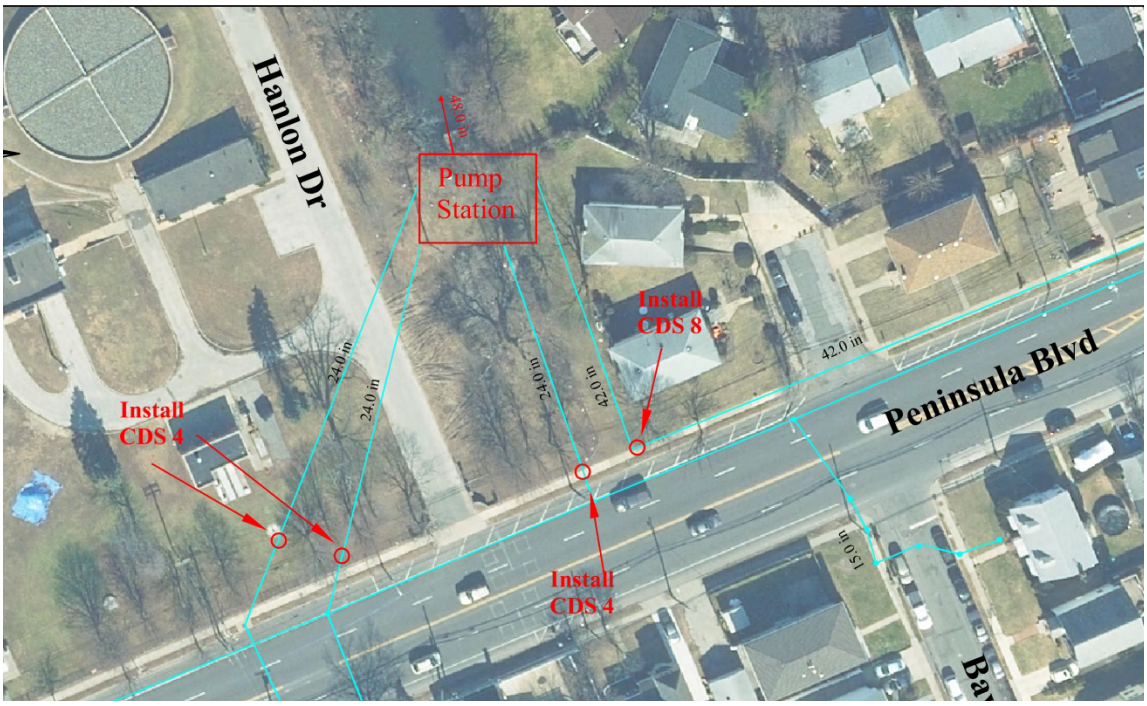


Figure 11: Cedarhurst Proposed Pump Station Location

3.3.2 Expected Performance

Installation of effective backflow prevention should significantly limit flooding as a result of tidal surcharging, which is experienced monthly. Furthermore, limiting the surcharging of the drainage network will allow for increased runoff storage in the empty pipes. The result is a significant reduction of flooding conditions in most areas up to the 1-year rainfall event; the flooding depicted in Figure 10 would be largely eliminated.

The installation of a pump station will further improve flooding conditions up to the 10-year rainfall event (5.1" rainfall in 24 hours) and limited improvement is expected for lower frequency events.

3.3.3 Estimated Benefits

Stormwater infrastructure upgrades in the Village of Cedarhurst would significantly reduce the frequency and severity of flooding along Peninsula Boulevard and its cross streets. Benefits which would be realized include reducing the frequent deployment of barriers by the DPW; reducing traffic risks, including vehicle and pedestrian risks associated with large ponding areas and barriers; improving emergency access to areas previously flooded on a recurring basis; and reducing or eliminating nuisance/recurring flooding of the cross-streets and driveways (except for some of the larger rainfall events), significantly improving residents' peace of mind.

4.0 HAMLET OF INWOOD DRAINAGE ASSESSMENT

4.1 Stormwater Drainage Problems

During periods of heavy rains and high tides, the capacity of the stormwater drainage system in Inwood is exceeded and water backs up from the stormwater system into the streets causing localized flooding and pooling of water on roadways. Bayswater Boulevard is an area of particular concern. This was identified in the Inwood Stormwater Infrastructure Upgrades Project in the March 2014 Five Towns CRP (Figure 12). Other areas subject to flooding include Walnut Road and the intersection with Bayswater Boulevard (see Figure 13), Chestnut Road, Davis Avenue, Maple Road, and Prospect Place. A broader view of the extent of flooding during a severe high tide event is shown in Figure 14. The extent of flooding is exacerbated by a coincidental rainfall. It is this flooding extent that the drainage system analysis addressed.



Figure 12: CRP – Inwood Stormwater Infrastructure Project Plan



Figure 13: Flooding at Bayswater Boulevard and Walnut Road



Figure 14: Inwood – Extent of Typical Flooding

Like Cedarhurst, the concept plan presented in the Five Towns CRP included in the installation of improved backflow prevention devices and stormwater system upgrades. Additionally, upper drainage area diversion via a pressure pipe, inline detention storage and pump stations were considered.

4.2 Modeling and Results

As discussed previously, hydraulic drainage models were developed from the outfalls landward until pipe sizes were below 24 inches in diameter. The Inwood model extent, shown in Figure 15, includes three primary drainage networks: the Bayswater Boulevard line, a short line at Walnut Road, and the Chestnut Road/Maple Road network.

Potential improvements evaluated for the Inwood drainage systems include backflow prevention, larger pipes, a diversion pipe from the Oak Avenue area; inline detention storage (underground), and a pump station (25 cfs).

A diversion pipe from Oak Avenue did not provide any significant flood relief due to the small drainage area at that part of the system. The length of pipe – from Oak Avenue to the bay – was also expected to be significantly costly and would pass through the Inwood Country Club property. The results of the analysis are presented in Table 2.



Figure 15: Inwood Drainage Model Schematic

Table 2: Inwood Modeling Results

Bayswater Boulavard					Alternative 1	Alternative 2	Alternative 3
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention	Storage @ Ramp	25 CFS Pump
1 Inch	4.2	-0.9	4.5	5.3	0.1	-0.8	-0.5
2 Inch	4.2	0.5	4.5	5.3	4.5	1.5	2.2
1 Year	4.2	1.3	4.4	5.3	5.2	2	2.6
10 Year	4.2	3.9	4.4	5.3	5.3	3.5	5.2
Walnut Road							
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention		
1 Inch	3.4	-0.1	4.4	5.4	-0.1		
2 Inch	3.4	0.3	4.4	5.4	3.5		
1 Year	3.4	0.5	4.4	5.4	3.6		
10 Year	3.4	1	4.4	5.4	3.6		
Chestnut Road							
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention		
1 Inch	4.7	1.1	4.4	5.4	1.4		
2 Inch	4.7	1.4	4.4	5.4	4.9		
1 Year	4.7	1.8	4.4	5.4	5.1		
10 Year	4.7	3.7	4.4	5.4	5.1		
Maple Road							
Rain Event	Ground Elevation (ft)	Low Tide	Tide Cycle	Coincidental Rain/Tide	Coincidental Backflow Prevention		
1 Inch	4.7	0.5	4.4	5.4	1.5		
2 Inch	4.7	1.1	4.4	5.4	4.9		
1 Year	4.7	1.6	4.4	5.4	5.1		
10 Year	4.7	2.3	4.4	5.4	5		

Notes: (1) Elevations in Feet NAVD88.
(2) Tidal cycle and coincidental flooding based on 5.39 ft NAVD (estimated) spring tide.
(3) Colored cells represent improvements in flooded conditions.

4.3 Proposed Inwood Improvements

4.3.1 Overview

Based on model results, the following improvements are proposed to limit recurring flooding within Inwood:

1) **Backflow Prevention:** The installation of backflow prevention devices at the outfalls at Bayswater Boulevard, Walnut Road and the Chestnut Road/Maple Road system. These outfalls are shown in Figures 16 through 18.



Figure 16: Walnut Road Outfall



Figure 17: Maple Road Outfall



Figure 18: Bayswater Boulevard Outfall

2) **Pipe Improvements:** Pipe size improvements were evaluated for the Inwood drainage networks; however, they did not result in measurable changes in flood conditions. The Bayswater line is already large (42-inch) and additional capacity will not measurably improve conditions during high tide events.

3) **Inline Storage:** Additional inline detention was considered for the Bayswater Boulevard drainage line; however, open space is limited. Therefore, an underground system was considered, located under the Town of Hempstead's Inwood Marina parking lot. This underground detention structure would be 70 feet by 130 feet, with a depth of approximately 3 feet. The bottom would be perforated to allow for infiltration. Due to the narrow size of the drainage area, this improvement does store a sufficient quantity of runoff to reduce flood elevations. An acceptable real estate agreement would be needed to allow for installation and periodic maintenance of the facility. The proposed layout is shown in Figure 19.

4) **Pump Station:** A pump station at the end of Bayswater Boulevard would help alleviate much of the recurring flooding along that roadway. A 25 cfs pump eliminated much of the Bayswater flooding up to the 10-year flood event. However, space for a pump station is a concern. There appears to be adequate space on the Inwood Marina property; however, like the detention basin, an acceptable real estate agreement would be needed to allow for periodic maintenance of the station. The proposed pump station layout is shown in Figure 20.

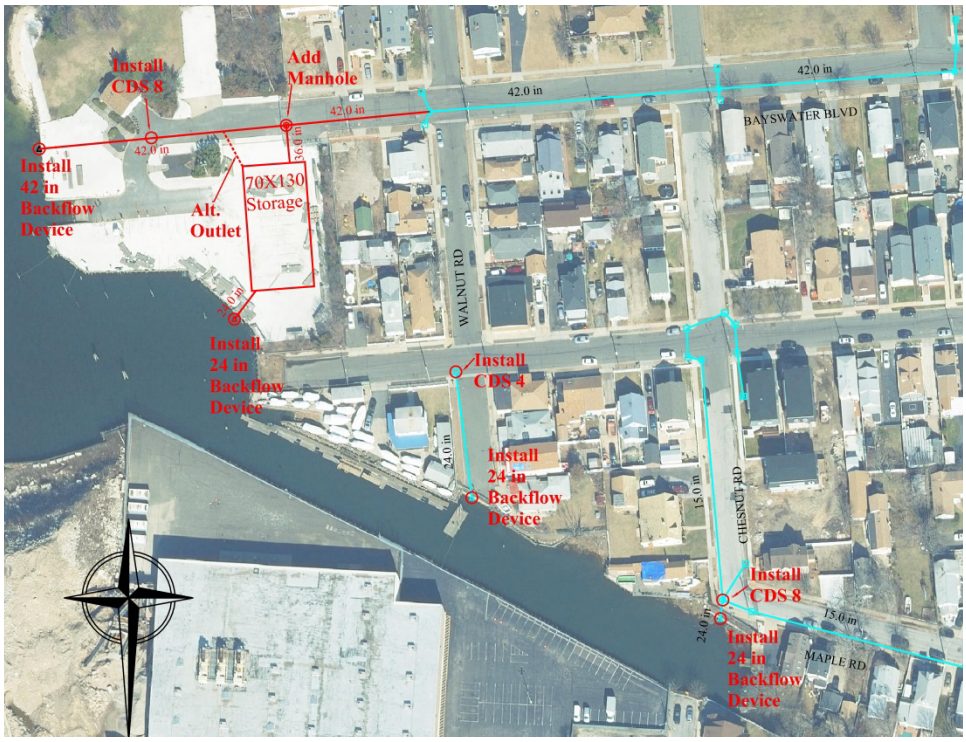


Figure 19: Inwood Stormwater Detention Plan



Figure 20: Inwood Proposed Pump Station

4.3.2 Expected Performance

Installation of effective backflow prevention should significantly limit flooding as a result of tidal surcharging, which is experienced monthly. Furthermore, limiting the surcharging of the drainage network will allow for increased runoff storage in the empty pipes. The result is expected to be a significant reduction in recurring flooding in most areas up to the 10-year rainfall event.

A detention basin under the Inwood Marina parking lot is also a feasible plan.

The installation of a pump station will further improve flooding conditions up to the 10-year rainfall event (5.1" rainfall in 24 hours) and limited improvement is expected for lower frequency events.

4.3.3 Estimated Benefits

Stormwater infrastructure upgrades in the Inwood section of the Town of Hempstead would significantly reduce the frequency and severity of flooding along Bayswater Boulevard and the cross streets of Walnut Road and Chestnut Road. Traffic risks associated with large ponding area would be reduced. Emergency access to areas previously flooded on a recurring basis would be improved. Nuisance/recurring flooding of the cross-streets and driveways would be reduced or eliminated except for some of the larger rainfall events, significantly improving residents' peace of mind.

5.0 HAMLET OF WOODMERE DRAINAGE ASSESSMENT

5.1 Stormwater Drainage Problems

During periods of heavy rains and high elevations of Cedar Point Lake (CPL), the capacity of the stormwater drainage system in Woodmere is exceeded and water backs up from the stormwater system into the streets causing localized flooding and pooling of water on roadways. Reported problem areas include: Derby, Church, Barnard, and Arbuckle Avenues; Ibsen Street, Howard Ave, Island Ave, Jefferson Street, King Street, Lowell Street and Moore Street, Lakeside Drive, Rica Lane, Midway, Norman Way, Donald Lane and Saddle Ridge Road; in addition to Golf Drive and the north-south corridors that connect to Golf Drive. These areas were identified in the Woodmere Stormwater Infrastructure Upgrades project in the March 2014 Five Towns CRP (Figure 21). The extent of flooding is exacerbated by a coincidental rainfall.

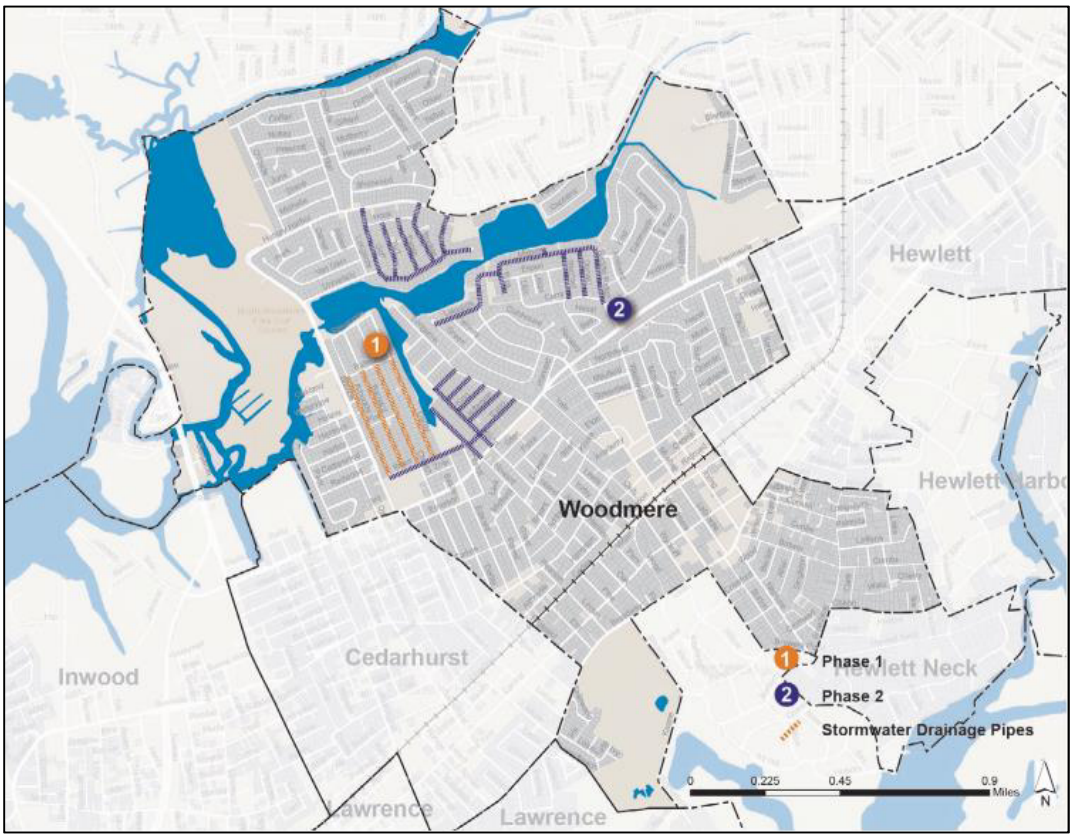


Figure 21: CRP – Inwood Stormwater Infrastructure Project Plan

In a three-day period in October, 2005, the region experienced almost 14 inches of rainfall. This event exceeded the 100-year rainfall and resulted in the overflow of CPL and extensive flooding in the surrounding area, as shown in Figures 22 and 23. Flooding from an event of this magnitude is not addressed directly in this analysis. However, large events which quickly fill the lake impact other areas of Woodmere through backwater surcharging and flooding and backwater surcharging and associated flooding were addressed in the drainage analyses.



Figure 22: Flooding at Longacre Boulevard (North from Peninsula Boulevard), October 2005



Figure 23: Flooding at Cedar Point Lake, from Tide Gate, October 2005

5.2 Cedar Point Lake Plans

5.2.1 Introduction

CPL is a man-made waterbody at the mouth of Motts Creek. The primary drainage areas to the lake include Motts Creek, Fosters Brook and Doxey Brook, as well as a couple of other smaller tributaries. At the mouth of the lake are a set of tide gates and a pump station. The tide gates regulate flow to Jamaica Bay (via Head of Bay) and limit tidal backflow into the lake. The gates, initially installed in the 1950's consist of five tide flap gates backed up with five manually–operated sluice gates. The tide gates are functional; however, the sluice gates are in various states of inoperability due to minimal maintenance.

The pump station consists of four 5,750 gallon per minute (gpm) pumps or a total of approximately 50 cfs of discharge.

5.2.2 October 2005 Storm

In October, 2005, the CPL watershed experienced over 13 inches of rainfall over a 72-hour period. The intense rainfall, coupled with higher than usual high tides, resulted in widespread flooding of the lake, which was exacerbated when the pump station failed due to flood inundation. Flood elevations reached approximately 4.85 feet NAVD88, or over 5 feet above the normal lake elevation of -0.45 feet NAVD. Flooding surcharged the local stormwater drainage system in Woodmere before overtopping the lake's shoreline and flooding large portions of Woodmere.

5.2.3 2007 Analysis

Following the 2005 storm and pump station failure, Gannett Fleming (GF) conducted an analysis of the hydrology and pump station as part of a study to upgrade the pump station and make it more resilient. That study was updated in May 2008. As part of the analysis, GF conducted a water budget for the lake. Based on projected inflows from the contributing drainage areas for various events, pump station performance, and typical tidal cycles, GF concluded that the existing pump station capacity was sufficient to limit flooding in the area during large rainfall events.

Upgrades to the pump station were proposed including replacing existing equipment and elevating critical equipment to prevent shutdown and damage during high water events, such as those which occurred in 2005 and again during Superstorm Sandy in 2012.

In the spring of 2012, Nassau County was preparing to make renovations and improvements to the pump station to address the problems encountered during the 2005 storm as well as address residents' concerns about recurring flooding, which had occurred several times since 2005. The project was delayed due to Superstorm Sandy.

5.2.4 Superstorm Sandy

In October, 2012, Superstorm Sandy inundated the Five Towns area with a storm surge up to 10 feet NAVD. The tide gates were overtopped and the pump station was again damaged. As a result, Nassau County has moved forward with a plan to upgrade the pump station in line with the recommendations in the GF report. That upgrade is currently in the process of being awarded and contracted by the County.

5.2.5 Current Actions

As part of the current drainage analysis, a new hydrologic and hydraulic analysis of Doxey Brook was completed. Discharges calculated in the latest analysis were based on TR-55 methodology and are significantly greater than the discharges estimated in the GF report. A detailed routing of the discharges using inflow hydrographs, stage versus storage calculations, and various tailwater conditions was not conducted; however, it is likely that during a significant rain event with a corresponding high tide that the lake may be subject to flooding. This has been a concern of residents since the 2005 storm.

5.2.6 Proposed Improvements

The proposed improvements, most importantly the installation of backflow prevention devices, will limit surcharging of the stormwater drainage network and potential backwater flooding due to high lake levels. Additional pipe improvements will increase stormwater conveyance at critical locations and improve the drainage network performance during large events.

5.3 Modeling and Results

Three drainage systems were analyzed in Woodmere: N-3, in the vicinity of Arbuckle Avenue and Ibsen Street; N-4, in the area of Golf Drive; and N-5, near Amhurst, Westwood and Woodmere Boulevard. These areas represent three distinct systems for analysis. Like the other communities' concepts presented in the Five Towns CRP, conceptual improvements included in the installation of improved backflow prevention devices and stormwater system upgrades.

As discussed previously, hydraulic drainage models were developed from the outfalls landward until pipe sizes were below 24 inches in diameter. The Golf Drive drainage network consisted mostly of pipes

smaller than 24 inches, which were surveyed. The model schematics for each area, considerations, and results are presented in the following section.

5.3.1 Woodmere N-3

The Woodmere N-3 drainage area included primary networks along Arbuckle Avenue and its cross streets, and extended to Howard Avenue. A separate line ran between Island Avenue and Longacre Avenue. A schematic of the model is shown in Figure 24.

Drainage issues in this area of Woodmere noted in the CRP and discussed by local officials seemed to stem mostly from backwater flooding from CPL during periods when the rainfall was coincidental with high lake elevation, which is usually temporary due to the tide gate and pump station performance at Branch Avenue. To better understand the drainage network performance, the network was modeled under two conditions: (1) with a normal, static lake level of -0.45 feet NAVD88, and (2) with the lake under a moderate flooding condition of 2.6 feet NAVD88 (+3 feet). The approximate 100-year flood elevation, experienced in 2005 and noted in Figures 22 and 23 above, is approximately 4.9 feet NAVD88.

In most cases, the drainage network functions normally with little or no flooding during normal lake conditions. Some surcharging occurs under an elevated lake condition, which may be alleviated through the installation of backflow prevention devices at outlets such as at Arbuckle Avenue, shown in Figure 25.



Figure 24: Woodmere N-3 Drainage Model Schematic



Figure 25: Arbuckle Avenue Outfall in Cedar Point Lake

Under extreme flooding conditions due to runoff, such as experienced in October 2005, flooding from the lake will inundate the areas shown in Figures 26 and 27. The installation of backflow prevention devices will help to limit most of this inundation.



Figure 26: Woodmere N-3 – Extent of Flooding near Arbuckle Avenue, 100-year Event



Figure 27: Woodmere N-3 – Extent of Flooding near Island Avenue, 100-year Event

Table 3 shows the results of the Woodmere N-3 analysis. As shown in the table, the installation of backflow prevention devices will help alleviate much of the coincidental flooding experienced in the area even during moderate lake flooding, up to the 10-year rainfall event. Increasing pipe sizes at various locations throughout the network will help alleviate flooding at the 10-year event and larger; however, the primary factor in improved drainage network performance is the elimination of system surcharging.

Table 3: Woodmere (N-3) Modeling Results

Arbuckle Road						
	Existing			Alternative 1		Alternative 2
Rain Event	Ground Elevation (ft NAVD)	Normal Lake (-0.45 ft)	Coincidental Lake (2.6 ft)	Normal Lake Back Flow Prevention	Coincidental Lake Back Flow Prevention	Increase Pipe Size with Back Flow Prevention
1 Inch	3.7	-0.4	2.7	-0.5	2.5	NA
2 Inch	3.7	2.6	3.6	2.2	2.8	NA
1 Year	3.7	4.4	4.5	3.8	3.4	NA
10 Year	3.7	5.2	5.2	5	3.5	2.5

Raleigh Street						
	Existing			Alternative 1		Alternative 2
Rain Event	Ground Elevation (ft NAVD)	Normal Lake (-0.45 ft)	Coincidental Lake (2.6 ft)	Normal Lake Back Flow Prevention	Coincidental Lake Back Flow Prevention	Increase Pipe Size with Back Flow Prevention
1 Inch	3.5	0	2.7	0	2.6	NA
2 Inch	3.5	0.8	3.6	0.3	3.2	NA
1 Year	3.5	1.6	3.7	0.7	3.3	NA
10 Year	3.5	3.8	3.8	1.6	3.4	2.8

Barnard, Ibsen, and Howard Outlet Backyard						
	Existing			Alternative 1		Alternative 2
Rain Event	Ground Elevation (ft NAVD)	Normal Lake (-0.45 ft)	Coincidental Lake (2.6 ft)	Normal Lake Back Flow Prevention	Coincidental Lake Back Flow Prevention	Increase Pipe Size with Back Flow Prevention
1 Inch	3.6	-0.5	2.7	-0.5	1	NA
2 Inch	3.6	-0.2	2.9	-0.3	2.6	NA
1 Year	3.6	0.5	3.6	0.3	3.4	NA
10 Year	3.6	3.4	4	0.5	3.8	3.2

Poe Street						
	Existing			Alternative 1		Alternative 2
Rain Event	Ground Elevation (ft NAVD)	Normal Lake (-0.45 ft)	Coincidental Lake (2.6 ft)	Normal Lake Back Flow Prevention	Coincidental Lake Back Flow Prevention	Increase Pipe Size with Back Flow Prevention
1 Inch	3.7	0.1	2.7	0	2.6	NA
2 Inch	3.7	2.6	3.6	0.6	3.3	NA
1 Year	3.7	4.5	4.6	1.2	3.4	NA
10 Year	3.7	5.2	5.2	2.1	3.8	3.2

Easement Backyard						
	Existing			Alternative 1		Alternative 2
Rain Event	Ground Elevation (ft NAVD)	Normal Lake (-0.45 ft)	Coincidental Lake (2.6 ft)	Normal Lake Back Flow Prevention	Coincidental Lake Back Flow Prevention	Increase Pipe Size with Back Flow Prevention
1 Inch	6.1	-0.4	3.1	-0.4	2.6	NA
2 Inch	6.1	3.5	3.6	2.9	3.4	NA
1 Year	6.1	4.1	4.4	3.7	4.2	NA
10 Year	6.1	5	6.4	2.8	5	4.5

Notes: (1) Elevations in Feet NAVD88.
(2) Normal lake elevation of -0.45 feet NAVD88; high water elevation of 2.6 feet NAVD88 for modeling.
(3) Colored cells represent improvements in flooded conditions.

5.3.2 Woodmere N-4

The Woodmere N-4 drainage area included the primary network north of CPL at Golf Drive, Turf Road, and Bunker Road. A schematic of the model is shown in Figure 28.



Figure 28: Woodmere N-4 Drainage Model Schematic

Similar to the Woodmere N-3 areas, the flooding in the Golf Drive/Bunker Road area seemed to stem mostly from backwater flooding from CPL during periods when the rainfall was coincidental with high lake elevation, which are temporary due to the tide gate and pump station performance at Branch Avenue. Similar to N-3, the N-4 network was modeled under two conditions: (1) with a normal, static lake level of -0.45 feet NAVD88, and (2) with the lake under a moderate flooding condition of 2.6 feet NAVD88. The approximate 100-year flood elevation is not shown for this area; the area is not subject to measurable flooding during an event similar to the October 2005 storm.

In most cases, the drainage network functions normally with little or no flooding during normal and high lake conditions. Some surcharging occurs under an elevated lake condition, which can be alleviated through the installation of backflow prevention devices at outlets such as at Bunker Road, shown in Figure 29, which is partially submerged under normal conditions.



Figure 29: Bunker Road Outfall in Cedar Point Lake

Although the need for drainage improvements in the N-4 area were noted in the 2014 CRP, modeling developed from survey and terrain information collected for the N-4 area of Woodmere does not support the need for any additional measures beyond the installation of backflow prevention devices to address potential flooding issues by eliminating surcharging and the loss of stormwater storage. However, the systems were modeled as unblocked and flowing full. As shown in Figures 30 and 31, the pipes are older pipes, partially submerged depending on lake conditions and partially blocked with silt. The installation of backflow prevention devices will include cleaning the ends and ensuring the backflow preventers are installed unhindered. The backflow prevention devices will likely help to limit inundation from events larger than the 10-year event, although these were not modeled. The results of the drainage analysis are shown in Table 4.



Figure 30: Golf Drive and Turf Road Outfall



Figure 31: Golf Drive and Eagle Drive Outfall

Table 4: Woodmere (N-4) Modeling Results

Golf Drive			
		Existing	
Rain Event	**Ground Elevation (ft.)**	**Normal Lake Elevation (-0.45 ft NAVD)**	**Coincidental Static Lake Elev./Rain**
1 Inch	6.3	0.3	3
2 Inch	6.3	1.1	3
1 Year	6.3	1.4	3
10 Year	6.3	2.2	5.1
Turf Road			
		Existing	
Rain Event	**Ground Elevation (ft.)**	**Normal Lake Elevation (-0.45 ft NAVD)**	**Coincidental Static Lake Elev./Rain**
1 Inch	6.4	0.8	3
2 Inch	6.4	1.2	3
1 Year	6.4	1.5	3
10 Year	6.4	2	5.1
Bunker Road			
		Existing	
Rain Event	**Ground Elevation (ft.)**	**Normal Lake Elevation (-0.45 ft NAVD)**	**Coincidental Static Lake Elev./Rain**
1 Inch	5	-0.4	2.6
2 Inch	5	-0.2	2.6
1 Year	5	0.1	3.2
10 Year	5	2.4	4.4
Golf Court			
		Existing	
Rain Event	**Ground Elevation (ft.)**	**Normal Lake Elevation (-0.45 ft NAVD)**	**Coincidental Static Lake Elev./Rain**
1 Inch	8.6	5.3	5.4
2 Inch	8.6	5.8	5.8
1 Year	8.6	6.2	6.2
10 Year	8.6	8.2	8.2

Notes: (1) Elevations in Feet NAVD88.
(2) Normal lake elevation of -0.45 feet NAVD88; high water elevation of 2.6 feet NAVD88 for modeling.

5.3.3 Woodmere N-5

The Woodmere N-5 drainage area included the primary network along Midway Street, Norman Way, and Amherst Drive. A schematic of the model is shown in Figure 32.

This area is included in the CRP as an area of potential improvement; however, like N-3, concerns seemed to stem mostly from backwater flooding from CPL during periods when the rainfall was coincidental with high lake elevation, which are temporary due to the tide gate and pump station performance at Branch Avenue. Like the other Woodmere areas, the network was modeled under two conditions: (1) with a normal, static lake level of -0.45 feet NAVD88, and (2) with the lake under a moderate flooding condition of 2.6 feet NAVD88. The approximate 100-year flood elevation, experienced in 2005 and noted in Figure 33, was approximately 4.85 feet NAVD88.



Figure 32: Woodmere N-5 Drainage Model Schematic



Figure 33: Woodmere N-5 – Extent of Flooding near Saddle Ridge Road, 100-year Event

Like the N-3 drainage areas, in most cases, the drainage network functions normally with little or no flooding during normal and high lake conditions. Some surcharging occurs under an elevated lake condition, which can be alleviate through the installation of backflow prevention devices at outlets such as at Norman Way, shown in Figure 34.



Figure 34: Norman Way Outfall in Cedar Point Lake

The Midway Street/Saddle Ridge Road outfall was severely overgrown/submerged and could not be located.

Cleaning and clearing of brush and sediment, and the installation of backflow prevention devices is warranted at the N-5 outfalls; however, the rim elevations upstream of the outfalls are above typical flood levels in CPL – the lowest being 3.9 feet on Saddle Ridge Road, which would limit flooding under most conditions. Therefore, more robust drainage improvements are not warranted. This is shown in the results of the drainage analysis are shown in Table 5.

Table 5: Woodmere (N-5) Modeling Results

Amhurst to Saddle River Outlet				Alternative 1	Alternative 1	Alternative 2	Alternative 2
		Existing		Back Flow Prevention	Backflow Prevention	Increase Outlet Pipe	Increase Outlet Pipe
Rain Event	Ground Elevation	Normal Lake (-.045 ft NAVD)	Coincidental Lake (2.6 feet NAVD)	Normal Lake	Coincidental Lake	Normal Lake	Coincidental Lake
1 Inch	4.5	-0.4	2.6	-0.4	2.8	-0.4	2.6
2 Inch	4.5	2.1	3.3	1.7	4.4	1.4	3.8
1 Year	4.5	4.6	4.8	4.6	4.6	3.9	4.2
10 Year	4.5	5.1	5.2	5.1	5.2	5	4.9
Norman Way				Alternative 1	Alternative 1	Alternative 2	Alternative 2
		Existing		Back Flow	Backflow Prevention	Increase Outlet	Increase Outlet
Rain Event	Ground Elevation	Normal Lake (-.045 ft NAVD)	Coincidental Lake (2.6 feet NAVD)	Normal Lake	Coincidental Lake	Normal Lake	Coincidental Lake
1 Inch	4.4	-0.4	1	-2.4	-2.4	-1.8	-1.8
2 Inch	4.4	-0.4	2.6	-0.4	2.8	-0.4	2.6
1 Year	4.4	0.8	2.7	-0.4	3.6	0.2	3
10 Year	4.4	1	3.2	-0.2	3.6	0.2	3.4

Notes: (1) Elevations in Feet NAVD88.
(2) Normal lake elevation of -0.45 feet NAVD88; high water elevation of 2.6 feet NAVD88 for modeling.
(3) Colored cells represent improvements in flooded conditions.

5.4 Proposed Woodmere Improvements

5.4.1 Overview

Based on model results, the following improvements are proposed to limit recurring flooding within areas of Woodmere adjacent to CPL:

1) **Backflow Prevention:** The installation of 16 backflow prevention devices at all outfalls at CPL. These outfalls are shown in Figures 35 through 37.

2) **Pipe Improvements:** Pipe size improvements were evaluated for the Woodmere networks, primarily for the final pipe reach from the terminal manhole to the outfall, which is most often the controlling drainage feature. Improvements in pipe size will improve conveyance from the drainage network and limit flooding.

   Flooding conditions are improved in the N-5 area through outfall pipe size improvements. In area N-3, pipe improvements provide some flood elevation reduction at the 10-year event and may be considered. Proposed pipe improvement locations are shown in Figures 38 and 39.



Figure 35: Woodmere Outfalls Requiring Backflow Prevention (N3: 8 of 16)



Figure 36: Woodmere Outfalls Requiring Backflow Prevention (N4: 4 of 16)


Install Backflow Device
Install Backflow Device
Install Backflow Device
Install Backflow Device
Install CDS 4
Install CDS 4
MIDWAY
48.0 in
48.0 in
48.0 in
48.0 in
48.0 in
12.0 in
18.0 in
15.0 in
15.0 in
15



Figure 39: Woodmere Proposed Pipe Improvements (N5)

5.4.2 Expected Performance

Installation of effective backflow prevention should significantly limit flooding as a result of high lake levels and rainfall. Furthermore, limiting the surcharging of the drainage network will allow for increased runoff storage in the empty pipes. The result is significantly limiting flooding on in most areas for the larger rainfall events.

5.4.3 Estimated Benefits

The installation of backwater prevention devices in the Woodmere section of the Town of Hempstead would improve stormwater infrastructure performance around CPL. Traffic risks associated with ponding and barriers would be reduced. Emergency access during large flood events would be improved. The impact of large rainfall events, which quickly fill the lake, would be lessened, improving residents' peace of mind.

6.0 HAMLET OF HEWLETT DRAINAGE ASSESSMENT

6.1 Stormwater Drainage Problems

Drainage problem areas in the Hamlett of Hewlett include the area of Kew Road from Stevenson Road to Quay Avenue, and East Broadway near Franklin Avenue; and the area of Broadway, from Burton Avenue to Piermont Avenue, including north-south roadways in between, south along Woodside Drive and Cedar Avenue. These areas were identified in the Hewlett Stormwater Infrastructure Upgrades project in the March 2014 Five Towns CRP (Figure 40). Most of the drainage network on north side of the Hamlet of Hewlett drains to Doxey Brook. When the brook is flowing full due to heavy rainfall, outfalls (see Figures 41 and 42) are blocked and subject to brook surcharging. The extent of flooding is exacerbated by a coincidental rainfall. It is this flooding extent that the drainage system analysis addressed.

The Town of Hempstead has recently installed a 48-inch connection at East Broadway and Franklin Avenue to improve conveyance.

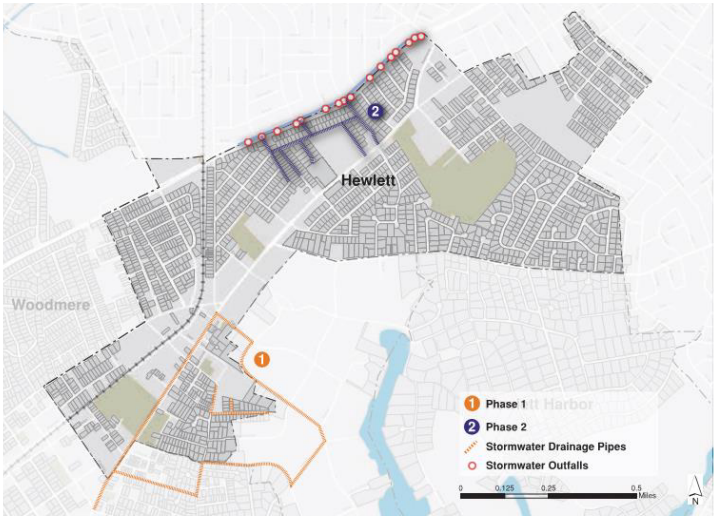


Figure 40: CRP – Hewlett Stormwater Infrastructure Project Plan



Figure 41: Quay Ave Outfall in Doxey Brook (24-inch flared)



Figure 42: Stevenson Road Outfall in Doxey Brook (15-inch)

Portions of Broadway and associated flooding are addressed in the Village of Woodsburgh assessment.

Like Woodmere, the concept presented in the Five Towns CRP included in the installation of backflow prevention devices and stormwater system upgrades.

6.2 Modeling and Results

The Hewlett model, shown in Figure 43, includes two primary drainage networks: Quay Avenue and Stevenson Road. Because the outfalls are on Doxey Brook which is often dry, a tailwater elevation had to be developed for the potentially blocked conditions. The coincidental frequency water surface elevations in Doxey Brook, in a model discussed later, were used for each event's tailwater condition. The tailwater conditions for each rainfall event are listed below:

Doxey Brook Tailwater Elevations:

1-inch rainfall = 5.75 feet NAVD
2-inch rainfall = 5.66 feet NAVD
1-year rainfall = 7.59 feet NAVD
10-year rainfall = 9.35 feet NAVD



Figure 43: Hewlett Drainage Model Schematic (Doxey Brook Area)

Potential improvements evaluated for the Hewlett drainage systems include installing backflow prevention; larger outfall pipes, and increasing the size of some drainage network pipes.

6.3 Proposed Hewlett Drainage Improvements

6.3.1 Overview

Based on model results, the following improvements are proposed to limit recurring flooding within the Village:

1) **Backflow Prevention:** The installation backflow prevention devices at the outfalls along Doxey Brook, as shown in Figure 44.
2) **Pipe Improvements:** Pipe size improvements were evaluated for the Hewlett drainage networks; several improvements to downstream pipes will allow for improved conveyance and reduced flooding, as shown in Figure 45.

6.3.2 Expected Performance

Installation of effective backflow prevention should significantly limit surcharge conditions when Doxey Brook is flooded. The increased pipe storage should improve drainage conditions in the network.

6.3.3 Estimated Benefits

Stormwater infrastructure upgrades in the Hewlett section of the Town of Hempstead would improve drainage conditions in areas adjacent to Doxey Brook.



Figure 44: Hewlett Proposed Backflow Prevention Devices



Figure 45: Hewlett Proposed Pipe Improvements

7.0 VILLAGE OF LAWRENCE DRAINAGE ASSESSMENT

7.1 Stormwater Drainage Problems

Flooding occurs in the Village of Lawrence when stormwater from rainfall events combines with the presence of tidal waters within the stormwater collection piping. The tidal waters reduce available capacity within the collection piping network and impede flow within the system until the local tidal waters recede, allowing for the return of gravity flow to the outfall. This was identified in the Lawrence Stormwater Infrastructure Upgrades project in the March 2014 Five Towns CRP and is illustrated in Figure 46. Key problem areas include Lakeside Drive, Victoria Place, Meadow Drive, Meadow Lane at Marbridge Road, North Street, and Causeway Road. A broad view of the extent of flooding during a severe high tide event with no precipitation is shown in Figure 47. The extent of flooding is exacerbated by a coincidental rainfall. It is at this flooding extent that the drainage system analysis was evaluated.



Figure 46: CRP – Lawrence Stormwater Infrastructure Project Plan



Figure 47: Lawrence Flooding Extent – 4.75 feet NAVD (Spring Tide)

7.2 Recent Actions

Recent actions taken in the Village of Lawrence preclude the need for further analysis of tidal influence in one area: Lakeside Drive. Two 48-inch culverts at Rock Hill Road have had Tideflex backflow prevention devices installed to limit tidal surge inundation of the Lakeside Drive area. The backflow prevention devices are shown in Figure 48.



Figure 48: Rock Hill Road Outfalls (Village of Lawrence)

7.3 Initial Field Investigations

Initial investigations of the focus areas were conducted to verify hydrologic and hydraulic conditions. The results of the investigations are presented below.

7.3.1 Victoria Place

Victoria Place has minimal drainage due to a relatively flat roadway. The surface elevation (using LIDAR information) is between 4.0 and 5.0 feet NAVD. There is a stormwater collection system consisting of two inlet structures connected to a 6 to 8-inch diameter outfall located on the corner of Edward Bentley Road and Albert Place. The inlet structures were filled with sand. The outfall (in need of repair per the outfall inspection report) discharges approximately one hundred feet away to the east into the adjacent marsh. Depth-to-groundwater at this location (per USGS) is estimated at less than 4 feet below grade and tidal fluctuation within the marsh could frequently be equal to the height of the drainage system. Backflow of tidal waters could compromise this drainage system and allow localized flooding at the inlet structures. In addition to maintaining existing system components, potential solutions for this area must consider groundwater elevation and the elevation of the local roads (see Figure 49).



Figure 49: Victoria Place, Lawrence

7.3.2 Lakeside Drive South

Although backflow prevention has been installed on the twin 48-inch outfalls, the Lakeside Drive system still appears to encounter flooding. The Lakeside Drive drainage system is comprised of a total of six catch basins that connect to a large diameter trunk line, which discharges approximately 490 feet to the east into Bannister Bay. The trunk line connects through a manhole at an invert of 1.00' NAVD under Lakeside Drive South and Meadow Causeway into the dual 48-inch outfalls. As noted previously, the outfalls are each protected with a duckbill backflow prevention device. The average elevation of Lakeside Drive at the inlet to the outfall system is approximately 5.5 feet NAVD with a depth-to-groundwater (per USGS) of approximately 2 feet. During the field investigation conducted on a dry day, there was visible

flow entering the inlet side of the outfall pipe. This would indicate the presence of groundwater entering the system or runoff from another source (see Figures 50 and 51).

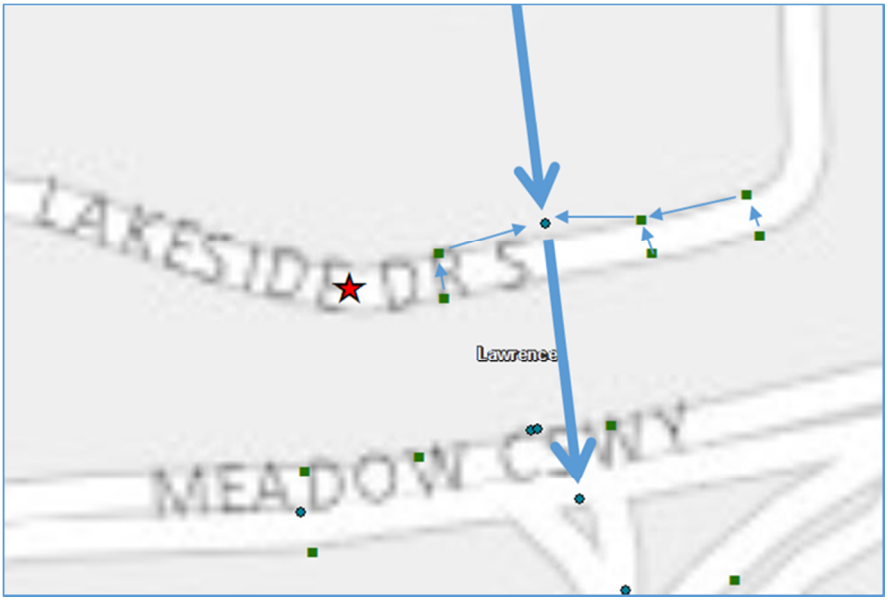


Figure 50: Lawrence Drive South, Lawrence



Figure 51: Lakeside Drive South Catch Basins

7.3.3 Meadow Drive

Meadow Drive consists of at-grade (or grade) inlets that are directly connected to a central drainage pipe traveling east to an outfall that discharges into Woodmere Channel. The last grade inlets before entering the 165 foot long buried outfall could be tidally-influenced as evidenced by standing water in the inlet structures. The outfall is not currently protected with a backflow prevention device. Any branching grade inlets that are not directly connected with the outfall are filled with sand. The average surface elevation of the area is approximately 6.5 feet NAVD with a surface-to-ground water depth of 6 feet (per USGS). During the site investigation there was a small amount of flow in the inlet side of the outfall, indicating that the system may be subject to infiltration from groundwater (see Figures 52 and 53).

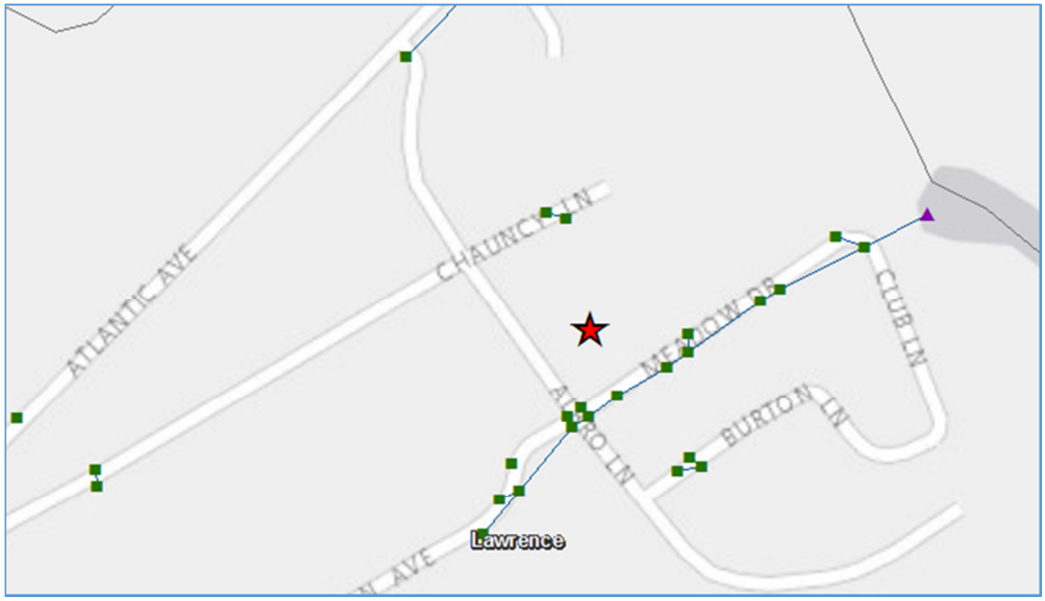


Figure 52: Meadow Drive, Lawrence



Figure 53: Meadow Drive Catch Basins

7.3.4 Marbridge Road at Meadow Lane

Marbridge Road at Meadow Lane has at-grade and curb catch basins that collect storm water flowing south to Causeway Road, then into an outfall on Bannister Bay. Inlets that are in-line with the trunk line appear to be clean, presumably due to recent upstream rainfall. Depth-to-groundwater elevation is shallow, estimated at 1-2 feet below grade (per USGS) and signs of infiltration were present in the catch basins. The surface elevation is at a sufficient elevation to not be affected by tidal influence. However, the outfall for this system (Causeway and North) is affected by tidal influence and, as already stated, it is recommended to be fitted with a backflow prevention device (see Figures 54 and 55). Despite appearing to be in good condition, the intersection of Marbridge and Meadow experiences frequent flooding, as shown in Figure 56. Further testing via dye and CCTV was warranted and conducted (see later sections).



Figure 54: Marbridge Road at Meadow Lane



Figure 55: Marbridge/Meadow Catch Basins



Figure 56: Typical Flooding at Marbridge Road

7.3.5 Meadow Lane at Broadway

Curb catch basins at this intersection appear to be filled with debris and require cleaning. The northwest catch basin on Meadow Lane has a collapsed metal grate, causing a blockage of stormwater. The surface elevation at this location is sufficiently high to not be affected by tidal influence (see Figures 57 and 58).

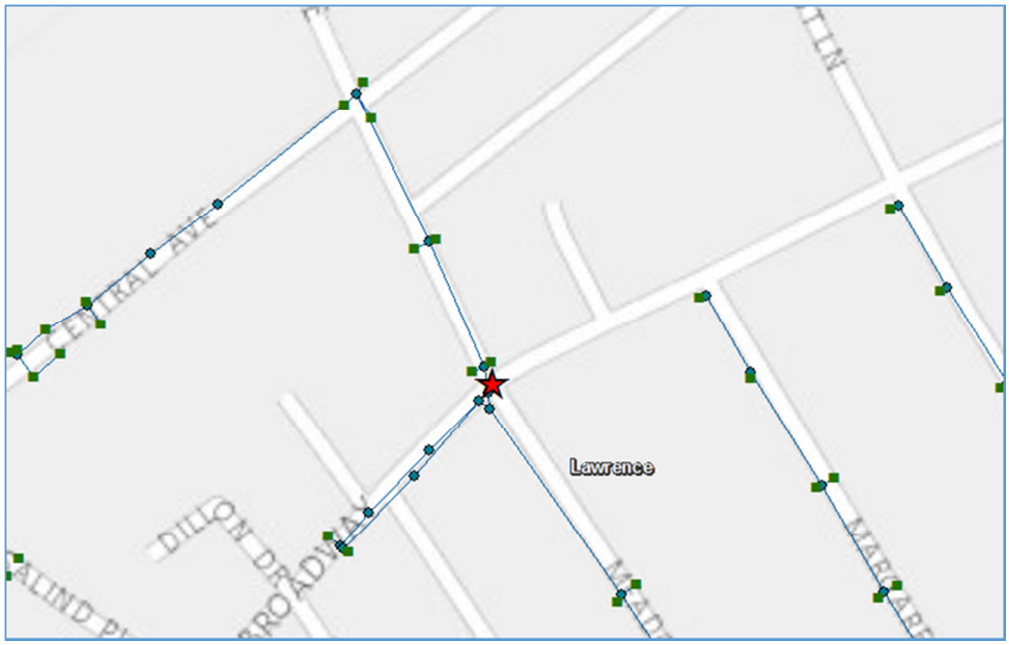


Figure 57: Meadow Lane at Broadway



Figure 58: Meadow Lane Catch Basins

7.3.6 Initial Recommendations

Initial recommendations from the field inspections included the following. These were further considered in the development of the proposed improvement plans. Maintenance issues (e.g., catch basin cleaning) were not considered as part of this analysis.

Victoria Place:

- Provide backflow prevention devices in all outfalls within the area
- Raise the road elevation above high tide elevation in an area

Lakeside Drive South:

- Clean out the trunk line (outfall pipe) from the backflow prevention devices to the inlet structures
- Clean out the catch basins to remove visible sand deposits to restore proper drainage

Meadow Drive:

- Install a backflow prevention device on the system outfall
- Grade inlets not in-line with outfall are filled with sand and should be cleaned
- Investigate inflow and infiltration of the system through CCTV inspection

Marbridge Road on Meadow Lane:

- Grade inlets not in-line with outfall are filled with sand and require cleaning
- Investigate inflow and infiltration of the system through CCTV inspection

Meadow Lane at Broadway:

- Clean out catch basins as they are filled with sand and prevent proper drainage
- Repair NW catch basin as the metal grate is blocking proper drainage

7.4 Modeling and Results

Hydraulic/hydrologic drainage models were developed from the outfalls landward until stormwater collection pipe sizes decreased to below 24 inches in diameter. Some exceptions were made for imperative pipes within the system. The Lawrence model extent, shown in Figure 59, includes a single primary drainage network starting north on Central Avenue and discharging on the southern end near Causeway Road.

A backflow prevention device on the Causeway Road outfall (Figure 60) was relocated in 2016 to the outfall of the tidal "pond" south of the network outfall. Per Village of Lawrence representatives, the movement of the backflow prevention device to the new location has reduced the influence of tidal effects on the outfall pond and has decreased the majority of the immediate tidal flooding within the stormwater system. The model was developed with a backflow prevention device at the original location; however, follow-up modeling was conducted with the backflow prevention device in the new location to verify the proposed plan to add a second backflow device at the system outfall (see next section).



Figure 59: Lawrence ("Meadow") Model Schematic



Figure 60: Relocated Tide Valve (Pond Outfall)

Potential improvements evaluated for the Lawrence stormwater drainage system include the installation of a new backflow prevention device, larger diameter pipes, an adjustments to existing piping to achieve proper drainage slopes, the addition of parallel storm water collection pipe(s), or added storage to the system. The results are presented in Table 6.

Table 6: Lawrence Modeling Results

Lawrence (Meadow) Modeling Results

Causeway Rd (MH-14)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Invert Adjust	Flooding	Backflow w/ Parallel Pipe	Flooding
1 Inch	7.43	0	4.5	4.6	NO	0.7	NO	0.3	NO	0.6	NO	-0.1	NO
2 Inch	7.43	0.6	4.5	4.6	NO	2.6	NO	3.6	NO	2.7	NO	2.8	NO
1 Year	7.43	0.9	4.6	4.7	NO	2.9	NO	3.4	NO	2.9	NO	2.7	NO
10 Year	7.43	1.3	5.4	5.6	NO	4.3	NO	4.2	NO	3.6	NO	3.5	NO

North Street (MH-5)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Invert Adjust	Flooding	Backflow w/ Parallel Pipe	Flooding
1 Inch	3.18	-3.2	4.5	4.5	YES	0.7	NO	0.3	NO	0.7	NO	-0.3	NO
2 Inch	3.18	1.4	4.5	4.8	YES	2.6	NO	3.6	YES	3.1	NO	3.1	NO
1 Year	3.18	2.3	4.5	4.8	YES	3.4	YES	3.5	YES	3.5	YES	3.2	YES
10 Year	3.18	3	4.6	4.9	YES	3.6	YES	4.2	YES	3.6	YES	3.5	YES

North Street (MH-4)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Invert Adjust	Flooding	Backflow w/ Parallel Pipe	Flooding
1 Inch	4.71	-0.7	4.5	4.5	NO	0.7	NO	0.3	NO	0.6	NO	-0.3	NO
2 Inch	4.71	5.5	5.6	5.6	YES	3.5	NO	3.7	NO	4.6	NO	5.3	YES
1 Year	4.71	5.6	5.7	6.1	YES	5.5	YES	5.6	YES	5.7	YES	5.5	YES
10 Year	4.71	5.8	5.9	6.3	YES	5.9	YES	6	YES	5.9	YES	5.7	YES

Marbridge Rd (MH-39)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Invert Adjust	Flooding	Backflow w/ Parallel Pipe	Flooding
1 Inch	5.02	1.9	5	5	NO	1.4	NO	1.4	NO	2	NO	2	NO
2 Inch	5.02	6.2	6.2	6.2	YES	6.4	YES	4	NO	6.1	YES	6.4	YES
1 Year	5.02	6.4	6.5	6.5	YES	6.5	YES	4.5	NO	6.4	YES	6.4	YES
10 Year	5.02	6.6	6.7	6.7	YES	6.7	YES	5.4	YES	6.7	YES	6.6	YES

Meadow Ln (MH-11)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Invert Adjust	Flooding	Backflow w/ Parallel Pipe	Flooding
1 Inch	7.51	0.5	5	5	NO	0.7	NO	0.3	NO	0.7	NO	0.2	NO
2 Inch	7.51	1	6.3	6.5	NO	6.4	NO	3	NO	6	NO	6.4	NO
1 Year	7.51	6.4	6.5	6.8	NO	6.5	NO	3.1	NO	6.4	NO	6.5	NO
10 Year	7.51	6.6	6.8	7.1	NO	6.7	NO	3.2	NO	6.7	NO	6.6	NO

Broadway (MH-32)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Invert Adjust	Flooding	Backflow w/ Parallel Pipe	Flooding
1 Inch	21.27	13.8	13.8	14	NO	13.8	NO	13.8	NO	13.8	NO	13.8	NO
2 Inch	21.27	14.8	14.8	15.8	NO	14.8	NO	14.7	NO	14.7	NO	14.8	NO
1 Year	21.27	15	15	16.2	NO	15	NO	14.9	NO	14.9	NO	14.9	NO
10 Year	21.27	15.3	15.3	16.7	NO	15.3	NO	15.2	NO	15.2	NO	15.2	NO

Notes:
(1) Elevations in Feet NAVD88
(2) Tidal cycle and coincidental flooding based on 5.39 ft NAVD (estimated) spring tide
(3) Colored cells represent improvements in flooded conditions

7.5 Causeway Road Outfall Backflow Prevention Analysis

The Lawrence outfall pond is a retention pond located at the Lawrence Yacht and Country Club near the intersection of North Street and Causeway Road. Retention ponds are permanent bodies of water designed to retain stormwater. Pond levels typically fluctuate in response to precipitation and inflow from pipes connecting to storm drains. This retention pond is located downstream of the main drainage system's 60-inch diameter outfall (see Figure 61) and upstream of a 60-inch diameter outfall installed underneath the golf cart path (see Figure 62).

Surrounded by natural vegetation, the retention pond receives inflow from the 60-inch diameter storm drain serving the Meadow Lane/Causeway Road area. It is drained by a 60-inch diameter culvert under the cart path. That culvert is equipped with a backflow device as it is affected by the tide differential in Bannister Bay.



Figure 61: Causeway Road 60" Outfall to Pond

Additionally, there are dual 18-inch diameter overflow pipes that pass through the cart path embankment above the top of the 60-inch diameter culvert (see Figure 62, foreground). These overflow pipes allow for tidal water to enter the retention pond during extreme tidal events; however, they do allow water to exit the retention pond into Bannister Bay when the pond becomes flooded. The overflow pipes effectively limit the pond's operating depth to a maximum of 7 feet. With a maximum depth of 7 feet, this retention pond and piping system allows for approximately one million gallons of storage.



Figure 62: Pond Outfall and 18" Overflow Pipes

A hydraulic model was developed to compare the effects on the Lawrence outfall retention pond both with and without a backflow prevention device on the Meadow Lane/Causeway Road drainage system's outfall, utilizing an approximately 5-inch (10-year) rain event. The tidal tailwater marigram applied at the outfall into Bannister Bay is seen in Figure 63.

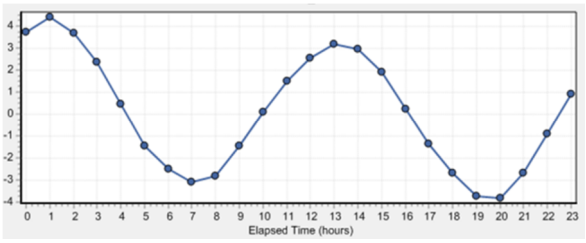


Figure 63: Typical Tidal Marigram, Bannister Bay

The existing conditions results of pond depth, pond flow in and pond flow out are shown in Figure 64.

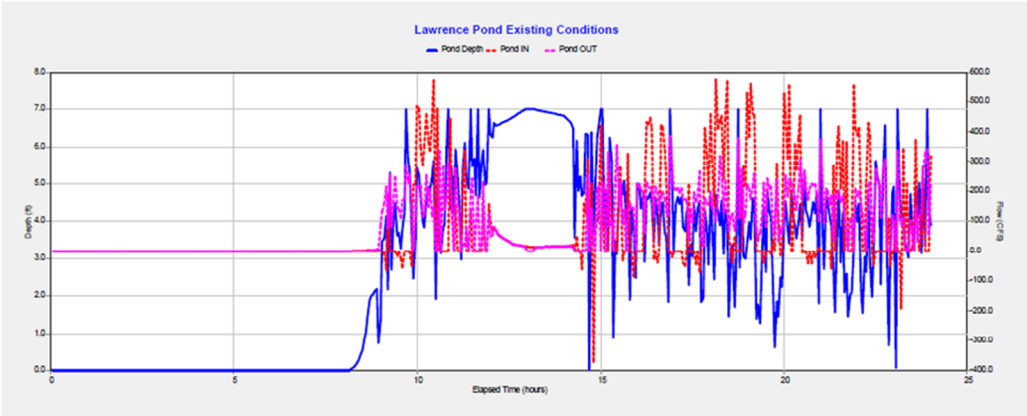


Figure 64: Pond Existing Conditions

Under existing conditions with only the existing backflow device on the 60-inch diameter retention pond outlet, the depth of the retention pond begins to fluctuate after high tide with an average value of ~4.0 feet of height.

The system was then modeled with an additional backflow prevention device on the network 60-inch outfall. The added backflow prevention device model results of pond depth, pond flow in and pond flow out are shown in Figure 65.

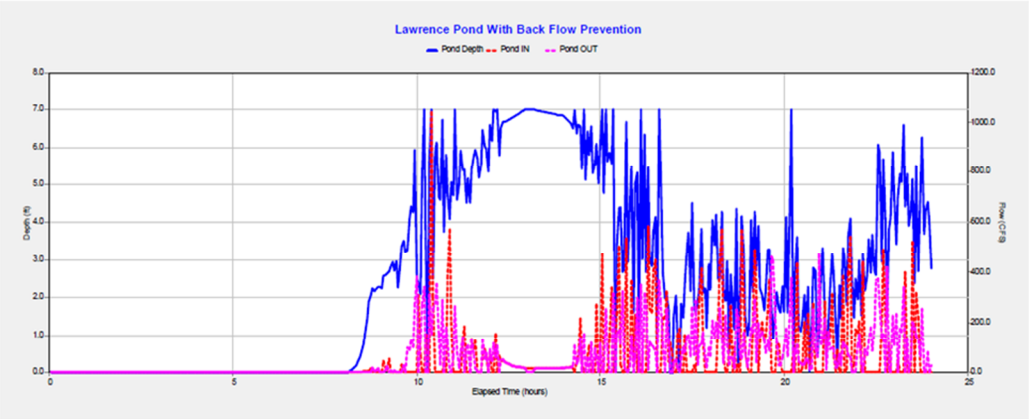


Figure 65: Pond Improved Conditions

With the backflow prevention device installed in the 60-inch diameter drainage network outfall, the average fluctuation in depth of the retention pond decreases to ~3.0 feet, with less extreme values (heights) than under existing conditions. Keeping inflow/outflow values around the same after the storm event, the proposed 60-inch diameter backflow device keeps the retention pond depth closer to equilibrium than under existing conditions.

The proposed backflow prevention device (network outfall) mitigates tidal water inflow back into the drainage system, allowing for more storage within the drainage system as well as maintaining a lower average retention pond elevation during a rain event.

7.6 Hollywood Crossing

Local residents recently complained about flooding issues at Hollywood Crossing/Barrett Road. Recent flooding of the intersection is shown in Figure 66. This area was further investigated with pipe cleaning and CCTV inspection.



Figure 66: Hollywood Crossing/Barrett Road Flooding

7.7 Additional Field Investigations

After follow-up discussions with community officials and receiving feedback from local residents, additional attention was focused on drainage issues at the intersection of Marbridge and Meadow Roads, Causeway Road, and Hollywood Crossing/Barrett Road. Nassau County and Village of Lawrence DPW staff investigated multiple locations through pipe cleaning, dye testing, and CCTV inspections.

7.7.1 Field Locating

Village officials attempted to re-verify pipe sizes and locations in the field. Field inspection markups of existing pipe networks are shown Figures 67 through 69.

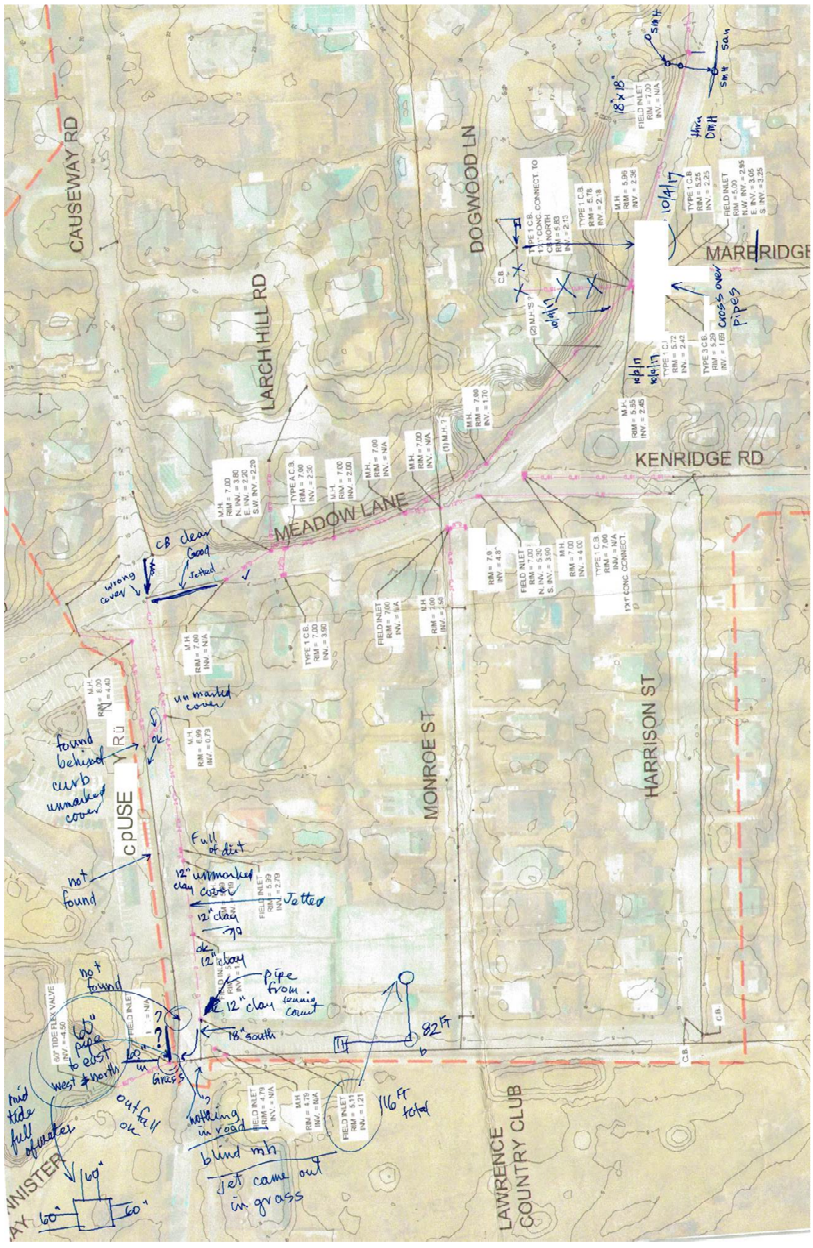


Figure 67: Field Locations Markup – Village of Lawrence

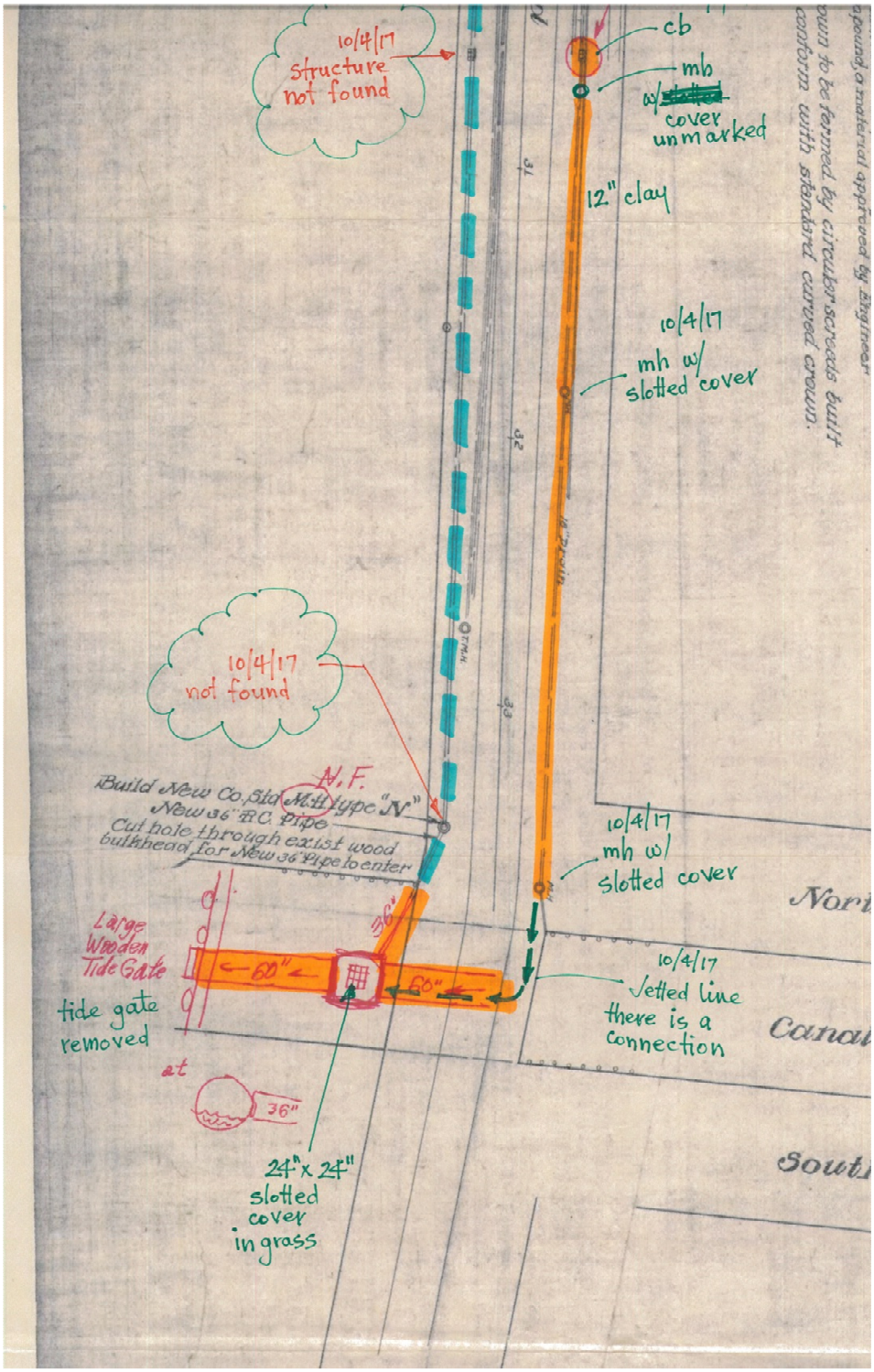


Figure 68: Field Locations Markup – Causeway Road to North Road

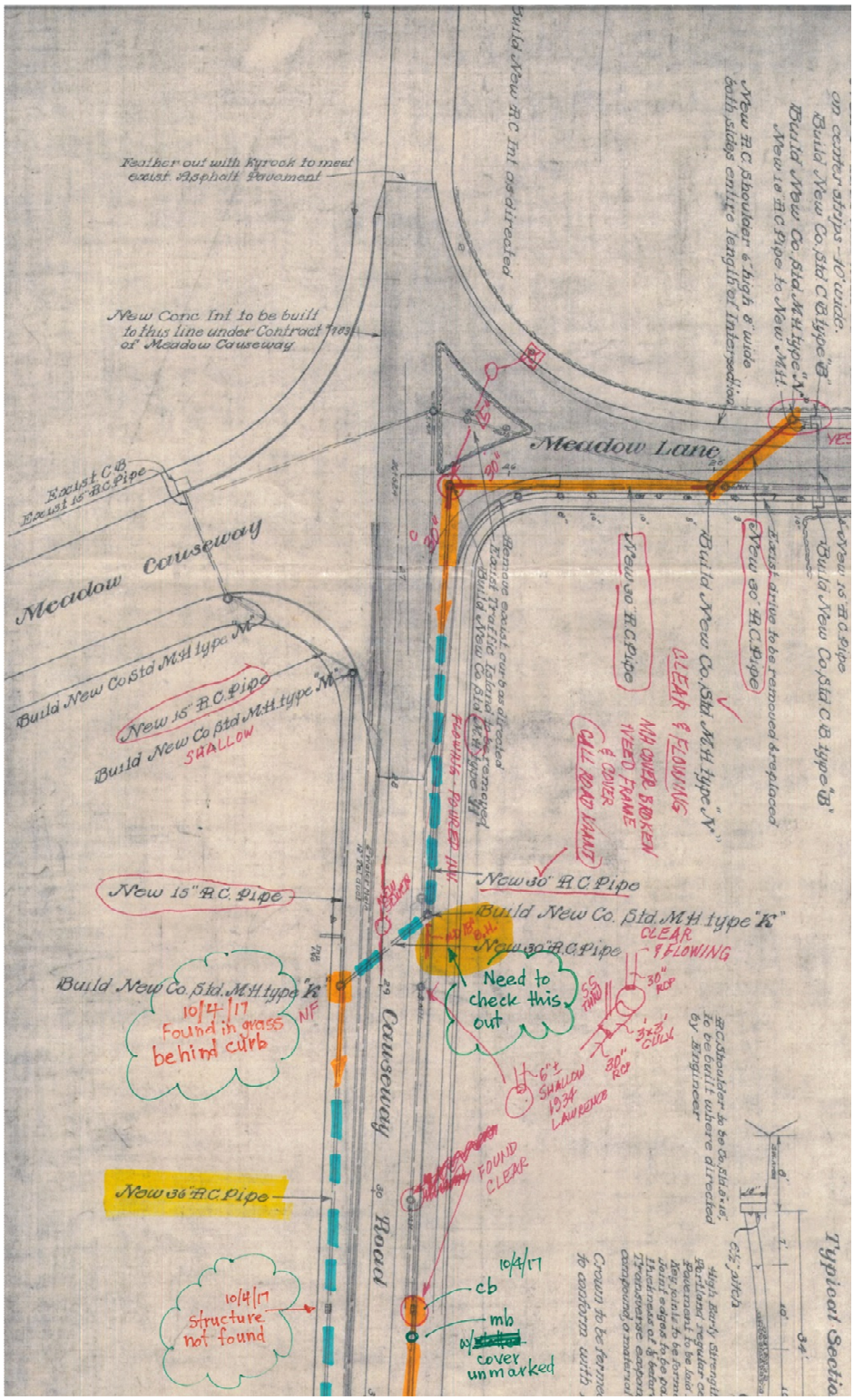


Figure 69: Field Locations Markup – Causeway Road and Meadow Lane

7.7.2 Pipe Cleaning

Prior to additional field inspections (CCTV), drainage pipes in the trouble spots in the Village of Lawrence were cleaned using a water jet truck with a hose and pressure washing sled. These areas included Marbridge Road, Meadow Lane between Marbridge Road and Causeway Road, and Causeway Road from Meadow Lane to North Street to the outfall. Additional areas cleaned were on Hollywood Crossing and Barrett Road. The pipe cleaning locations are shown in Figure 70.



Figure 70: Pipe Cleaning Locations – Village of Lawrence

Notes for the Marbridge Road cleaning are shown in Figure 71.

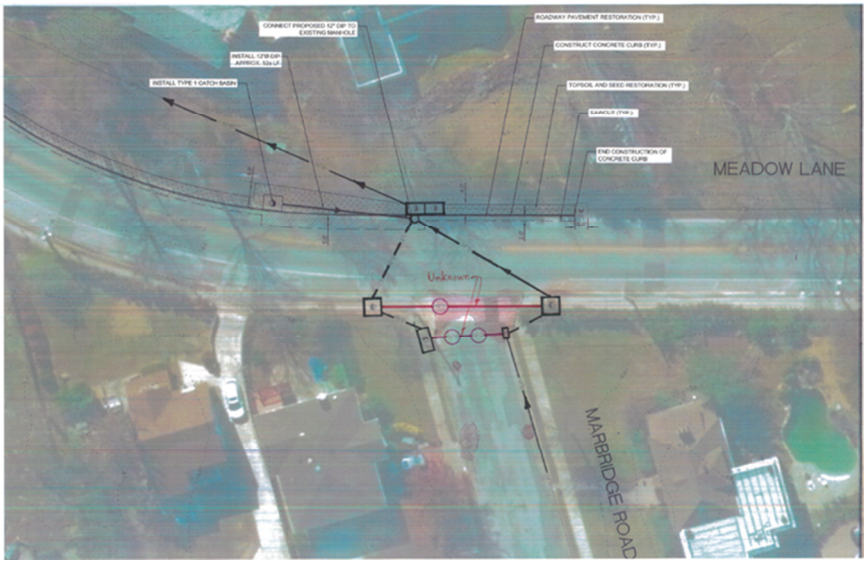


Figure 71: Pipe Cleaning Notes – Marbridge Road

7.7.3 Dye Testing

Due to concerns about the exact pipe configuration along Causeway Road and North Road, the Village conducted dye testing, which involved inserting non-toxic dye and runoff into the network to track the flowpath. Dye was added at the intersection of Causeway and Meadow Lane, about 800 feet upstream of the 60-inch outfall junction. There was a small amount of flow within the pipes to carry the dye. Initially the dye took a while to reach the first manhole but then continued downstream accordingly. There is a manhole that cannot be located (covered or paved over) right before the grate which leads to the outfall. At the grate, the dye trail was lost but this could have been due to sitting water in the basin or obstruction of flow. The jet pipe cleaning confirmed that this line is connected to the grate before the outfall; however, dye did not exit the system. The dye test was followed up with a CCTV inspection (see later section).

7.7.4 CCTV Inspections

Pipeline video inspection via closed-circuit television monitoring is a method used to visually inspect the interiors of pipelines. This is a common application to determine the condition of smaller diameter stormwater and sewer lines. The inspection is completed from a service truck, a cable and winch, and typically a tractor-mounted inspection camera, as shown in Figure 72.



Figure 72: Typical Tractor-Mounted CCTV Inspection Camera

Over the course of three days, approximately 4,500 linear feet of stormwater piping was inspected at locations of known flood-prone site locations, unconfirmed piping configurations, and cleaned areas that were not confirmed. These inspected areas are shown in Figure 73 and included:

- All stormwater collection structures at the corner of Marbridge Road and Meadow Lane,
- The main stormwater pipe on Meadow Lane (between Marbridge Road and Causeway Road),
- The main stormwater pipe on Causeway Road (from Meadow Lane to North Street at the outfall),
- The corner of Monroe Street and North Street,
- The corner of Harrison Street and North Street,
- The main stormwater pipe on Harrison Street,
- The main stormwater pipe under the golf course (starting at Barrett Road and Bayberry Road),
- The connected pipes at the intersection of Hollywood Crossing, Washington Avenue and Barrett Road.



Figure 73: CCTV Inspection Locations

7.7.5 Field Inspection Results

The CCTV inspection revealed a number blocked pipe conditions impacting stormwater flow. These conditions are discussed below.

Marbridge Road and Meadow Lane:

At the corner of Marbridge Road and Meadow Lane, two pipes (18" diameter and 12" diameter) were found to be collapsed. Otherwise, pipes in this area are in good condition. Catch basins need to be cleaned from debris. The Marbridge Road inspection notes are shown in Figure 74.



Figure 74: Marbridge Road – CCTV Notes

Although the 18" diameter and 12" diameter pipes are cross-connections between catch basins, their repairs could help limit flooding in this particular area. A covered structure was found between two catch basins on Meadow Lane; this structure cannot be accessed from the street and adds another pipe into the main line across the street. The notes indicate the location of the 12" diameter collapsed pipe (see Figure 74). The obstructions at the locations shown in Figure 74 are shown in Figure 75.



Figure 75: Marbridge Road Obstructions

Along Meadow Lane, there was an obstruction in a manhole along the 30" diameter pipe run. Otherwise, pipes in this area are in good condition and catch basins need to be cleaned from debris. As shown in the photos (Figure 76), a wooden plank was restricting flow downstream, as well as collecting debris during low flow periods. Removing the plank allowed for flow to move downstream and flushing of the debris collection.



Figure 76: Meadow Lane Manhole Debris

Also, along Meadow Lane there was a utility pipe constricting the flow area of a 36" diameter pipe crossing the street, and allowing for debris to build up within the collection system. The figures below display the location of the constricted pipe (Figure 77) and an image of pipe interior (Figure 78).

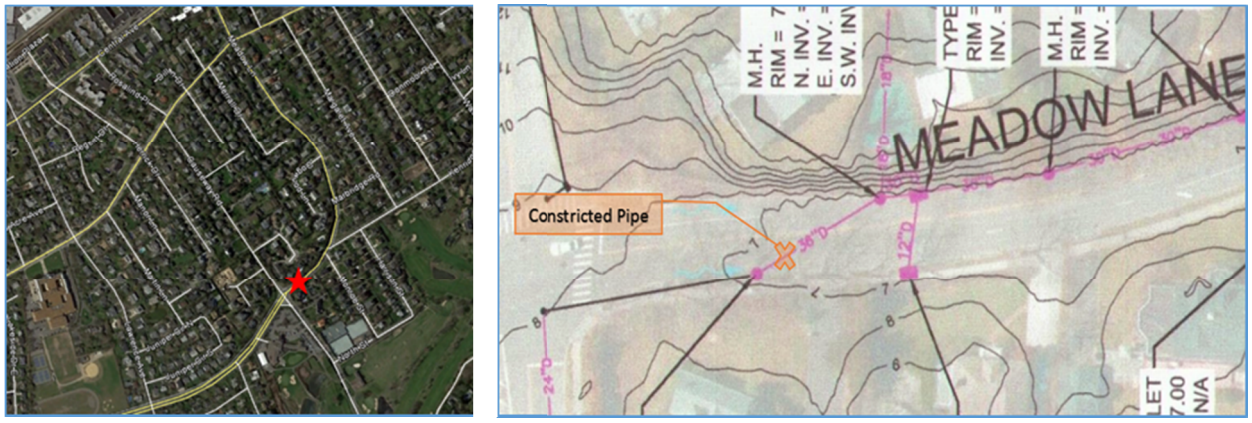


Figure 77: Meadow Lane Pipe Constriction Location



Figure 78: Meadow Lane Pipe Constriction - Utility Pipe

Causeway Road:

Along Causeway Road, there was a utility pipe constricting the flow area of a 36" diameter pipe crossing the street, and allowing for debris to build up within the collection system. The location is shown in Figure 79. The blockage is shown in Figure 80.

Also along Causeway Road, closer to the 60" diameter outfall, there is a 10" diameter incoming pipe along the main 36" diameter pipe. The 10" diameter incoming pipe introduces a large root, which constricts flow. The manhole for this pipe is covered, and prevents access for clearing this pipe. The location of the root constriction is shown in Figure 81. Pipe photos are shown in Figure 82.

The last three joints along the 36" diameter pipe before the outfall grate are largely offset, as shown in Figure 83. This should be repaired, as it could be introducing infiltration from groundwater within the system as well as roots. This intrusion could restrict flow and cause larger offsets.



Figure 79: Causeway Road Pipe Constriction Location



Figure 80: Causeway Road Pipe Construction

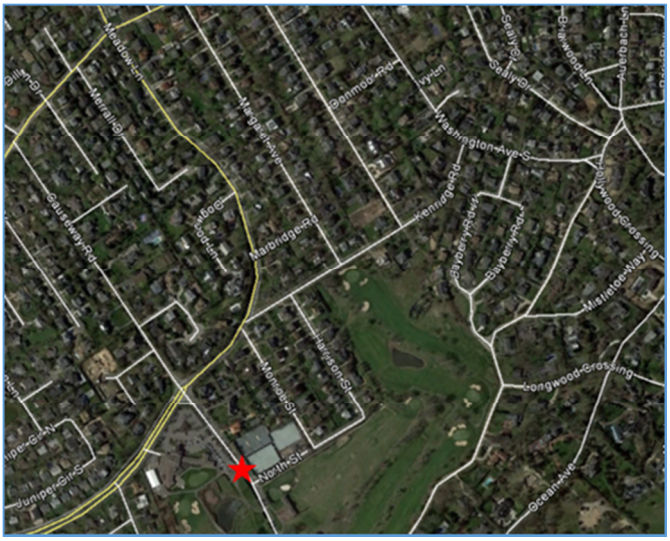


Figure 81: Causeway Road Pipe Constriction – Root



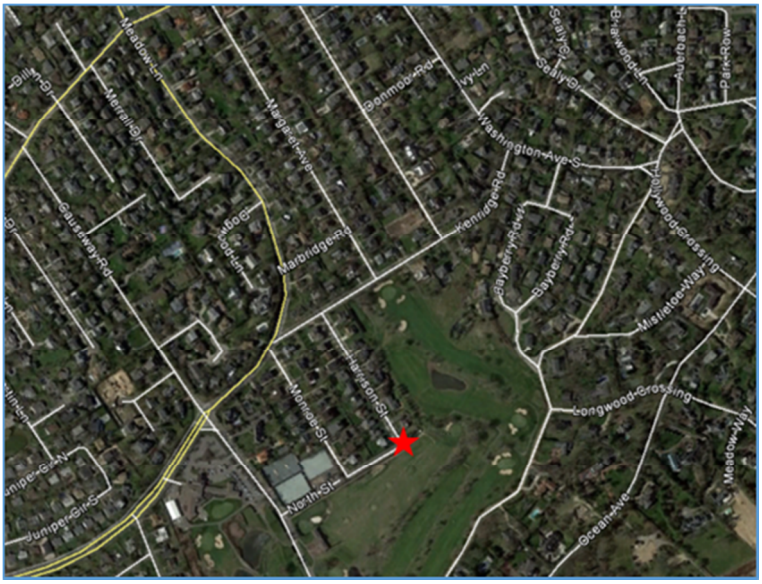
Figure 82: Causeway Road Pipe Constrictions – Covered Access



Figure 83: Causeway Road Pipe Offset

Harrison Street and North Street:

On the corner of Harrison Street and North Street, there are two catch basins collecting to an 8" diameter pipe, which flows into the covered culvert before the outfall. The 8" diameter pipe has many joint offsets, causing the pipe to stagger (see Figure 85). The pipe also has a broken piece which, with the offsets, collectively allows for groundwater infiltration. The stagger of the pipe did not allow for further inspection, and the survey was terminated.


Meadow Ln
Merrain Rd
Gaylord Rd
Gaylord Dr
Gaylord Pl
Gaylord Rd
Gaylord Rd
Gaylord Rd

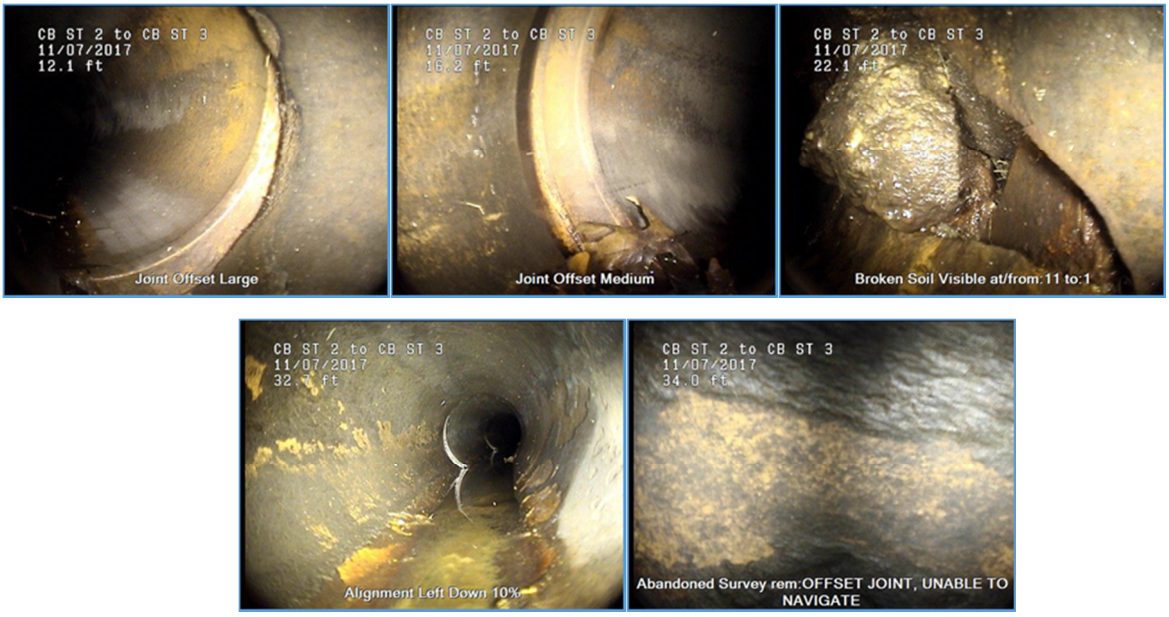


Figure 85: Harrison and North Street Offsets

There is a 36" diameter pipe running down Harrison Street that collects from the northern catchments of the system. Two manholes on Harrison Street are covered, not allowing access to the pipe. This has caused an abandoned inspection of the covered culvert, as it was unreachable. It is recommended to fix these manhole access points in order for further inspection of the covered culvert.

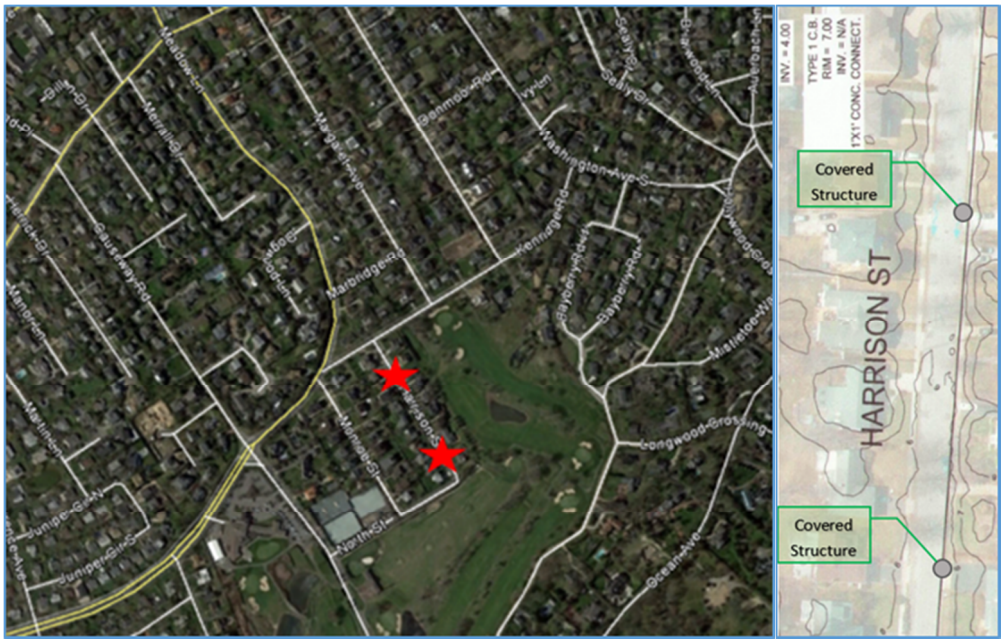


Figure 86: Harrison Street Manhole Locations



Figure 87: Harrison Street System – Blocked Access

Golf Course - Barrett Road Connection:

There is a 24" diameter pipe that connects from Barrett Road to North Street underneath the golf course. This pipe is overwhelmed with mud; the survey inspection was terminated ~200" into the inspection. It is recommended that this pipe is cleaned out thoroughly, as it is the connection of the eastern and western parts of the system where the outfall is.

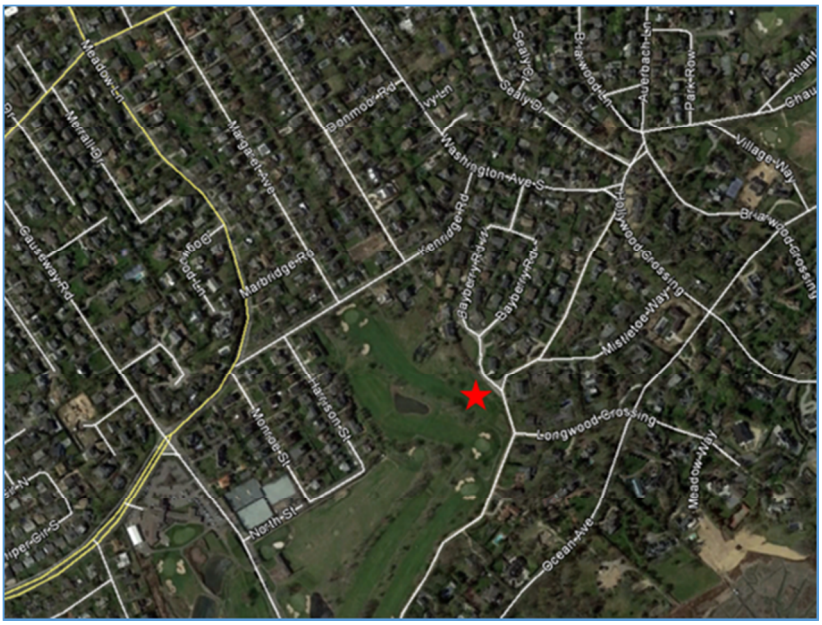


Figure 88: Golf Course Constricted Pipe Location

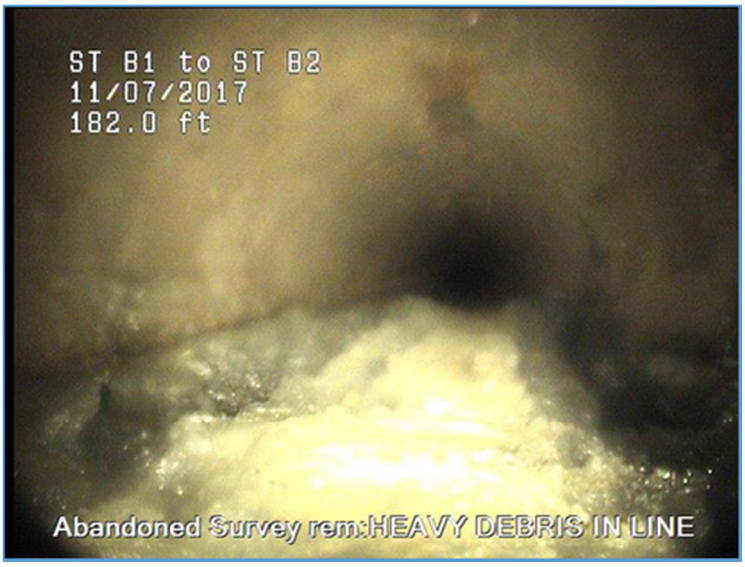


Figure 89: Golf Course Pipe Debris

Barrett Road:

Along Barrett Road, before Hollywood Crossing, there is a utility pipe that constricts the flow area of a 10" diameter pipe crossing Barrett Rd. This utility pipe allows for debris to build up and constricts the flow collected on the east side of the street (see Figures 90 and 91). In general, the pipes/catch basins in this area need to be cleaned, as there is significant debris build-up that is constricting the flow in the pipes.

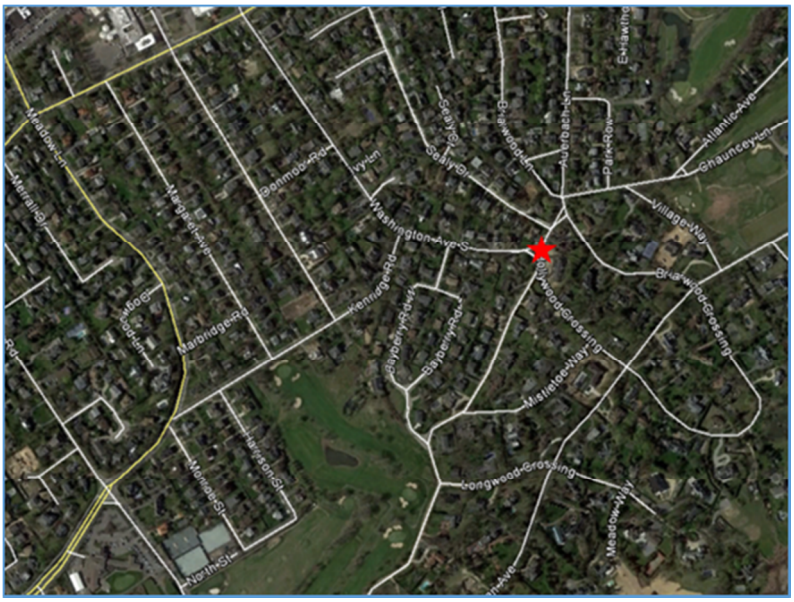


Figure 90: Barrett Road Pipe Constriction Location



Figure 91: Barrett Road Pipe Constrictions

7.8 Proposed Lawrence Improvements

7.8.1 Overview

Based on model results, the following improvements to the existing storm water collection system are proposed to limit recurring flooding within the Village of Lawrence:

1) **Backflow Prevention:** The installation of a new backflow prevention device at the 60-inch diameter outfall near Causeway Road and North Street.

2) **Pipe Improvements**: Pipe size improvements were evaluated for the Lawrence storm water drainage network which included the increase of diameters for those sections of piping that were at capacity and/or surcharged during normal rain events, as well as reopening or repairing/restoring paved over catch basins.

3) **Additional Pipe Improvements**: Pipe slopes were evaluated, based on the elevation of the outfall, to have proper slopes for adequate drainage.

4) **Additional Storage Improvements**: Parallel pipes were added to supplement pipes that were determined to be at capacity and/or surcharged during normal rain events, but could not be considered for diameter increase and or slope adjustment.

7.8.2 Expected Performance

Installation of effective backflow prevention should significantly limit flooding as a result of tidal surcharging, which is experienced monthly. Furthermore, limiting the surcharging of the drainage network will allow for increased runoff storage within the storm water collection pipes. The installation of the backflow prevention device is expected to result in a significant reduction in recurring flooding at those locations and elevations noted in Table 6 up to the 2-inch rainfall event.

For pipes located on Causeway Road and Meadow Lane, the installation of pipes of greater diameter will further improve flooding conditions up to the 1-year rainfall event by providing increased capacity along with reducing the restriction in the storm water collection system at Marbridge Road. The improvements would include replacing approximately 900 linear feet of 30-inch diameter pipe on Causeway Road with 60-inch diameter pipe; replacing approximately 200 linear feet of 12-inch diameter pipe with 48-inch diameter pipe at the corner of Causeway Road and Meadow Lane.

7.8.3 Estimated Benefits

Benefits would be realized through reduced damages to drainage system components and associated maintenance costs over time. Less frequent flooding caused by concurrent tidal fluctuation and precipitation should reduce the potential for property damages and would reduce public emergency expenditures associated with response of emergency personnel and equipment to flooded areas of key roadways. The water quality of system effluent into the bay would be improved as compared to stagnant flood waters discharging into the bay, resulting in environmental benefits manifested in improved plant and animal habitat.

8.0 VILLAGE OF WOODSBURGH DRAINAGE ASSESSMENT

8.1 Stormwater Drainage Problems

Similar to the other communities evaluated in this study, flooding can occur in the Village of Woodsburgh when stormwater from rainfall events combines with presence of tidal waters within the stormwater collection piping. The tidal waters reduce available capacity within the collection piping network and impede flow within the system until the local tidal waters recede allowing for the return of gravity flow. Key problem areas include Railroad Avenue, Ivy Hill Road and Broadway. A broad view of the extent of flooding during a severe high tide event with no precipitation is shown in Figure 92. When the tide elevation is high, outfalls (see Figures 93 and 94) are submerged and the stormwater system is subject to surcharging. The tidal backflow valve on the 36-inch diameter outfall appears to be stuck in a slightly open position which means that the device is not closing over the outfall pipe as intended. This condition allows for the intrusion of tidal water into the collection piping during a portion of the tidal cycle. The extent of flooding in the problem areas is exacerbated by a coincidental rainfall. It is this extent of flooding by which the drainage system analysis was conducted.

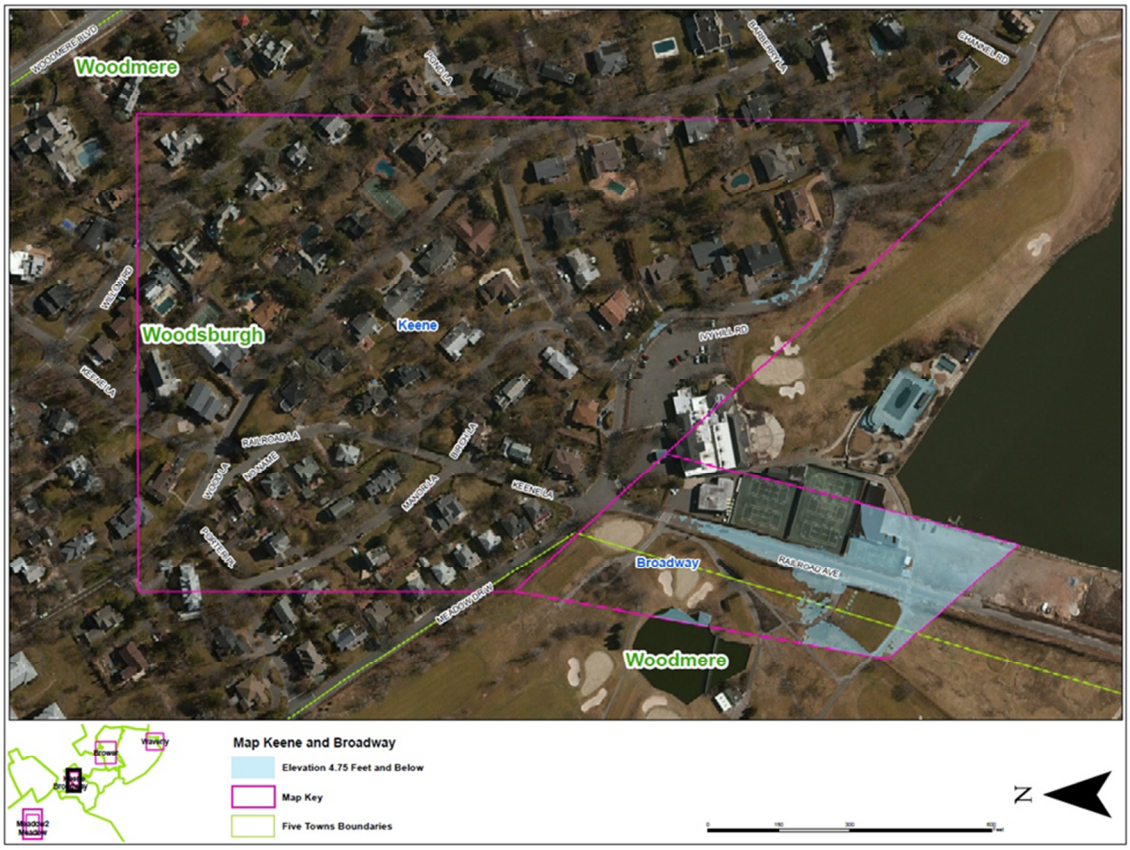


Figure 92: Woodsburgh Flooding Extent – (4.75 feet NAVD flood elevation)



Figure 93: Woodsburgh 60-inch Ellipse Outfall



Figure 94: Woodsburgh 36-inch Diameter Outfall with Flap Valve

8.2 Modeling and Results

Hydraulic/hydrologic drainage models were developed from the outfalls landward until stormwater collection pipe sizes were below 24 inches in diameter. Some exceptions were made for imperative pipes within the system. The Woodsburgh (Keene) model extent, shown in Figure 95, includes a single primary drainage network starting north on Keene Lane and Wood Lane and discharging on the southern end on Railroad Avenue. The Woodsburgh (Broadway) model extent, shown in Figure 96, includes a single primary drainage network starting north on Broadway near Brower Avenue and discharging on the southern end at Railroad Avenue next to the discharge for Woodsburgh (Keene).

Potential improvements evaluated for the Woodsburgh (Keene and Broadway) stormwater drainage system include the installation of new backflow prevention devices and larger diameter pipes with adjustment to achieve the proper slope. The results are presented in Tables 7 and 8.



Figure 95: Woodsburgh ("Keene") Model Schematic



Figure 96: Woodsburgh ("Broadway") Model Schematic

Table 7: Woodsburgh ("Keene") Modeling Results

Woodsburgh (Keene) Modeling Results									
Railroad Rd (MH-67)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	6.28	2.2	4.4	4.4	NO	2	NO	1	NO
2 Inch	6.28	3.4	4.6	4.9	NO	3.4	NO	3	NO
1 Year	6.28	4	5.7	6.1	NO	5.5	NO	3	NO
10 Year	6.28	5.8	6.1	6.2	NO	6.1	NO	3.5	NO
Ivy Hill Rd (MH-70)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	6.17	2	4.4	4.4	NO	2.1	NO	2	NO
2 Inch	6.17	3.3	4.6	4.8	NO	3.4	NO	3.2	NO
1 Year	6.17	4	5.6	5.8	NO	5.5	NO	3.5	NO
10 Year	6.17	5.9	6.1	6.2	YES	6.1	NO	4.5	NO
Pond Rd (MH-55)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	8.65	4	4.4	4.4	NO	4	NO	4	NO
2 Inch	8.65	7.7	7.2	7.8	NO	7.7	NO	7.1	NO
1 Year	8.65	7.9	7.9	7.9	NO	7.9	NO	7.9	NO
10 Year	8.65	8.2	8.3	9.1	YES	8.1	NO	8.2	NO
Keene Ln (MH-56)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	8.4	4	4.4	4.4	NO	4	NO	4	NO
2 Inch	8.4	6.6	6.7	8	NO	6.6	NO	6.5	NO
1 Year	8.4	6.8	6.9	8.4	NO	6.8	NO	6.7	NO
10 Year	8.4	7.1	7.2	8.6	YES	7.2	NO	6.9	NO
Keene Ln (MH-51)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	9.59	5.8	5.8	6	NO	5.8	NO	5.8	NO
2 Inch	9.59	9.2	9.2	9.7	YES	9.2	NO	9.2	NO
1 Year	9.59	9.4	9.5	9.9	YES	9.4	NO	9.4	NO
10 Year	9.59	9.6	9.6	10	YES	9.6	YES	9.5	NO
Meadow Dr (MH-57)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	8.2	3.6	4.4	4.4	NO	3.6	NO	3.6	NO
2 Inch	8.2	4.4	4.6	4.8	NO	4.4	NO	4.4	NO
1 Year	8.2	4	5.7	7.8	NO	5.5	NO	5	NO
10 Year	8.2	5.9	6.1	8.5	YES	6.1	NO	6	NO
Notes:									
(1) Elevations in Feet NAVD88									
(2) Tidal cycle and coincidental flooding based on 5.39 ft NAVD (estimated) spring tide									
(3) Colored cells represent improvements in flooded conditions									

Table 8: Woodsburgh ("Broadway") Modeling Results

Woodsburgh (Broadway) Modeling Results

Railroad Ave (MH-88)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	3.02	-0.7	4.4	4.4	YES	2.4	NO	1.1	NO
2 Inch	3.02	0.2	4.5	4.5	YES	2.6	NO	2.5	NO
1 Year	3.02	0.4	4.5	4.5	YES	2.6	NO	2.6	NO
10 Year	3.02	0.6	4.5	4.5	YES	2.7	NO	2.8	NO

Broadway (MH-4)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	20.84	5.1	5.1	5.3	NO	5.3	NO	5.3	NO
2 Inch	20.84	6	6	6.2	NO	6	NO	5.8	NO
1 Year	20.84	6	6	6.4	NO	6	NO	6	NO
10 Year	20.84	6.2	6.2	6.7	NO	6.2	NO	6.2	NO

Broadway-Wood Ln (MH-1)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	21.29	16.3	16.3	16.7	NO	16.7	NO	16.7	NO
2 Inch	21.29	20.3	20.3	20.6	NO	18.4	NO	18.3	NO
1 Year	21.29	21.1	21.1	21.6	YES	21	NO	19.1	NO
10 Year	21.29	21.4	21.4	21.8	YES	21.2	NO	19.4	NO

Broadway-Burton Rd (MH-4)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	22.65	18.3	18.3	18.6	NO	18.4	NO	18.6	NO
2 Inch	22.65	22.2	22.2	22.3	NO	21	NO	21.3	NO
1 Year	22.65	22.6	22.7	22.75	YES	21.5	NO	21.6	NO
10 Year	22.65	22.7	22.8	22.8	YES	22.6	NO	22.6	NO

Broadway-Conklin (MH-11)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	23.31	21.2	21.2	21.4	NO	21.2	NO	20.5	NO
2 Inch	23.31	21.9	23.6	23.6	YES	22	NO	21.8	NO
1 Year	23.31	23.2	23.8	23.8	YES	23.3	NO	23.2	NO
10 Year	23.31	23.4	24	24	YES	23.4	YES	23.4	YES

Notes:
(1) Elevations in Feet NAVD88
(2) Tidal cycle and coincidental flooding based on 5.39 ft NAVD (estimated) spring tide
(3) Colored cells represent improvements in flooded conditions

8.3 Proposed Woodsburgh Improvements

8.3.1 Overview

Based on model results, the following improvements are proposed to limit recurring flooding within the Village of Woodsburgh:

1) **Backflow Prevention:** The installation of new backflow prevention devices at the 36-inch diameter outfall and 60-inch diameter outfall on Railroad Avenue.

2) **Pipe Improvements**: The increase in the diameter of pipes that were at capacity and/or surcharged during normal rain events as well as providing proper slopes for adequate drainage.

8.3.2 Expected Performance

Installation of effective backflow prevention should significantly limit flooding as a result of tidal surcharging, which is experienced monthly. Furthermore, limiting the surcharging of the drainage network will allow for increased runoff storage in the collection pipes. The installation of the backflow prevention devices is expected to result in a reduction in recurring flooding at those locations and elevations noted in Table 8 up to the 1-year rainfall event.

Replacing pipe located on Railroad Avenue with pipes of greater diameter will further improve flooding conditions for the "Keene" model up to the 10-year rainfall event. The improvements would include replacing about 1,100 linear feet of 30-inch diameter pipe on Railroad Avenue with about 800 linear feet of 48-inch diameter pipe and about 300 linear feet of 30-inch diameter pipe.

8.3.3 Estimated Benefits

Benefits would be realized through reduced damages to drainage system components and associated reductions in maintenance costs over time. Less frequent flooding caused by concurrent tidal fluctuation and precipitation events should reduce the potential for property damages and would reduce public emergency expenditures associated with response of emergency personnel and equipment to flooded areas of key roadways. The water quality of system effluent into the bay should be improved, resulting in environmental benefits from improved plant and animal habitat.

9.0 VILLAGE OF HEWLETT BAY PARK DRAINAGE ASSESSMENT

9.1 Stormwater Drainage Problems

Flooding can occur in the Village of Hewlett Bay Park when stormwater from rainfall events combines with presence of tidal waters within the stormwater collection piping. The tidal waters reduce available capacity within the collection piping network and impede normal gravity flow within the system until such time the tidal waters recede. This inhibits the system's ability to drain storm water to the local receiving water. Key problem areas were identified and emphasized by the Village and include the intersection of Lefferts Road and Cedar Avenue, north of the intersection on Cedar Avenue and west of the intersection on Lefferts Road. A broad view of the extent of flooding during a severe high tide event with no precipitation is shown in Figure 97. When the tide elevation is high, outfalls are blocked and the stormwater system is subject to surcharging (see Figures 98 and 99). The extent of flooding is exacerbated by a coincidental rainfall; it is this flooding extent at which the drainage system was evaluated.



Figure 97: Hewlett Bay Park Flooding Extent



Figure 98: Hewlett Bay Park 36-inch Diameter Outfall



Figure 99: Hewlett Bay Park 60-inch Diameter Outfall

9.2 Modeling and Results

Hydraulic/hydrologic drainage models were developed from the outfalls landward until stormwater collection pipe sizes decreased to a diameter less than 24 inches. Some exceptions were made for imperative pipes within the system. The Hewlett Bay Park model extent, shown in Figure 100, includes a single primary drainage network starting west at Broadway and Brower Avenue and discharging at the eastern end in two outfalls at the terminus of Lefferts Road.

Potential improvements that were evaluated for the Hewlett Bay Park stormwater drainage system include the installation of a new backflow prevention device, larger diameter pipes; an adjustment of existing piping to achieve the proper slope, and the addition of parallel pipes or added storage to the system. The results are presented in Table 9.



Figure 100: Hewlett Bay Park (Brower) Model Schematic

Table 9: Hewlett Bay Park (Brower) Modeling Results

Hewlett Bay Park (Brower) Modeling Results													
Lefferts Rd (South Outfall Line CB-79)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Parallel Pipe	Flooding	Backflow w/ Invert Adjustment	Flooding
1 Inch	4.69	1.1	4.6	4.8	YES	2.5	NO	1.3	NO	3.3	NO	0.9	NO
2 Inch	4.69	4.3	5.1	5.1	YES	4.3	NO	2.3	NO	3.7	NO	3.5	NO
1 Year	4.69	5.4	5.5	5.5	YES	2.6	NO	2.6	NO	4.7	YES	5.3	YES
10 Year	4.69	5.8	5.9	5.9	YES	2.7	NO	2.7	NO	5.2	YES	5.6	YES
Lefferts Rd (North Outfall Line MH-81)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Parallel Pipe	Flooding	Backflow w/ Invert Adjustment	Flooding
1 Inch	4.58	3.1	4.7	4.8	YES	3.1	NO	1.3	NO	3.5	NO	1	NO
2 Inch	4.58	4.45	5.4	5.9	YES	4.4	NO	2.4	NO	4	NO	3.6	NO
1 Year	4.58	5.6	5.7	6.8	YES	3.3	NO	3.1	NO	5	YES	5.4	YES
10 Year	4.58	6.1	6.2	8.9	YES	3.3	NO	3.7	NO	5.4	YES	5.7	YES
Lefferts Rd (CB-68)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Parallel Pipe	Flooding	Backflow w/ Invert Adjustment	Flooding
1 Inch	6.09	1.1	4.7	4.9	NO	2.6	NO	1.4	NO	3.6	NO	1	NO
2 Inch	6.09	4.6	5.4	5.5	NO	4.6	NO	3.5	NO	4	NO	3.7	NO
1 Year	6.09	5.6	5.7	5.7	NO	2.6	NO	3.7	NO	5.7	NO	4.5	NO
10 Year	6.09	6.1	6.2	6.2	YES	2.7	NO	3.7	NO	6.2	YES	6.5	YES
East Broadway (MH-58)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Parallel Pipe	Flooding	Backflow w/ Invert Adjustment	Flooding
1 Inch	9.94	3.85	5.2	5.2	NO	3.85	NO	3.85	NO	3.85	NO	3.85	NO
2 Inch	9.94	3.9	8.2	8.3	NO	6.7	NO	5.7	NO	8.2	NO	7.3	NO
1 Year	9.94	8.4	8.5	8.5	NO	5.45	NO	5.4	NO	8.3	NO	8.4	NO
10 Year	9.94	8.9	8.9	9	NO	3.85	NO	5.4	NO	8.9	NO	9.2	NO
Brower (MH-29)		Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding	Backflow w/ Parallel Pipe	Flooding	Backflow w/ Invert Adjustment	Flooding
1 Inch	18.93	12.3	12.3	12.3	NO	12.3	NO	12.3	NO	12.3	NO	12.3	NO
2 Inch	18.93	12.7	12.7	12.8	NO	12.7	NO	12.7	NO	12.7	NO	16.3	NO
1 Year	18.93	13.3	13.4	13.6	NO	12.2	NO	12.2	NO	13.2	NO	19.2	YES
10 Year	18.93	17.8	18.9	19.4	YES	12.2	NO	12.2	NO	19.3	YES	19.4	YES
Notes:	(1) Elevations in Feet NAVD88.												
	(2) Tidal cycle and coincidetal flooding based on 5.39 ft NAVD (estimated) spring tide.												
	(3) Colored cells represent improvements in flooded conditions												

9.3 Proposed Hewlett Bay Park Improvements

9.3.1 Overview

Based on model results, the following improvements are proposed to limit recurring flooding within the Village of Hewlett Bay Park:

1) **Backflow Prevention:** The installation of backflow prevention devices at the 60-inch diameter outfall and 36-inch diameter outfall at the terminus of Lefferts Road.

2) **Pipe Improvements:** Pipe size improvements were evaluated for the Hewlett Bay Park drainage network which included the increase of pipe diameters that were at capacity and/or surcharged during normal rain events.

3) **Additional Pipe Improvements:** Pipe slopes were evaluated, based on the elevation of the outfall, the existing piping have proper slopes for adequate drainage.

4) **Additional Storage Improvements:** Parallel pipes were added to supplement pipes that were determined to be at capacity and/or surcharged during normal rain events, but could not be considered for diameter increase and slope adjustment

9.3.2 Expected Performance

Installation of effective backflow prevention devices should significantly limit flooding as a result of tidal surcharging, which is experienced monthly. Furthermore, limiting the surcharging of the drainage network will allow for increased runoff storage in the collection pipes. The installation of the backflow prevention device is expected to result in a reduction in recurring flooding at these locations and for elevations noted in Table 9 up to the 10-year rainfall event.

Replacing pipes located on Lefferts Road with pipes of a greater diameter will not provide for additional significant improvement of flooding conditions after the installation of the backflow prevention devices for a 10-year rainfall event. The improvements would include replacing approximately 1,500 linear feet of 36-inch diameter pipe with 48-inch diameter pipe, approximately 560 linear feet of 24-inch diameter pipe with 30-inch diameter pipe and approximately 510 linear feet of 12-inch diameter pipe with 18-inch diameter pipe.

9.3.3 Estimated Benefits

Benefits would be realized through reduced damages to drainage system components and associated reductions in maintenance costs over time. Less frequent flooding caused by concurrent tidal fluctuation and precipitation events should reduce potential for property damages and would reduce public emergency expenditures associated with response of emergency personnel and equipment to flooded areas of key roadways. The water quality of system effluent into the bay would be improved, resulting in environmental benefits from improved plant and animal habitat.

10.0 VILLAGE OF HEWLETT HARBOR DRAINAGE ASSESSMENT

10.1 Stormwater Drainage Problems

Flooding occurs in Hewlett Harbor when storm water drainage system outfalls become submerged by tidal conditions, allowing tidal waters to flow back into the storm water drainage system. This reduces system capacity, reduces inline storage and inhibits the system's ability to drain storm water to the local receiving water. Historically, per Village representatives, water tends to pool along Pepperidge Road (in the area of Auerbach Avenue, Heather Lane, and the Village Hall) for several days after rain events because of inadequate drainage of stormwater. This was identified in the Hewlett Harbor Stormwater Infrastructure Upgrades project in the March 2014 Five Towns CRP in Figure 101. A broad view of the extent of flooding during a severe high tide event with no precipitation is shown in Figure 102. The extent of flooding is exacerbated by a coincidental rainfall. It is this flooding extent that the drainage system was evaluated.



Figure 101: CRP – Hewlett Harbor Stormwater Infrastructure Project Plan



Figure 102: Hewlett Harbor Flooding Extent – (4.75 feet NAVD elevation)

10.2 Current GOSR Project

Hewlett Harbor has a separate, CDBG-DR-funded project sponsored by GOSR for stormwater infrastructure upgrades to provide flood mitigation. That project includes a drainage analysis and proposed drainage system upgrades. The infrastructure upgrades project is being completed by D&B Engineers and Architects, P.C.

The original proposed project presented in March 2016 included significant pipe size increases and a new stormwater drainage line, as well as a new outfall to address low frequency rainfall related flooding. The project presented challenges related to easements for the pipeline.

Following the project review, GOSR and the Bureau of Environmental Review and Assessment (BERA) did not feel the project included sufficient environmental or green features to meet regulatory requirements. D&B revisited the proposed project and evaluated several green infrastructure features; however, the inclusion of additional stormwater recharge components in additional plans presented in July 2016 were: (1) not practical given the limited space/real estate available to include necessary sized structures, and (2) the project did not provide sufficient runoff reduction to meet the goals of the project. Furthermore, a primary plan exceeds the available funding for that project and the secondary, recommended plan does not meet the expected drainage improvement or flood reduction goals of the project.

The analysis of Hewlett Harbor as part of the Five Towns Drainage Study was to address frequent, recurrent flooding for smaller storm events, while keeping with the available funding for the Five Towns Community Reconstruction Zone.

10.3 Modeling and Results

A hydraulic/hydrologic drainage model was developed from the outfall landward until stormwater collection pipe decreased in size to below 24 inches in diameter. Some exceptions were made for imperative pipes within the system. The Hewlett Harbor model extent, shown in Figure 103, includes a single primary drainage network starting west on Waverly Avenue and Pepperidge Road to the discharging on the east into Thixton Creek.

Potential improvements evaluated for the Hewlett Harbor stormwater drainage system included the installation of a new backflow prevention device; and larger diameter pipes. The results are presented in Table 10.



Figure 103: Hewlett Harbor ("Waverly") Model Schematic

Table 10: Hewlett Harbor (Waverly) Modeling Results

Hewlett Harbor (Waverly) Modeling Results

Pepperidge Rd (MH-28)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	5.62	-0.6	4.4	4.5	NO	-0.6	NO	-0.6	NO
2 Inch	5.62	0.6	4.7	4.7	NO	1.9	NO	1.9	NO
1 Year	5.62	1.2	4.9	5	NO	2.2	NO	2	NO
10 Year	5.62	1.7	5	5	NO	2.9	NO	2.1	NO

Everit Waverly (MH-25)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	5.13	0.07	4.4	4.5	NO	0.1	NO	0.1	NO
2 Inch	5.13	0.85	4.8	4.8	NO	1.9	NO	1.9	NO
1 Year	5.13	1.9	5	5.2	YES	2.5	NO	2.1	NO
10 Year	5.13	4.4	5.2	5.2	YES	4.7	NO	4.4	NO

Azure (MH-5)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	4.41	0.7	4.4	4.4	NO	0.7	NO	0.7	NO
2 Inch	4.41	1.4	4.7	4.7	YES	2	NO	2	NO
1 Year	4.41	3.1	5.1	5.1	YES	3.3	NO	3.2	NO
10 Year	4.41	4.3	5.2	5.2	YES	4.5	YES	4.2	NO

Heather Ln (CB-3)		Existing Conditions (water level FT)				Alternative 1		Alternative 2	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coicidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size	Flooding
1 Inch	4.84	1.8	4.4	4.5	NO	1.8	NO	1.8	NO
2 Inch	4.84	2.2	4.9	4.9	YES	2.2	NO	2.6	NO
1 Year	4.84	4.3	5.1	5.1	YES	4.2	NO	2.8	NO
10 Year	4.84	5	5.3	5.3	YES	5	YES	3.2	NO

Notes:
(1) Elevations in Feet NAVD88.
(2) Tidal cycle and coincidetal flooding based on 5.39 ft NAVD (estimated) spring tide.
(3) Colored cells represent improvements in flooded conditions

10.4 Proposed Hewlett Harbor Improvements

10.4.1 Overview

Based on model results, the following improvements are proposed to limit recurring flooding within the Village of Hewlett Harbor:

1) **Backflow Prevention:** The installation of backflow prevention device at the 48-inch diameter outfall.

2) **Pipe Improvements**: Pipe size improvements were evaluated for the drainage networks which included the increase of pipe diameters that were at capacity and/or surcharged during normal rain events as well as providing proper slopes for adequate drainage.

10.4.2 Expected Performance

Installation of effective backflow prevention should significantly limit flooding as a result of tidal surcharging, which is experienced monthly. Furthermore, limiting the surcharging of the drainage network will allow for increased runoff storage in the collection pipes. The installation of the backflow prevention device is expected to result in a significant reduction in recurring flooding at those location and elevations noted in Table 10 up to the 1-year rainfall event.

Increased pipe diameters of the outfall pipe will further improve flooding conditions for the "Waverly" model up to the 10-year rainfall event. The improvements would include replacing approximately 1,200 linear feet of 48-inch diameter pipe along the outfall with 1,200 linear feet of 60-inch diameter pipe. The increased system capacity achieved with these improvements provides for improved flooding conditions in the Village.

10.4.3 Estimated Benefits

Stormwater infrastructure upgrades in Hewlett Harbor would reduce strain on the existing stormwater system. Over time this would lead to reduced maintenance costs and reduced costs to repair damaged stormwater system components. The frequency and severity of flooding caused by concurrent tidal fluctuations and precipitation events would be reduced. Functional downtime for services in the project area would be reduced as system upgrades work to prevent or minimize flooding. A reduction of flooding along Pepperidge Road in terms of maintaining continuity of operations and emergency access/egress. The NYRCR Plan notes that properties along Pepperidge Road should benefit from reduced repair costs due to stormwater flooding. Benefits would also include reduced public emergency costs.

11.0 VILLAGE OF HEWLETT NECK DRAINAGE ASSESSMENT

11.1 Stormwater Drainage Problems

Flooding can occur in the Village of Hewlett Neck when stormwater from rainfall events combines with tidal waters surcharging the stormwater collection piping. The tidal waters reduce available capacity within the collection piping network and impede normal gravity flow within the system until such time the tidal waters recede. This inhibits the system's ability to drain storm water to the local receiving water. Key problem areas were identified and emphasized by the Village and include the south end of Adams Lane near Dolphin Drive. Other areas that were noted to flood during rain events were on Smith Lane, Monroe Lane and Madison Street, and along Woodbine Ditch. This was identified in the Hewlett Neck Stormwater Infrastructure Upgrades project in the March 2014 Five Towns Community Reconstruction Plan in Figure 104. When the tide elevation is high, outfalls (see Figures 105 and 106) are blocked and the stormwater system is subject to surcharging. The extent of flooding is exacerbated by a coincidental rainfall; it is this flooding extent that the drainage system was evaluated.

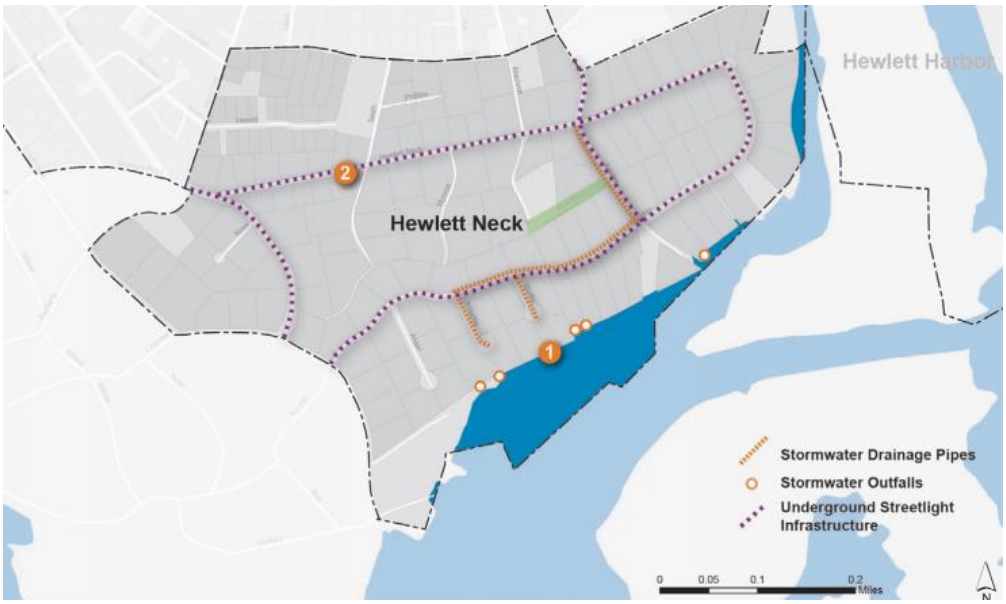


Figure 104: CRP – Hewlett Neck Stormwater Infrastructure Project Plan



Figure 105: Hewlett Neck 15-inch Diameter Outfall

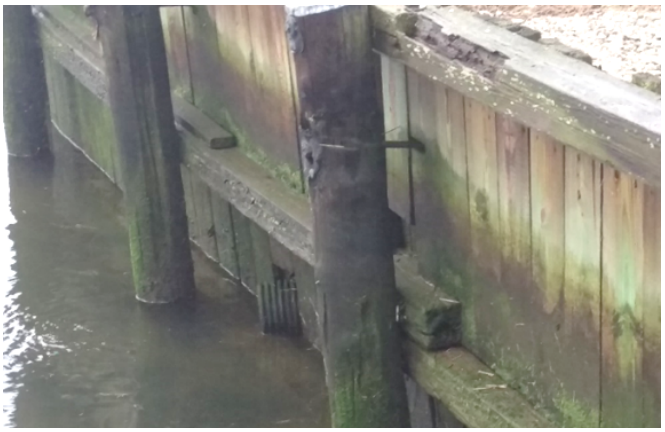


Figure 106: Hewlett Neck 8-inch Diameter Outfall

Several site visits of the Hewlett Neck area were conducted shortly after the occurrences of a rain event. It was noted that the problem area previously identified by the Village do not appear to have proper surface drainage. Storm water ponds in several areas and is unable to flow into the drainage system. This flooding is not from tidal events, but can be considered as nuisance flooding of the Hewlett Neck area. Photos from a limited rain event are shown in Figures 107 through 109.



Figure 107: Hewlett Neck Surface Puddling – 1



Figure 108: Hewlett Neck Surface Ponding – 2



Figure 109: Hewlett Neck Surface Ponding – 3

11.2 Modeling and Results

Hydraulic/hydrologic drainage models were developed from the outfalls landward; the pipes were classified from the Five Towns Community Reconstruction Plan. These pipes were between 8 and 24 inches in diameter. The Hewlett Neck model extent, shown in Figure 110, includes five outfalls all within their own drainage network and catchments along Dolphin Drive.

Potential improvements that were evaluated for the Hewlett Neck stormwater drainage system include the installation of new backflow prevention devices, large diameter pipe, and the regrading and roadway reconstruction of the modeled area while improving pipe sizes and adding additional catch basins to collect surface storm water and achieve proper drainage. The results are presented in Table 11.

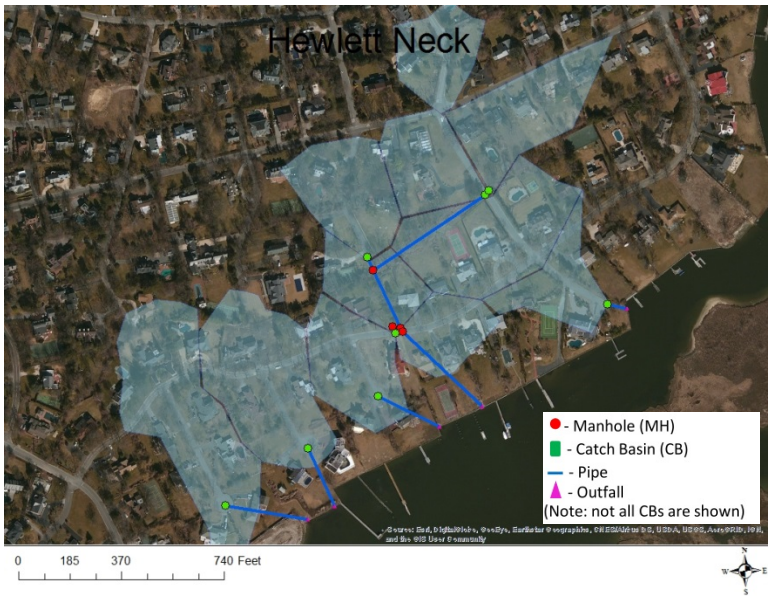


Figure 110: Hewlett Neck Model Schematic

Table 11: Hewlett Neck Modeling Results

Hewlett Neck Modeling Results

Alden Rd	Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size and Adj Inv	Flooding	Backflow w/ Resurfaced Road and additional pipes	Flooding
1 Inch	6.7	4	4.4	4.4	NO	3.8	NO	3.8	NO	4	NO
2 Inch	6.7	4.9	4.9	4.9	NO	4.9	NO	4.8	NO	4.8	NO
1 Year	6.7	5.8	5.9	5.9	NO	5.8	NO	5.8	NO	5.8	NO
10 Year	6.7	6.2	6.2	6.2	NO	6.2	NO	6.2	NO	6.2	NO

Priscilla Rd	Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size and Adj Inv	Flooding	Backflow w/ Resurfaced Road and additional pipes	Flooding
1 Inch	6.75	3.8	4.4	4.4	NO	3.8	NO	3.8	NO	3.8	NO
2 Inch	6.75	4.7	4.7	4.7	NO	4.7	NO	4.6	NO	4.6	NO
1 Year	6.75	5.6	5.6	5.6	NO	5.6	NO	5.6	NO	5.6	NO
10 Year	6.75	6.4	6.4	6.4	NO	6.4	NO	6.4	NO	6.4	NO

Curtis Rd	Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size and Adj Inv	Flooding	Backflow w/ Resurfaced Road and additional pipes	Flooding
1 Inch	6.3	3.8	4.4	4.4	NO	3.8	NO	3.8	NO	3.9	NO
2 Inch	6.3	4.2	4.5	4.5	NO	4.2	NO	4.2	NO	4.2	NO
1 Year	6.3	4.5	4.7	4.7	NO	4.5	NO	4.5	NO	4.5	NO
10 Year	6.3	5.5	5.5	5.5	NO	5.5	NO	5.5	NO	5.5	NO

Madison	Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size and Adj Inv	Flooding	Backflow w/ Resurfaced Road and additional pipes	Flooding
1 Inch	7.57	3.4	4.4	4.4	NO	3.4	NO	3.4	NO	3.5	NO
2 Inch	7.57	4.2	4.4	4.4	NO	4.2	NO	4.2	NO	4.2	NO
1 Year	7.57	4.6	4.8	4.8	NO	4.6	NO	4.6	NO	4.7	NO
10 Year	7.57	5.9	6	6	NO	5.9	NO	5.9	NO	6.4	NO

Adams Ln	Existing Conditions (water level FT)				Alternative 1		Alternative 2		Alternative 3	
Rain Event	Ground Elevation (ft)	Low Tide	High Tide	Coincidental Rain/Tide	Flooding	Backflow Prevention	Flooding	Backflow w/ Increased Pipe Size and Adj Inv	Flooding	Backflow w/ Resurfaced Road and additional pipes	Flooding
1 Inch	7.66	5	5	5.2	NO	5	NO	0.1	NO	3.2	NO
2 Inch	7.66	5.4	7.6	7.6	NO	5.4	NO	2.6	NO	3.8	NO
1 Year	7.66	5.6	7.9	7.9	YES	7.9	YES	2.7	NO	4.2	NO
10 Year	7.66	8.2	8.2	8.2	YES	8.2	YES	3.2	NO	5.2	NO

11.3 Proposed Hewlett Neck Improvements

11.3.1 Overview

Based on model results, the following improvements are proposed to limit recurring flooding within the Village of Hewlett Neck:

3) **Backflow Prevention:** The installation of backflow prevention device at the one 8-inch diameter, three 15-inch diameter and one 24-inch diameter outfalls.

4) **Pipe Improvements**: Pipe size improvements were evaluated for the drainage networks which included the increase of pipe diameters that were at capacity and/or surcharged during normal rain events as well as providing proper slopes for adequate drainage.

5) **Road Improvements**: The roads were evaluated for the proper runoff providing the networks, while including increase of pipe diameters that were at capacity and/or surcharged during normal rain events as well as providing proper placement of catch basins to collect surface storm water.

11.3.2 Expected Performance

Installation of effective backflow prevention should significantly limit the surcharging of the drainage network and will allow for increased runoff storage in the collection pipes. The installation of the backflow prevention devices is expected to result in a small reduction in recurring flooding at those location for elevations noted in Table 11 up to the 1-year rainfall event.

Increased pipe sizes will further improve flooding conditions for the "Hewlett Neck" model up to the 10-year rainfall event. The improvements would include replacing approximately 80 linear feet of 30-inch diameter pipe up to the outfall, 620 linear feet of 24-inch diameter pipe, and three new manholes with connection of these new pipes. The increased capacity achieved by these measures will help limit recurring flooding.

The road improvement part of the proposed project will reduce the extent of flooding in the Village of Hewlett Neck up to the 10-year rainfall event along with a reduction in the puddling along the roads. These improvements would include regrading and repaving approximately 120,000 square feet of road adding curb, and eight new curb inlet catch basins connecting to the existing system along with the addition of 1,520 linear feet of 12-inch diameter pipe, 80 linear feet of 30-inch diameter pipe, 620 linear feet of 24-inch diameter pipe and three new manholes. The increased capacity and improved grading should improve recurring flooding conditions.

11.3.3 Estimated Benefits

Stormwater infrastructure upgrades in Hewlett Neck would minimize street flooding while reducing the strain on the existing stormwater system. Over time this would lead to reduced maintenance costs and reduced costs to repair damaged stormwater system components. The frequency and severity of flooding caused by concurrent tidal fluctuations and precipitation events would be reduced. Functional downtime for services in the project area would be reduced as system upgrades work to prevent or minimize flooding. Benefits would also include reduced public emergency costs.

ATTACHMENT 1
Outfall Maps

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4
3
5
Hewlett
6
Woodmere
Hewlett Bay Park
Hewlett Harbor
7
2
Cedarhurst
Hewlett Neck
Inwood
Woodsburgh
8
1
Lawrence
9
10
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Outfall
Outfall Survey Index
Five Towns Boundaries
N
0
1,300
2,600
5,200 Feet

Five Towns Outfalls

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Inwood

Lawrence

24B0001
24B0002
24B0003
24B0005
24B0008
25B0002
25B0001
25CRB01

Legend

- Outfall
- Outfall Survey Index
- Five Towns Boundaries

N

0 200 400 800 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Woodmere
Inwood
Cedarhurst
23C0013
23C0010
23C0011
23C0012
23C0016
23D0016
23D0017A
23D0017B
23D0017C
23D0017D
23D0025
23D0026
23D0015
23D0022C
23D0022D
23D0022B
23D0022A
23C0022
23C0021
23C0020
23D0027
23D0029B
23D0029A
23C0025
23C0024
23C0023
23C0027
23C0026
Beconn_1
23C0028
24C0001
24C0002
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Outfall
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Five Towns Boundaries
N
0
200
400
800 Feet


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Outfall Survey Index
Five Towns Boundaries
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0
200
400
800 Feet
22C0002
22C0003
22C0004
23C0001
23C0002
23C0003
23C0004
23C0005
23C0006
23C0007
23C0008
23C0014
23C0015
23C0018
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23D0006
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22D0016
22D0020
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22E0055
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M6
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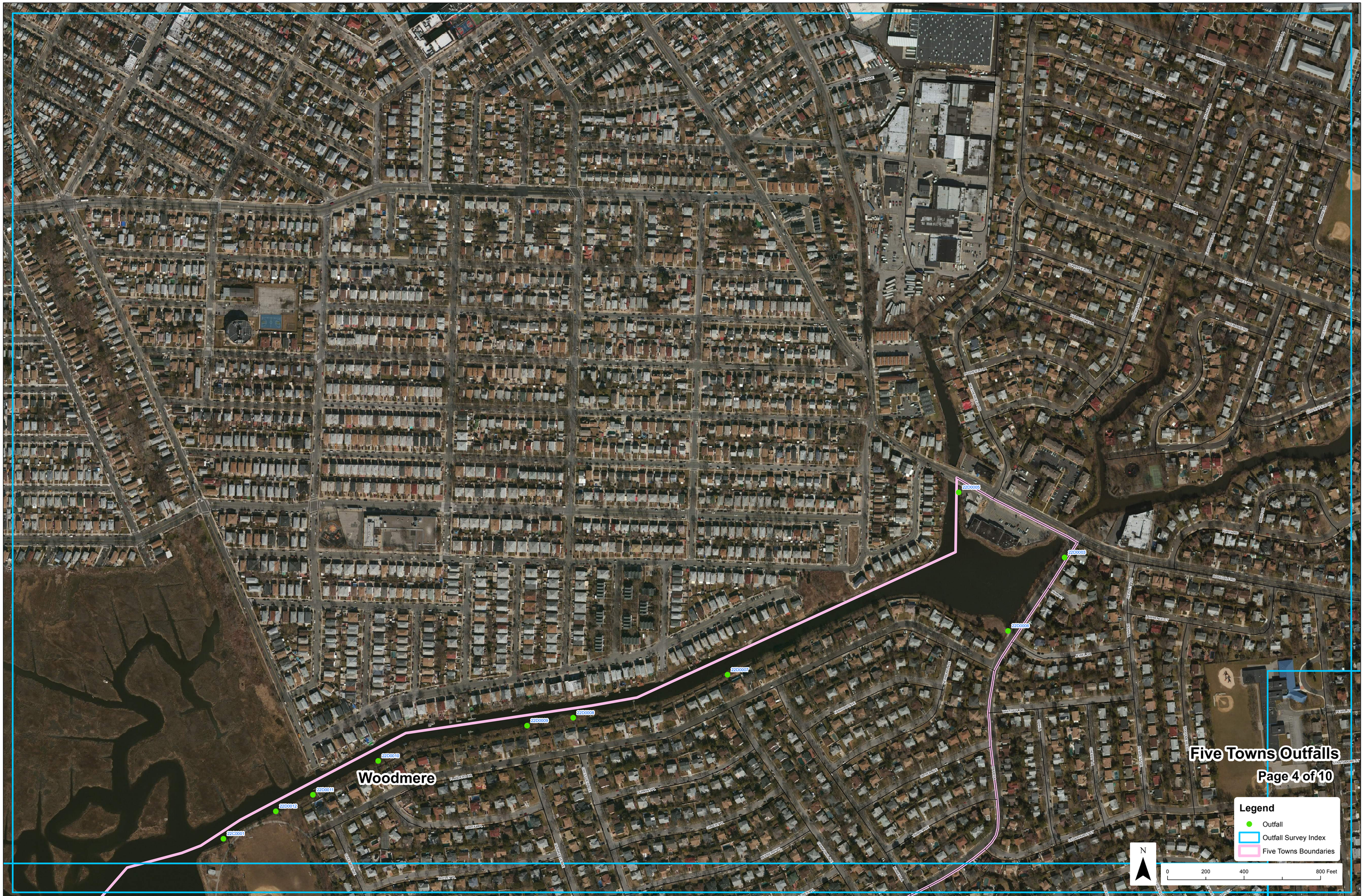
ecom_2
LOWE'S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22D0003
22D0004
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22D0006
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22D0008
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22D0010
22D0011
22D0012
Woodmere
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Five Towns Boundaries
N
0
200
400
800 Feet


22E0020
22E0021
22E0022
22E0023
22E0024
22E0048
22E0047
22E0062
22E0046
22E0049
22E0061
22E0050
22E0051
22E0025
22E0026
22E0027
22E0028
22E0029
22E0030
22E0045
22E0044
22E0043
22E0042
22E0041
22E0039
22E0040
22E0036
22E0038
22E0037
22E0035
22E0034
22E0033
22E0032
22E0031
22F0050
22F0049
aecom_4
aecom_5
aecom_5.5B
aecom_5
aecom_5.5A
aecom_6
aecom_6
aecom_7
MB
23E0004
23E0003
23E0002
23E0001
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800 Feet


22F0061
22F0059
22G0015
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22F0058
Hewlett
Hewlett Bay Park
Hewlett Harbor
23G0010
24S0001
23F0003
UNK6
23F0001
23F0002
M3
23F0004
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23F0001
23F0002
M2
23F0004
UNK1
23F0005
23F0006
M3
M1
M4
18
23F0007
23F0008
23F0011
23F0010
23F0012
UNK2
23F0013
23F0014
23G0001
23G0002
23G0003
23G0004
UNK5
23G0005
24G0002
UNK3
24G0005
21
24G0006
22
10
24G0004
24G0003
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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


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24E0001
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24F0005
24F0006
UNK5
UNK6
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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


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25D0006
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25D0003
25D0004
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UNK1
M8
M2
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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


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26C0007
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