Long Island Drainage
An Overview of Conditions in the Nassau and Suffolk Regions
February 24, 2020

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Prepared for: LICA

LONG ISLAND CONTRACTORS’ ASSOCIATION, INC.
## TABLE OF CONTENTS

- **Executive Summary** ........................................................................................................... Page 1
- **Introduction and Purpose** .................................................................................................. Page 10
- **Meetings with Municipalities** ........................................................................................... Page 11
- **Common/Recurring Issues and Deficiencies** ................................................................ Page 11
- **Inadequate Facilities** ........................................................................................................ Page 12
- **Aging Infrastructure** ......................................................................................................... Page 13
- **Outdated Design Standards** ............................................................................................. Page 14
- **Maintenance of Existing Systems** .................................................................................... Page 15
- **Walkable Communities** .................................................................................................... Page 16
- **Climate Change** ................................................................................................................ Page 16
- **Sea Level Rise** .................................................................................................................. Page 16
- **Economic Costs of Inadequate Drainage** ........................................................................ Page 18
- **Burdensome Time-Consuming Process to Secure Funds from State and Federal Agencies** ........................................................................................................................................ Page 19
- **Conclusions/Observations** ............................................................................................... Page 19

## APPENDICES

*(Transmitted Electronically Only)*

- Complementary Documents
  - From NCDPW
  - From NYSDOT
  - From SCDPW
  - From Town of Babylon
  - From Town of Huntington
  - From Town of Islip
  - From Town of Smithtown

- Population and Miscellaneous Data
- Sea Level Rise
Executive Summary

Long Island has flooding problems! While this comes as no surprise to Long Islanders who regularly deal with these issues, there seems to be a perception throughout much of New York State that, with the exception of major storm events such as Hurricane Gloria in 1985, the “Halloween Storm” or “Perfect Storm” in 1991, and more recently Superstorm Sandy in 2012, flooding of roadways and other infrastructure elements is not a recurring problem on Long Island. After all, Long Island is surrounded on all sides by water (hence “island” in the name), and whatever precipitation falls onto it will quickly drain towards the Long Island Sound, the numerous bays and rivers, and of course, the Atlantic Ocean. Furthermore, storm surges are an inherent risk in coastal communities and should be expected, and water levels drop quickly from these surges when the tides recede. The discussions and evidence provided within this document, and conclusions reached will be dispel this notion Long Island is the drainage equivalent of the “Garden of Eden.”

Images flashed across news broadcasts during major storm events occurring on Long Island show high winds blowing debris throughout neighborhoods, toppled trees which have damaged buildings and automobiles, the occasional loss of a roof top, and flooding attributed to the rising tide caused by the storm. Hours after the storm has passed, damage is still evident, but normally the flood waters are gone, reinforcing the idea all flood waters drain away quickly when the tides recede, appearing inconsequential.

Compare these images to those in regions of New York State and Vermont affected by Tropical Storms Irene and Lee in 2011. News reports showed raging rivers, houses being swept away as riverbanks were overtopped, bridges collapsing, and large gaping holes in roadways carved by the flood waters. Hours after the storm had past, evidence of high-water levels remained, while the extent of the unspeakable devastation was laid bare. When placed side-by-side with the pictures of the aftermath of Superstorm Sandy, the results from Irene and Lee are more intense; houses damaged versus houses totally gone or irreparably destroyed, roadways littered with debris versus roadways with washout areas; utility poles bent over or broken versus poles at the bottom of a landslide, and neighborhoods disturbed versus neighborhoods no longer in existence. These stark differences can lead many to believe funding for flooding or drainage issues should be directed to those area more intensely affected.

Another consideration is the number of people impacted by the devastation. Long Island has approximately 2.8 million residents in Nassau and Suffolk Counties according to U.S. Census estimates dated July 2018. Suffolk and Nassau Counties rank fourth and sixth, respectively, in population, with Kings, Queens, and New York Counties occupying the top three spots; Bronx County ranked fifth. To put this into perspective; Suffolk and Nassau Counties have a combined population greater than the sum of the lowest populated 41 counties in the state; the area of Suffolk and Nassau Counties is approximately 1,200 square miles compared to 35,470 square miles of the lowest populated 41 counties. The average density for Suffolk and Nassau Counties is 2,368 people per square mile versus 76 people per square mile for the 41 counties noted above. When presented in this context, investing in drainage improvements throughout Suffolk and Nassau Counties benefits millions of residents in a relatively small geographical area.

The information within this document is intended to raise awareness of the need to invest in major infrastructure improvements to the drainage systems throughout Long Island which are constructed, owned, operated, and maintained by the various governmental agencies to not only address identified deficiencies, but to also improve these systems to an overall state of good repair to function adequately in the future, under more frequent and severe events. Deferring these expenditures is not an acceptable solution and will ultimately cost several times more to remediate later.
Modern and safe transportation facilities are critical to the quality of life and ecological and economic stability of the Long Island Region, and properly designed and constructed drainage systems are necessary components to ensure these facilities remain functional and reliable, particularly during times of emergencies. Allocation of substantial funding to address these identified issues is imperative to prevent any further deterioration and maintain a high level of mobility preparedness. For example, New York State Department of Transportation Region 10, has the following inventory:

<table>
<thead>
<tr>
<th>APPROXIMATE INVENTORY OF R-10 FACILITIES</th>
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<tbody>
<tr>
<td>(adapted from 2010 MOP Table, Updated - October 2019)</td>
</tr>
<tr>
<td><strong>Type</strong></td>
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<tr>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Open Channel Drainage</td>
</tr>
<tr>
<td>Stormwater Basins (recharge basins)</td>
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<tr>
<td>Drainage Structures</td>
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<tr>
<td>Drainage Pipe</td>
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<tr>
<td>Culverts – Large (120 locations)</td>
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<tr>
<td>Culverts – Small (unknown number)</td>
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<tr>
<td>Bridges – over tidal waters</td>
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<td>Bridges – over rivers</td>
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<td>SPDES outfalls</td>
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<tr>
<td>Stormwater Quality Structures</td>
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<td>Drainage Structures – subsets</td>
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<td>Concrete Block Construction – Total</td>
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<td>▪ Concrete Block Construction – Leaching Basins</td>
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<td>▪ Concrete Block Construction – Catch Basins/Manholes</td>
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<td>Precast Concrete Construction – Total</td>
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Nassau County has the following inventory of drainage facilities under its sole jurisdiction, not including any other assets from the Cities of Long Beach and Glen Cove, The Towns of Hempstead, North Hempstead, and Oyster Bay, and the 64 Villages within the County:

- 32 Culverts
- 6,100 Outfalls
- 37,500 Catch Basins
- 21,750 Manholes
- 4,065,000 Linear Feet of Drainage Pipe
- 650 Leaching Basins
- 867 Recharge Basin
Suffolk County has the following inventory of drainage facilities under its sole jurisdiction, not including any other assets from the Towns of Babylon, Huntington, Islip, Smithtown, Brookhaven, Southampton, Riverhead, East Hampton, Southold, and Shelter Island, and the 32 Villages within the County:

- 140 Culverts
- 300 Outfalls
- 2800 Catch Basins
- 350 Manholes
- 374,000 Linear Feet of Drainage Pipe
- 260 Leaching Basins
- 270 Recharge Basins.

When the assets of all agencies are considered together, the extent of the existing systems throughout Long Island is vast.

Before proceeding further into this document, presented below are some examples of significant, recurring, and potentially dangerous drainage issues on Long Island. These images, as well as others presented herein, showcase actual conditions and events which have occurred. These are not just isolated locations or anomalies, but rather the reality of the present state of the systems throughout the island. Lack of attention to the prevailing conditions and dedication of resources to investigate, redesign, and reconstruct the aging and currently deficient systems is the major cause for the unacceptable ability of the collective systems to function as required.
Thunderstorms pound NYC and LI

NY 25, Jericho Turnpike, west of NY 110, Walt Whitman Road. There is a recharge basin along the north side of NY 25 just west of NY 110 which appears to have capacity issues.

Article in Newsday, July 18, 2018. Showing flooding along NY 27, Sunrise Highway below the Long Island Rail Road Trestle in Massapequa (Nassau County).
Northern State Parkway
Eastbound at Carman Road
(Wolf Hill Road Exit 41).
Flooding across entire
roadway occurs regularly.
The existing drainage
system consists of leaching
structures installed during
the original construction in
the 1950s and minor
upgrades in the 1990s.

NY 27A, East Main Street
and Cooper Street/Willow
Street in Babylon Village.
Flooding regularly occurs at
this location during rainfall
events due to the influence
of the tide on the operation
of the drainage systems.
NY 27A, East Main Street, Babylon. Flooding regularly occurs at this location due to conveyance issues at Cooper Street/Willow Street. Note flooding of sidewalk and curb ramp. Not a desirable condition for a walkable community.

Robert Moses Causeway Northbound at exit for Southern State Parkway Eastbound. Flooding into the travel lanes occurs frequently due to apparent lack of conveyance capacity and absence of shoulders.
The images above are representative samples of common and recurring issues. See some pictures below of what can happen when drainage systems are not regularly upgraded, maintained and/or inspected.

NY 231 Northbound north of John Street/Long Island Rail Road in West Islip. Flooding into the travel lanes occurs frequently due to apparent clogging of inlet structures along the right shoulder and overgrowth of turf along the left shoulder, preventing drainage into the swale in the median.

NY 27, Sunrise Highway, South Service Road, North Babylon. Appears a section of CMP, which existed when this portion of NY 27 was constructed in the 1960s, collapsed, undermining the pavement.
To compound matters, storm frequencies and intensities are increasing. Note the flooding which occurred in the August 13, 2014 rainfall event, which crippled travel on Long Island.
Convinced now Long Island has extensive drainage issues? The evidence is clear, and left unaddressed, the conditions will continue to worsen at an accelerated rate. The time to act is now to stave off the costs to repair not only the drainage systems, but also the collateral damage attendant with system failures, as seen in the photographs above.
1. Introduction and Purpose

Between the various public agencies on Long Island, there are hundreds of miles of roadway which contain drainage elements which must be analyzed, redesigned, repaired, and or/augmented to bring these systems to a state of good repair to address current deficiencies and begin the replacement of aging features, and improve their capabilities to adequately convey runoff from rainfall events which are occurring not only with greater intensities than in the past, but with increased frequencies.

This drainage inventory was initiated at the request of the Long Island Contractors’ Association, Inc. (LICA) to catalogue from a broader perspective the existing drainage facilities owned and maintained by the New York State Department of Transportation Region 10 Office, Nassau County Department of Public Work, Suffolk County Department of Public Works, and the various towns and villages, and determine the major issues which plague these systems. LICA entered into a contract with Greenman-Pedersen, Inc. (GPI), a consulting engineering firm with extensive experience in planning, design, and construction inspection of drainage improvement projects. A scope of work was developed, along with milestones submittal dates.

The materials presented within this document will be used by LICA during budget negotiations in the New York State Legislature to advocate for increased funding for Long Island to fully inventory, study, design, and construct improvements for drainage systems, and adequately maintain these facilities to:

- Increase safety for motorists, pedestrian and bicyclists using the roadway facilities;
- Channel water away from pavement structures and other roadway elements to reduce damage due to pumping, free-thaw cycles, and erosion/undermining, thereby significantly increasing the service lives of these features while decreasing maintenance costs;
- Reduce encroachment and damage onto nearby privately-owned lands and buildings;
- Provide for fully passable evacuation routes in the event of major storm events such as hurricanes;
- Improve water quality of local waterbodies, streams, creeks, and rivers by retaining runoff to settle out impurities before these runoff quantities enter their ultimate discharge points;
- Redirect runoff volumes in recharge basins to keep the local aquifers properly replenished;
- Properly respond to the increases in runoff volumes due to climate change;
- Address roadway flooding due to sea level rise;
- Provide for new drainage infrastructure along roadways which currently do not have curbs, so curbs can be added to better separate vehicular and non-motorized traffic and create more walkable communities.

GPI met with representatives of the following agencies:

- New York State Department of Transportation Region 10 Office
- Nassau County Department of Public Work
- Suffolk County Department of Public Works
- Suffolk County Highway Superintendents’ Association (SCHSA)
- Town of Islip Department of Public Works/Highway Department
- Town of Babylon Department of Public Works.

In addition, GPI coordinated and corresponded with other Suffolk County town representatives via email and in person at SCHSA events. These agencies worked cooperatively with LICA and GPI and provided valuable insight and data to help present the issues which are recurring and some of their plans to remedy deficiencies of which they are aware.
2. Meetings with Municipalities

As noted above, GPI met with the following agencies/organizations and/or has had correspondence with them:

- New York State Department of Transportation Region 10 Office (NYSDOT)
- Nassau County Department of Public Work (NCDPW)
- Suffolk County Department of Public Works (SCDPW)
- Suffolk County Highway Superintendents’ Association (SCHSA)
- Town of Islip Department of Public Works/Highway Department (TOIDPW)
- Town of Babylon Department of Public Works (TOBDPW)
- Town of Smithtown Highway Department (TOSHD)
- Town of Huntington Highway Department (TOHHD)
- Town of Brookhaven Highway Department (TOBHD).

Several meetings were convened with SCDPW, NCDPW, and NYSDOT to discuss the purpose of this inventorying exercise, elicit input from the staff members at various levels and from different functional units, collect data on existing conditions and deficiencies, and determine their future needs.

GPI also met with the SCHSA members to discuss issues and challenges confronting the more localized municipalities. Several presented plans in development for major improvements to their roadway and drainage systems to prepare for climate change and sea level rise. These areas were mostly located along the coastal and low-lying areas along the south shore, exclusive of any plans along the barrier islands separating the bays from the Atlantic Ocean.

3. Common/Recurring Issues and Deficiencies

The lack of funding to implement modifications to existing systems is a common issue amongst all agencies. Additionally, staffing and other resources to maintain existing systems are not available due to other priorities within the agencies and their governmental entities. Since most drainage features are underground and essentially “invisible”, there is an “out-of-sight-out-of-mind” philosophy which pervades the agencies. Recently mandated tax caps have also forced municipalities to “do more with less”, and oftentimes cuts are made to agencies where leaders believe the impacts of these reductions will not be as intense as other higher profile services.

Damage/deterioration of infrastructure elements due to lack of proper drainage is often hard to assess, and many times the causes of advanced states of degradation may be incorrectly attributed to other issues such as age, overuse, and damage by other means. In some cases, there may not even be an awareness of impacts of improper drainage because many of the facilities fail at an earlier rate because all lack adequate conveyance systems. For example, asphalt concrete overlays on parkways may all have similar service lives because of the amount of water retained on these roadways due to improper drainage. Perhaps if better systems were in place, water would be removed quicker, and less would infiltrate the pavement structures, thereby reducing damage caused by trapped water during freeze/thaw cycles. Furthermore, as potholes and chuckholes begin to form in these overlays, more water is permitted to penetrate the pavement structure, exacerbating the situation and accelerating the deterioration.
4. Inadequate Facilities

There are roadways which are used as daily commuter routes which experience regular flooding under almost any rainfall event. These tend to be older, local roadways constructed at a time when Long Island was more rural in character. Many of these roads had little to no positive drainage features relying mostly on sheet flow of the drainage to the edges of the pavement and into adjacent lands. As development occurred, usage of the roadways increased, but no improvements to the drainage elements were implemented. A section of New Highway, which is a two-lane roadway, approximately two miles in length between the Southern State Parkway and Conklin Street in East Farmingdale is an example of a commuter roadway which floods due to lack of proper drainage systems. During the AM peak period, over 800 vehicles per hours traverse this section in the northbound direction and over 600 vehicles per hour traverse the southbound direction in the PM peak period. During rainfall events, some regular users most likely reroute to NY 110 or CR 3, Wellwood Avenue, to avoid the flooding issues. With drainage and other roadway improvements, New Highway would be better able to function as a reliable alternate route to the heavily trafficked NY 110 and CR 3.

New Highway looking north. Note the extent of the flooding across the entire width of the pavement. During cold weather months, icing conditions can exist due to snow melting and re-freezing. This picture was taken October 27, 2019. This is a recurring condition. The amount of splash from the vehicles driving through the flooding is significant and causes poor visibility for opposing traffic being hit by the water from splashing. This is only one of several spots within this stretch of roadway where this type of flooding regularly occurs.
5. Aging Infrastructure

Primary limited access as well as local signalized arterials have drainage facilities which, while still functioning to some degree, have been in service in excess of 50 years. Many of the leaching, inlet and junction structures were constructed using concrete or cinder blocks which have deteriorated. Some of these basins have already collapsed, and others are in poor or bad condition. Based upon the conditions of nearby structures which had been cleaned and found to be in need of immediate repair or replacement, some structures are not being cleaned due to concerns that removal of the silt and debris may cause severe damage or total failure, as these materials are providing support to the walls, preventing collapse.

A prime example is the section of the Northern State Parkway from the Wantagh State Parkway to its eastern terminus at NY 454/ NY 347, Veterans Memorial Highway. To put the value of this asset into perspective, the section just to the east of Wantagh State Parkway carries over 100,000 vehicles per day during the week, with essentially equal volumes in both directions. Constructed under numerous contracts from 1947 until 1963 substantial portions of the original drainage systems are still in use. Some interim improvements to address known drainage deficiencies had been made when the parkway was reconstructed in 1993 to improve non-standard geometric features such as super-elevation rates, increase acceleration/deceleration lanes, and install guide railing where needed and when the interchanges with NY 110 and NY 231 were reconstructed. Much of the parkway runoff still discharges into individual leaching basins installed when the parkway was originally constructed. Some of these basins have not been located or inspected in decades, and their capabilities to adequately process runoff volumes are unknown.

Similar conditions exist along the Southern State Parkway throughout its entire length. While interim improvements have been made, flooding during typical rainfall events still regularly occurs. Excessive encroachment into the lanes can be observed between CR 2, Straight Path and NY 231, Deer Park Avenue, and at the interchange with Bay Shore Road and Robert Moses Causeway, particularly in the westbound direction.
6. Outdated Design Standards

There are many roadways in operation which were constructed and opened to traffic most likely before there were requirements for providing drainage. In the early 1900s with the advent of the automobile, roads were being constructed using various materials such as coal cinders, gravel, and oil and chips. As traffic volumes increased, more durable surfaces were used such as hot mix asphalt (Macadam) and Portland cement concrete. Most of these early roadways drained via sheet flow to the edges of pavement and into nearby low areas, swales, or ditches. As the areas became more developed and roadways had to be widened to accommodate the increased volumes, drainage inlets and piping networks were designed and constructed to convey runoff away from private properties and towards water bodies, detention/retention basins, leaching basins, and recharge basins.

When originally constructed, most of the parkways on Long Island were intended to access parks, thus the term “parkways”. Due to their limited access, lack of traffic signals, and prohibition of trucks, these quickly became major commuter routes.

The existence of a “drainage design standard” for the parkway system when originally conceived and designed could not be determined. Drainage inlets were required and provided along the parkways due to the curbed roadway sections and lack of shoulders to convey roadway runoff into swales or ditches. While aesthetically pleasing in appearance, the well-landscaped and curbed roadways present problems during heavy rainfall events, with the fall season and high wind events depositing debris onto the roadways and clogging inlets and drainage pipes; and storms in the winter where melting snow re-freezes at night resulting in slippery pavement surfaces.

In order to preserve the nature of the parkway system, reconstructed portions must provide curbs and landscaping. The current New York State Department of Transportation standard for encroachment of water (spread width) into the travel-way requires significantly more inlet structures and runs of pipe to properly convey the runoff volumes.
Some of systems along these older roadways may not be compliance with current design criteria. If reconstructed, these would need to be brought into compliance with current standards, particularly if recurrent deficiencies exist.

Presently, there are different design criteria for various roadway types. The primary arterials such as interstates and other limited access facilities (except parkways) have more stringent requirements due to higher traffic volumes traveling at high speeds, significant truck traffic, the use for emergency access and evacuation routes. Other roadway classifications may permit more runoff to be conveyed along the pavements due to lower speeds and volumes, limited public right-of-way to accommodate increased drainage features, and the costs to install these larger systems.

Local municipalities in Nassau County generally designed drainage conveyance systems to handle rainfall events with a maximum intensity of 2.5 inches per hour. Recharge basins were designed to store 5 inches of water over the entire watershed if there were positive overflow available, and 8 inches of water over the entire watershed if positive overflow were not available. These parameters may need to be revised to better enable drainage systems to contain runoff from more frequent and intense storm events.

As discussed elsewhere in this document, the design criteria may need to be reviewed and modified to account for climate change factors.

7. Maintenance of Existing Systems

Universally among all agencies is the concern regarding maintenance of the existing facilities. Agency representatives stated they do not have scheduled maintenance programs in place for the entirety of the drainage systems which fall under their jurisdictions. Chronic problem areas are known and documented, and oftentimes proactive measures are taken in advance of predicted storm events, however, most other problems are only addressed after a problem arises or is reported, which is reactive. Some of the reasons cited for lack of regularly scheduled maintenance are:

- Insufficient number of Staff needed
- Insufficient funds
- Unknown extent of the existing systems
- Unknown intake and discharge volumes
- Unknown sources of runoff
- Cleaning/repairing old systems could cause more damage than the “do nothing” option
- Mentality of “Do not search for a problem where one does not currently exist”
- Systems are essentially invisible to the public and officials, fostering the “Out of sight, out of mind” mindset
- Other issues within the jurisdictions have higher priorities.

Another challenge for the already overtaxed maintenance crews is the need to regularly monitor/clean water quality units so these function as designed to improve the quality of runoff which enters local water bodies. Many acknowledged these units are not maintained per the recommendations of the manufacturers due to lack of funding for replacement parts and staff which can be assigned to these tasks.
8. **Walkable Communities**

More and more people want to see the creation of walkable communities. These help to bring people together, along with promoting healthier lifestyles (walking/riding versus automobile travel) and reducing air and noise pollution for vehicles and improving the safety for non-motorized forms of transportation.

Current drainage criteria need to be reviewed and revised so those walking when rainfall events occur can safely cross streets without having to step in flows of water 10 feet wide and 5 inches deep. In order to meet this objective, more inlet structures would be required to intercept runoff sooner, thereby reducing the depths and breaths of these flows.

SCDPW is currently planning to install curbs along CR 80, Montauk Highway, from Medford Avenue in Patchogue to Lee Avenue in Southampton to accommodate sidewalks, which will provide defined spaces for pedestrians. Within this section, approximately 280,000 total linear feet for both sides of the road (26.5 centerline miles) do not have curb. Using an estimate of two inlet structures every 500 feet of roadway yields approximately 560 structures. The piping is estimated at 110,000 linear feet. Implementing this program will require significant dedication of funds just for the drainage element alone.

9. **Climate Change**

Regardless of the origin of the causes, climate change is a factor affecting frequency and duration of storm events. Over the past 50 years, the frequency of major storm events has increased, and when coupled with the greater intensities, the impacts to the existing drainage collection, conveyance, and storage facilities are even more severe, causing more flooding and damage to nearby roadways, and public and private facilities. Increased runoff volumes from these storms cannot be accommodated by systems designed to process volumes from lesser rainfall events. Even systems which are determined to be in good condition and would not be programmed for remedial repairs may need to be rebuilt to adequately manage these increased volumes.

10. **Sea Level Rise**

In addition to the impacts from climate change, many coastal communities must also contend with the challenges of sea level rise. Systems which discharge into tidal canals, rivers, and bays can be rendered inoperable if even a minor rainfall event occurs coincidentally with a high tide. These systems were designed to drain the area in a timely manner based upon a lower mean high-water elevation. Sea level rise over the last 50 years and its predicted increase in the next several hundred years has significantly reduced the ability of existing systems to function as required. In addition, more frequent high tide events are causing flooding on local streets as the water enters the drainage systems and comes up through the inlet grates which are at lower elevations than the elevation of the tide.
Recognizing the desire of many people to reside near the water, as many have raised houses and rebuilt on the same lots after Superstorm Sandy in 2012, several towns in Suffolk County have identified areas along their southern boundaries where roadway raisings are planned to counter the effects of sea level rise. Several of these towns, and some villages within these towns, have already performed selected roadway raisings, are currently implementing others, and will be letting others shortly, however, these account for only a small percentage of the total roadway miles requiring these measures. Furthermore, for these to be more effective, the existing drainage systems may need to be augmented, or raised to increase the differences in elevations between the lowest inlet grates and the anticipated higher tides, and the added volumes from increased storm frequencies and intensities.

More recurrent flooding due to increased frequency and intensity of storms. This event occurred in October 2019 in Lindenhurst, New York.

Numerous houses were being raised after Superstorm Sandy. Despite the risks and inconvenience of rising water levels, many residents still desire to reside close to the water. This image is from a street in Seaford, New York taken in 2013 after the storm.
11. Economic Costs of Inadequate Drainage

Economic impact costs for inadequate drainage conveyance are somewhat difficult to accurately calculate, since the damage can occur in numerous forms and over different time spans however, these costs do exist. Below are some consequences which may result due to the lack of ample conveyance features:

- Accelerated/premature deterioration of infrastructure such as roadway pavements, culverts and bridges
- Increased chances for overtopping curbs and berms, causing erosion of slopes and embankments
- Increase chances of turbid waters entering natural waterbodies
- Damage to ecosystems
- Damage to natural resources which impact economic health of area (destruction/pollution of clam beds, oyster beds, lobsters, fish, etc.)
- Travel delays for commuters, goods and services
- Increased usage of emergency crews and equipment and reallocation of funds for emergency repairs, which are often temporary
- Reduces maximum potential of other facilities such as roadways, sidewalks, parking lots due to flooding
- Likelihood of critical failure increases with more intense and frequent events
- Damage to vehicles, buildings/private property, utilities, etc.
- Longer response times for emergency services providers.

The lack of investment in needed drainage improvements is akin to the failed “deferred maintenance” philosophy of the New York City Transit Authority in the 1970s and 1980s. Deferments of the needed repairs to infrastructure, maintenance facilities, and rolling stock only increased the magnitude, costs, and time needed to re-mediate the deterioration and bring the individual elements back to a state of good repair. During this period, service reliability was poor which resulted in a decline in ridership and low morale for transit service providers and riders alike.

Allocation of funds for necessary drainage improvements need to be viewed as investments, not just expenditures. True cost-to-benefit ratio calculations need to be performed to prove to all stakeholders the value of these investments.

A similar example would be installing a proper gutter, leader, and dispersal path system for a single-family dwelling. Originally, these add costs to the construction of the building, but if properly installed and maintained will eliminate or significantly slow the deterioration of critical elements of the structure. Gutters should be cleaned in the fall and spring, leaders repaired, and dispersal pads/pipes cleared of accumulated debris to ensure water is directed away from the structure. If these are not maintained, water can infiltrate into the sheathing, framing, insulation, and foundation promoting mildew, mold, rot, and freeze-thaw cracks in the foundation, which will introduce even more water into the structure, accelerating the deterioration. Even after ten years of neglect, repairs to the deteriorated elements can easily cost several tens of thousands of dollars to repair. When compared to annual maintenance costs of $500 per year, the benefits from the relatively small cost of proper maintenance far outweigh the costs of future damage repairs.

The recent investments in the second and third track projects for the Long Island Rail Road were a recognition of the negative impacts of inadequate and unreliable rail service to the current economy of Long Island and the impediment to future growth of business, manufacturing, and other commercial opportunities. Investments in these improvements increases the movement of people and services between the New York City and Long Island Regions, benefiting both. In addition, the use of private automobile travel will be reduced, which improves the air quality and overall environment as well. Investments in improvements to the drainage systems will also have measurable positive impacts to the economies and environments of the entire region.
12. Burdensome and Time-Consuming Process to Secure Funds from State and Federal Agencies

- Numerous municipalities complained of process to obtain funds; many will not bother if less than $100,000
- Process is not streamlined, with no fixed review timeframes in many cases
- Overall funds are limited
- Processes often do not allow “piggybacking” of work needed along with drainage improvements
- Details and specifications foist upon municipalities which are at variance with their standard practices
- Lack of an advocacy group to assist agencies through the process
- Many forego applying for funds due to frustration with the process.

Representatives of the local municipalities have discussed the processes they need to follow to obtain additional funding for needed improvements. Sometimes these are onerous enough to require a fully dedicated staff member just to complete the needed paperwork and documentation, from agencies which are currently understaffed. Some of the comments received are noted below:

13. Conclusions/Observations:

Those who are charged with the responsibilities to improve the safety and conditions of the public roadways, while maintaining them to a level of adequate serviceability, are well-aware of the impacts to these facilities due to the lack of properly designed and constructed drainage features. Given the numerous constraints of time, funding, staffing, and available right-of-way, coupled with the competing interests within and among the various governmental entities, drainage issues have taken a lower priority. The only time drainage issues are of concern for most people is when there is a significant failure which impacts travel, movement of goods, or significant collateral damage. Recurrence flooding along roadways, even when proven to cause delays to motorists and other users, is generally tolerated and accepted as a normal circumstance.

Even when drainage failures on Long Island occur, they generally are more localized and do not have the same broader impacts as the failures of other underground or aerial features. If a water main breaks, thousands could be without water for hours or days at a time. A broken sewer main has the same impact as a broken water main and the attendant health concerns. Failure of electrical facilities, as evidenced during recent storms, can impact the lives of millions of people. What many people fail to realize, some of these problems may not have occurred if water were properly channeled away from these facilities. Some pipe breaks may be due to stresses within the pipes due to lack of support of underlying materials due to erosion caused by water entering the soil strata.

Based upon the information collected during the preparation of this document, there appears to be a need to develop a comprehensive strategy for the Long Island Communities to:

- Assess current conditions and deficiencies
- Identify the criteria to be used to meet the anticipated fluid climate conditions
- Develop an overall plan encompassing the needs of all agencies
- Develop a phased implementation plan
- Begin a public awareness program similar the one being used by “Citizens Campaign for the Environment” to explain the benefits of good drainage systems and the compatibility with other initiatives such as cleaning the environment, protecting sensitive water bodies, etc.
- Obtain support from other groups with varied and sometimes competing interests to show bipartisan agreement of the needs and benefits
- Design the improvements to address the most critical areas first
- Investigate methods and resources to procure funding.