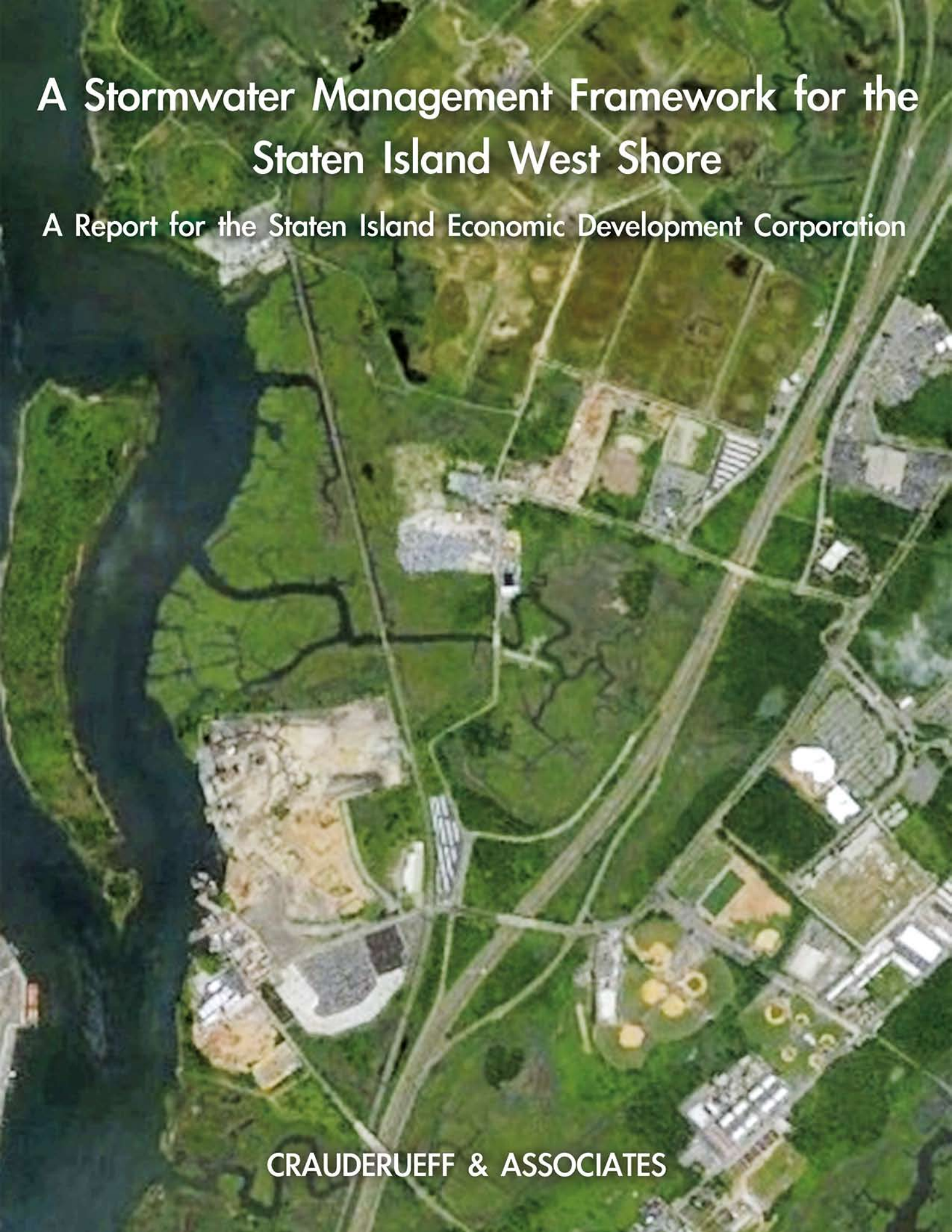

A Stormwater Management Framework for the Staten Island West Shore

A Report for the Staten Island Economic Development Corporation

CRAUDERUEFF & ASSOCIATES

Cover image credit: Google Maps (2013)

This report was completed by Crauderueff & Associates for the Staten Island Economic Development Corporation.

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Table of Contents

Executive Summary

This study develops a watershed-scale framework for the West Shore IBID/BOA area in the context of ongoing development policies and plans. Using a data inventory compiled for this analysis, this study also recommends three next steps.

The study area, approximately 230 acres, has 20 to 25 active businesses that lack basic infrastructure services, such as storm and wastewater management and modern roads. Several key existing sites within the study area experience stormwater challenges, including flooding during dry weather, wet weather, and extreme storm events. Business owners also seek improved wastewater services. Surrounding strategic sites, such as the GATX site and the Saw Mill Creek, may worsen or mitigate stormwater runoff challenges in the study area, depending on their future uses and site-specific designs.

Numerous development strategies have emerged from public agencies and the SIEDC suggesting both further growth and the use of a Bluebelt to manage stormwater. At the same time, the land use of the study area is highly regulated by the DEC and EPA due to the presence of tidal wetlands. The area also has been identified as a key ecological area by several citywide and borough-based analyses. Although numerous studies recommend a Bluebelt for the area, the NYC DEP presently prioritizes other areas of Staten Island and Queens for Bluebelt infrastructure investments. The study area was highly impacted by Superstorm Sandy, and much of it is situated within the 100-year flood zone. Flooding likely will increase in the study area due to climate change, based on sea level rise and the increased frequency and intensity of storms.

This study develops a framework for assessing stormwater management at the watershed scale, and explains the use of both green and gray infrastructure with respect to areas with high water tables. A data inventory identifies more than 50 data sources that could support further analysis, and identifies data gaps requiring further research.

This study recommends three next steps: (1) characterizing the watershed; (2) commissioning an engineering assessment for the Faztec Industries site; and (3) conducting a joint environmental and economic analysis of businesses. This joint analysis would identify site-specific stormwater management challenges and opportunities, and identify strategies to encourage business growth.

Chapter 1: Introduction to Study Area

Report Overview

This study develops a preliminary framework for assessing stormwater management in the West Shore Industrial Business Improvement District (WS-IBID), and prepares for a watershed characterization of this area. Given the prevalence of vacant properties along the West Shore of Staten Island, many have pointed to this area as strategic for economic development. The attraction of green businesses and the shared use of resources have emerged as priority development practices. The Staten Island Economic Development Corporation seeks to advance a 'Green Zone' strategy along the approximately 5,000 acres of the West Shore to facilitate development. The WS-IBID represents an approximately 230-acre area within the Green Zone that supports between twenty and twenty-five active businesses in the construction, recycling, transportation and trade industries.[1] The SIEDC recently submitted a BOA application to New York State with a similar boundary as the WS-IBID. The prospective BOA, encompassing a 178-acre area, would support the re-use of undeveloped and vacant land.[2] This report refers to the WS-IBID and BOA areas collectively as the 'study area.'

The study area within the Staten Island Green Zone includes the proposed WS-IBID (red boundary) and BOA area (black boundary). Image Courtesy the SIEDC.

The ultimate goal of this multi-phased stormwater project is to identify implementable, sites-specific strategies to manage stormwater for WS-IBID businesses, and for properties within the BOA area. The remainder of this study assesses, preliminarily, the policy context and environmental science relevant to the study area. This study also prepares for a watershed characterization through a data inventory and gap analysis. This study concludes with recommendations for further stormwater management planning within the study area. First, however, a brief discussion of the study area characteristics is in order.

Study Area Characteristics

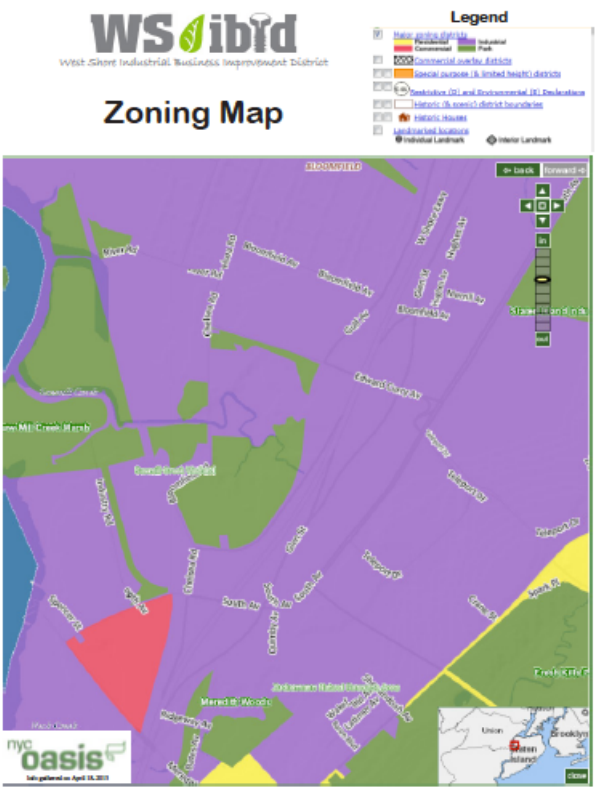
The study area is situated within the Bloomfield and Chelsea communities, borders the Travis neighborhood, and is northwest of Fresh Kills Park. Properties within the study area are situated along or near the waterfront, the Arthur Kill, a tidal strait. The study area historically was covered by wetlands; undeveloped land in the area continues to be covered predominately by tidal wetlands.

A total of seventy-two parcels exist within the WS-IBID; 52 parcels are privately owned on 132 acres of land, and 20 parcels are publically owned by NYC and NYS on 98 acres of land.[3] Whereas the IBID focuses on both developed and undeveloped sites, the proposed BOA focuses on activating undeveloped and under-utilized sites, including brownfields and wetlands. The area is predominately zoned manufacturing and parkland. There is not any housing within the WS-IBID, which does not contain any residentially zoned land. The SIEDC has received numerous bids for existing sites within the study area.

However, businesses within the study area lack basic stormwater, sewage, and transportation infrastructure. Occupied sites utilize septic systems to manage sewage, many narrow streets flood during dry weather, and neither site-specific nor watershed-based stormwater management best practices are consistently implemented. Active businesses have expressed concern with respect to flooding during dry weather, flooding during light and moderate wet weather events, and flooding during extreme weather events such as tropical storms and hurricanes. Businesses in the area were severely impacted by Superstorm Sandy.

The BOA Area. Image Courtesy the SIEDC.

As discussed in subsequent sections of this report, the study area is an ecologically sensitive area that has been prioritized for protection by several citywide studies. The area is highly regulated by



state and Federal agencies due to the presence of tidal wetlands. The low-lying condition of the study area contributes to its persistent flooding. Sea level rise and the increased frequency and intensity of rain events, two consequences of climate change, are likely to increase the area's risk of flooding in the future.

The WS-IBID area. Image Courtesy the SIEDC.

The WS-IBID is located in Staten Island Community Board 2, the 122nd Police Precinct District, the 50th New York City Council District, and Sanitation District 2. The area surrounding the WS-IBID consists of waterfront property and wetlands (almost exclusively tidal wetlands that flow into the Arthur Kill), commercial enterprises, and undevelopable parkland, owned by the City or the State.

High Profile Sites

Several higher profile sites merit extra consideration with respect to stormwater management. While some sites, such as Faztec Industries, are presently experiencing flooding challenges, others, such as the Saw Mill Creek, provide longer-term stormwater management benefits.

Faztec Industries

The Faztec Industries site, 3.3 acres in size, is a concrete aggregate company. This site, zoned M3-1, experiences flooding during dry and wet weather, and was flooded by Superstorm Sandy. Flooding challenges for the site, located at 200 Bloomfield Avenue, have increased post-Sandy. The entry road to the facility floods during dry weather, as depicted below; the flooding worsens after wet weather events. The road becomes covered by ice during the wintertime, becoming a safety hazard. The SIEDC reports difficulty planning for further transportation improvements given the persistent flooding in the area.

200 Bloomfield Avenue, Faztec Industries. Photo by Crauderueff & Associates.

501 Industry Road

An extreme sports facility utilizes the 501 Industry Road site, a former Chocolate Factory. This site lacks sanitary sewer hook-up, and has several acres of existing wetlands on-site. The facility currently occupies 3.6 acres, though it is expanding to an adjacent 5.2 acre site. The owner is interested in identifying solutions for managing its sanitary sewer needs as the business expands. The sites are zoned M2-1 and M3-1.

501 Industry Road (the 'Chocolate Factory'). Photo by Crauderueff & Associates.

The Island Charter Bus Company

The Island Charter Bus Company at Bloomfield Avenue experiences consistent flooding. This site, comprised of 1.0 and 1.3 acre lots, is adjacent to wetlands. The site is zoned M3-1.

Island Charter Bus Company at Bloomfield Avenue. Source: Google Earth

The Former GATX Site

The study area is surrounded by many properties whose future uses remain to be determined. One critical site adjacent to the study area is the GATX site, where NASCAR had proposed a racecar track. This site, a former petroleum facility located along the Arthur Kill, is approximately 660 acres in size.[4] NASCAR recently sold the site to a developer who has been undergoing negotiations with the DEC for site permitting and brownfield remediation. Two lots within the GATX site, totaling over 312 acres, neighbor the study area.

The GATX site in context of the Bloomfield-Teleport neighborhoods. Source: Working West Shore 2030, p. 20.

The development of this site could change the flow of water in the study area, potentially worsening or alleviating certain flooding problems.

The Saw Mill Creek. Photo Courtesy Rich Shaw, NRCS

Collective changes to the land use of many smaller properties could also significantly impact stormwater management in the WS-IBID area. The importance of a watershed scale analysis that considers the potential impact of properties outside of the study area is discussed in Chapters 3 & 4.

Saw Mill Creek

Saw Mill Creek, adjacent to the WS-IBID area, is a significant site due to its ecology. This site was originally zoned manufacturing but was transferred to the NYC DPR in 1994 to restore and preserve the land for ecological purposes.[5] The site supports the ecological health of the region, including biodiversity for herons (it is part of the Harbor Heron project supporting the resurgence of herons to New York City), birds of prey including falcons, and Eastern cottontail rabbits.[6] Both Saw Mills Creek and the nearby Merrill's Creek are considered Significant Coastal Fish and Wildlife Habitat by the NYS DEC. The Pralls Island Nature Preserve lies just off-shore from the Saw Mill Creek; these two sites and the Merrill's Creek have been designated priority wetland site status per the Federal Emergency Wetlands Resources Act of 1986. A 2007 assessment by the Wetlands Transfer Task Force considered Saw Mill Creek a 'high priority', assessed nineteen sites along the creek, and recommended the inter-governmental transfer of eight sites.[7] The preservation of these sites would support stormwater management of the region. Further research should identify the status of these suggested transfers, and consider how the Saw Mill Creek may help to mitigate stormwater within the study area and beyond.

Endnotes

[1]SIEDC WS-IBID application.
[2] SIEDC BOA application.
[3] IBID district plan, April, 2013.
[4] New York City Department of City Planning. (March, 2011). *Vision 2020: New York City comprehensive waterfront plan. p. 160.* Accessed August, 2013 from http://www.nyc.gov/html/dcp/pdf/cwp/vision2020_nyc_cwp.pdf
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[6] Ibid; New York City Wetlands Transfer Task Force (WTTF). (September, 2007). *Recommendations for the transfer of City-owned properties containing wetlands*. New York.
[7] WTTF, 2007.

Chapter 2: Policy & Planning Analysis

Introduction

Chapter 2 summarizes relevant planning and policy initiatives with respect to stormwater management in the study area. The study area is a sensitive environmental area regulated by state and Federal wetlands regulations, and prioritized by local planning initiatives for balanced development and preservation. Although New York City does not have any laws regulating wetlands, which could fill state and federal regulatory gaps, as a matter of policy it has actively sought to acquire certain strategic privately owned properties with wetlands. In other instances, the City has preserved publically owned land by transfer to the DPR or DEP through interagency memoranda of agreements (MOUs). Although post-Sandy planning efforts have shed new light on the sensitivity of waterfront areas to flooding, no clear directive exists for the development of the study area.

Federal & NYS Regulations

Both the Federal and New York State governments regulate and require permits for wetlands. The below section summarizes key regulations with respect to their relevance to the WS-IBID area.[1]

Wetland Mapping

Mapping provides much of the basis for wetland policymaking and regulation. Wetland maps for New York City, originally filed between 1987 and 1995, have not been amended, though the 2012 NYC Wetlands Strategy used satellite imagery to identify the presence of wetland citywide.[1] Moreover, the extent of wetlands varies by time of day, by time of year, and over the course of multiple years. Thus, the point in time when mapping occurs, as well as the criteria used to identify wetlands, can impact whether and how they are mapped. Wetland maps provide not only a guide for the present location of wetlands, but also a guide for where they existed in the past. The historic land cover of wetlands is one strong indicator of a flood prone area.

The Federal Clean Water Act

Section 404 of the Federal Clean Water Act (CWA) regulates entities seeking to dredge or fill waters of the United States, which include wetlands. A permit program, overseen by the U.S. Environmental Protection Agency, is administered by the U.S. Army Corps of Engineers. Development projects using fill on wetlands may require a permit through CWA Section 404.[2] Wetlands requiring a CWA Section 404 permit are defined as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."[3] This regulation may require projects in the study area to gain a Section 404 permit, given the prevalence of wetlands and the potential use of fill to support development projects.

The National Environmental Policy Act (NEPA) & the Coastal Zone Management Act (CZMA)

Two additional relevant Federal laws include the NEPA, which requires an environmental impact assessment for major Federal projects, and the CZMA, which requires state coastal management planning for the receipt of certain Federal funds. As

[1] The policy and planning analysis in this report is intended for general informational purposes only. Specific development projects should seek legal guidance for further information with respect to any specific site or set of sites.

the Federal government does not own any land within the study area, NEPA is not immediately relevant. The CZMA requires state-based coastal zone management plans for obtaining certain sources of federal funds, and has impacted some local planning efforts that seek certain sources of Federal funding.[4]

New York State Freshwater Wetlands Regulations

The Freshwater Wetlands Act provides the New York State Department of Environmental Conservation with the authority to regulate mapped freshwater wetlands that typically are 12.4 acres or larger, or have special local significance.[2] At times, the DEC has argued that multiple nearby smaller freshwater wetlands should be covered under this regulation, arguing the sites are connected by surface water. The DEC also regulates 'adjacent areas' up to 100 feet from the freshwater wetlands, though occasionally the distance may be larger.[5] Common activities requiring a permit, listed below, include many development activities relevant to the study area. However, as many sites within and near the study are below 12.4 acres in size, this law may not apply to certain properties covered by freshwater wetlands.

Common activities requiring a freshwater wetlands permit
Construction of buildings, roadways, septic systems, bulkheads, dikes, or dams
Placement of fill, excavation, or grading
Modification, expansion, or extensive restoration of existing structures
Drainage, except for agriculture
Application of pesticides in wetlands

Source: New York State Department of Environmental Conservation

New York State Tidal Wetlands Regulations

Through the Tidal Wetlands Land Use Regulations, the NYS DEC has the authority to regulate mapped tidal wetlands of any size, as well as 'adjacent' areas up to 150 feet from the tidal wetland boundary.[6,3] The DEC maintains guidelines on its website for more than 50 types of land uses.[7] Permits are required for three categories of wetlands: the most stringently regulated, fresh marsh, intertidal marsh, high marsh, and salt meadow; the second most stringently regulated, coastal shoals bars and flats, littoral zone; and the least stringently regulated, adjacent areas. Certain high polluting uses are considered incompatible and cannot receive a permit on designated lands.

[2] Article 24 Part 663 of the Environmental Conservation Law Freshwater Wetlands Program codifies the Freshwater Wetlands Act.

[3] Article 25 Part 661 of the New York Environmental Conservation Law codifies the Tidal Wetlands Land Use Regulations.

NYC Waterfront Revitalization Program

Mayor Bloomberg's 2002 *New York City Waterfront Revitalization Program* developed a framework for assessing development projects along the city's coastal zone, seeking to mutually advance, where feasible, economic development, environmental protection, and waterfront access. This report helped NYC to comply with the Federal CZMA in an effort to quality for certain sources of Federal funding. Much of the study area is situated in one of three citywide 'Special Natural Waterfront Areas' (SNWAs), the Northwest Staten Island / Harbor Herons SNWA. SNWAs are defined as "large areas with concentrations of the natural resources, including wetlands, habitats and buffer areas," with the goal "to avoid any adverse primary or secondary impacts to the coastal ecosystem."[8] The Northwest Staten Island / Harbor Herons SNWA was provided this designation due to its tidal wetlands habitats, freshwater wetlands habitats, and significant coastal fish and wildlife habitats. Development impacts were to be minimized in these areas given their significant ecosystem benefits.[9]

Interagency Wetlands Transfer Task Force

Pursuant to Local Law 83, an interagency Wetlands Transfer Task Force (WTTF) inventoried City-owned land covered by wetlands and developed recommendations with respect to transferring many of these properties to city agencies, such as DPR and DEP, to protect them from development. This task force, convened by the Bloomberg Administration, was comprised of members from the NYC EDC, the NYC Department of Citywide Administrative Services, the DEP, the NYC Audubon, the Regional Plan Association, the DPR, and the Coalition for the Bight. With respect to the study area, the WTTF focused on the Saw Mill Creek wetland to consider publically owned land that could be preserved. The study, completed in 2007, recommended the interagency transfer of eight properties to DPR to advance preservation goals. The WTTF's section on Saw Mill Creek is provided in Appendix F.[10]

NYC Wetlands Strategy

Local Law 31 of 2009 required the City to create a comprehensive, citywide wetlands protection strategy. This strategy, incorporated into Mayor Bloomberg's *PlaNYC* sustainability initiative, puts forth recommendations for protecting, mitigating, restoring, and assessing wetlands in NYC. According to this strategy, the City will not develop regulations protecting freshwater wetlands smaller than 12.4 acres, which are neither covered by State nor Federal regulations. Rather, the City committed to a 3-pronged approach; it will: (1) seek to acquire wetlands from private land owners, particularly for the smaller freshwater wetlands not protected through State or Federal Regulations; (2) facilitate the use of off-site wetlands mitigation practices; and (3) continue to implement the WTTF's recommendations.

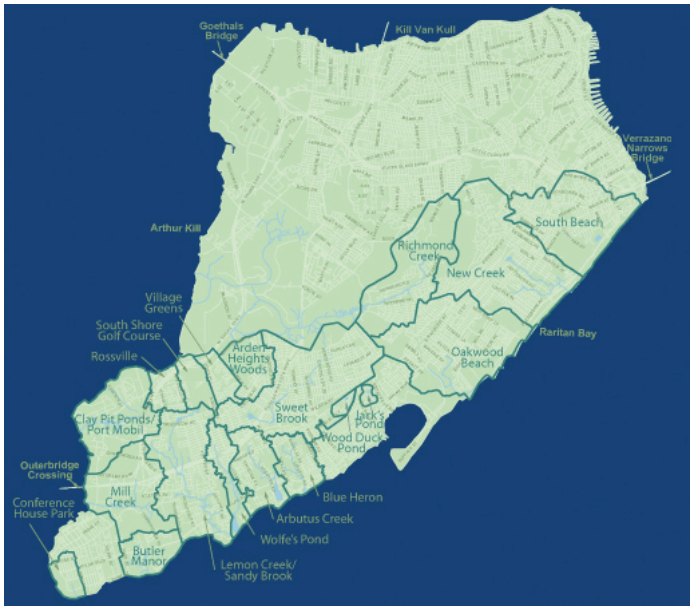
NYC Department of Environmental Protection (DEP) Planning

The NYC DEP provides stormwater infrastructure to communities citywide. The DEP has developed the Staten Island Bluebelt, a system of existing and constructed wetlands that manage stormwater primarily along the South Shore. The DEP's Green Infrastructure Plan commits to using green infrastructure where cost-effective, in addition to gray infrastructure, to meet its Clean Water Act Consent Order with New York State.[11] This plan focuses exclusively on areas with combined sewer systems, however, and therefore does not apply to the study area.

The Bluebelt Concept

The Staten Island Bluebelt utilizes a watershed-scale approach to manage stormwater runoff through both green and gray infrastructure approaches. The Bluebelt utilizes wetlands and streams as natural 'holding tanks' and conveyances to restore pre-development hydrology in 16 South Richmond watersheds. The Bluebelt, consisting of more than 14,000 acres (325 of which have been acquired by the City of New York), uses existing and constructed

wetlands with 'gray infrastructure' best management practices. The Bluebelt reduces the flow of stormwater, removes pollutants, and both detains and retains stormwater. The Bluebelt requires major capital expenditures by the DEP, which spent $72 million on acquisition from 2002 to 2011 and more than $350 million on infrastructure projects from its inception in the early 1990's through 2012.[12] The 16 South Richmond watersheds are delineated in the below map.



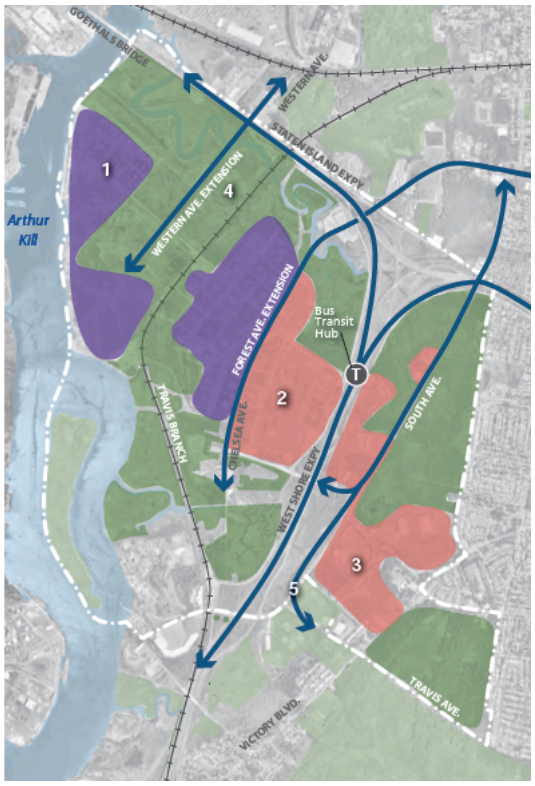
Staten Island Bluebelt Watersheds. Source: NYC DEP in Urban Omnibus, accessed September 2013 from http://urbanomnibus.net/2010/12/the-staten-island-bluebelt-storm-sewers-wetlands-waterways/.

Recent studies suggest that expanding the Staten Island Bluebelt to the West Shore would be a sensible stormwater management strategy. Both the *Staten Island Green Zone* study and the NYC EDC and DCP's *Working West Shore 2030* plan recommend Bluebelt strategies for the West Shore. However, the DEP has prioritized residential areas with failing septic systems for stormwater management, using the Bluebelt model where feasible.

The DEP is developing a Mid-Island Staten Island Bluebelt and a Bluebelt in Queens to address flooding. As the West Shore is less dense, less residential, and has less septic failure than other areas, the agency has not prioritized this area for stormwater infrastructure, including Bluebelt interventions.[13]

EDC & DCP's *Working West Shore 2030* Plan

In 2010, the NYC DCP and EDC released the plan, *Working West Shore 2030: Creating Jobs, Improving Infrastructure and Managing Growth* (*WWS 2030*).[14] The *WWS 2030's* Bloomfield-Teleport land use strategy encompasses much of the study area. The report identified four main characteristics of the Bloomfield-Teleport area: (1) an abundance of vacant and underutilized industrial areas; (2) significant highway, bridge and rail freight infrastructure; (3) underutilized office facilities; and (4) large natural areas that are not readily accessible or viewable. The plan notes that many of the natural areas need mitigation from contamination resulting from previous uses. The plan recommends five development strategies, as identified in the below image on page 11: (1) encouraging major maritime and industrial uses; (2) facilitating the development of a mixed industrial and commercial center along the West Shore expressway; (3) increasing the vibrancy and diversity of the Corporate Park and Teleport campus; (4) expanding and improving natural areas, and using natural areas as a network of public open spaces; and (5) supporting a comprehensive transportation network, including the creation of new road connections to facilitate access to the West Shore from nearby neighborhoods.[15] The WWS 2030 plan also provided land use strategies for adjacent neighborhoods. The Bloomberg Administration's *Vision 2020* citywide waterfront plan is consistent with the *WWS-2030* plan. *Vision 2020* recommends for the Bloomfield waterfront, "reutiliz[ing] industrial sites with modern distribution, maritime and commercial facilities that utilize the waterfront for goods movement, with sensitivity to existing wetlands," exploring infrastructure financing mechanisms, and seeking opportunities for public waterfront access as open space.[16]



Bloomfield-Teleport, WWS 2030, p. 21.

Post-Sandy Planning

In June, 2013 the Mayor's Office released the Special Initiative for Rebuilding and Resiliency (SIRR) Report, which provides a post-Sandy planning analysis primarily intended to inform the spending of post-Sandy Federal funding. The report also lays out an approach for longer-term climate adaptation planning. With respect to Staten Island, the bulk of planning has taken place in the east and south shores. Most relevant to the study area, the SIRR report commits to "[continuing] to implement and accelerate its innovative Bluebelt draining program."[17] Although these commitments are to the South Richmond, East Shore and Mid-Island Bluebelt areas, the City has, more generally, taken great interest in the use of green infrastructure to manage extreme storm events.

Several additional planning efforts are underway. The NYC DCP has commissioned a study assessing the use of green infrastructure after extreme storm events, as well as a study identifying climate adaptation measures in Significant Maritime Industrial Areas. The DCP also has proposed a flood resilience text amendment that would allow or require certain building and mechanical system improvements for properties within the 100-year flood zone. A significant amount of planning continues to take place post-Sandy, meaning the policy landscape can be expected to change over the next several years as the City continues its climate adaptation efforts.[18]

Conclusion

The multiple planning initiatives for the study area provide analysis at the site, neighborhood, and business district scales. As mentioned in Chapter 1, numerous site-specific plans exist both within and surrounding the study area. The regulatory approach by the DEC also is site-specific, whereby permits for the use of wetlands are typically reviewed and provided based on site-specific analyses. The EDC and DCP's *Working West Shore 2030* plan takes a neighborhood-scale approach, particularly with respect to leveraging existing infrastructure and open space. And, the WS-IBID and BOA areas have been developed based on the collective interests of businesses in the area.

What is missing from these planning scales is a connection to the flow of water in the study area. Although the DEP conducts watershed-scale analyses, it is prioritizing its resources in other watersheds. (The DEP's watershed-scale analyses are expensive, frequently costing several million dollars per watershed, and require transportation infrastructure to be planned or built.) Nonetheless, the flow of water should inform the planning and development initiatives underway. The next section lays out a framework for assessing the study area with respect to the watershed scale, and takes a preliminary look at the impacts of storm surge and climate change on the study area.

Endnotes

[1] City of New York. (2012). *New York City wetlands strategy*. Accessed August, 2013 from http://www.nyc.gov/html/planyc2030/downloads/pdf/nyc_wetlands_strategy.pdf
[2] U.S. Environmental Protection Agency. (n.d.). *Wetland Regulatory Authority*. Accessed August, 2013 from http://water.epa.gov/type/wetlands/outreach/upload/reg_authority.pdf
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[5] New York State Department of Environmental Conservation. (2013). *Freshwater Wetlands Program*. Accessed August, 2013 from http://www.dec.ny.gov/lands/4937.html; New York City Wetlands Transfer Task Force (WTTF). (September, 2007). *Recommendations for the transfer of City-owned properties containing wetlands*. New York.
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[16] New York City Department of City Planning. (March, 2011). *Vision 2020: New York City comprehensive waterfront plan. p. 160.* Accessed August, 2013 from http://www.nyc.gov/html/dcp/pdf/cwp/vision2020_nyc_cwp.pdf
[17] City of New York. (2013). *A stronger, more resilient New York.* Accessed August, 2013 from http://nytelecom.vo.llnwd.net/o15/agencies/sirr/SIRR_singles_Lo_res.pdf
[18] New York City Department of City Planning. (2013). *Proposed flood resilience text amendment*. http://www.nyc.gov/html/dcp/pdf/flood_resiliency/presentation.pdf

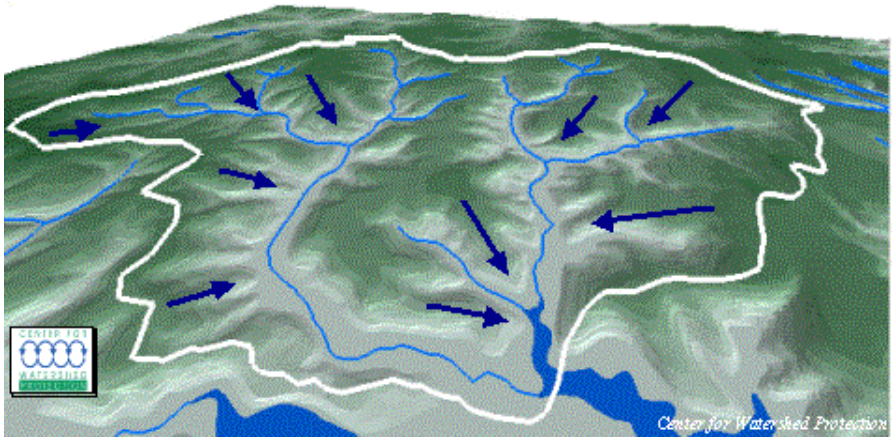
Chapter 3: Environmental Framework & Conditions

Watershed-scale Framework

The watershed is a useful scale for analyzing storm water runoff and flooding challenges. The EPA defines a watershed as "the area that drains to a common waterway, such as a stream, lake, estuary, wetland, aquifer, or even the ocean."[1] The below image provides an example watershed, delineated in white, with arrows identifying the flow of water within the watershed to a common body of water.

The amount, speed, and direction of stormwater can be altered through the development process, both by sites within and outside of the watershed. As discussed in the following section, development can degrade the quality of wetlands, increasing the risk of flooding.

Further research needs to delineate the watershed in which the study area is situated to more fully understand its storm water management challenges. A more detailed description of how a watershed can be analyzed in the context of the study area is discussed in Chapter 4 and Chapter 5.



Watershed delineation. Source: Center for Watershed Protection, in Minnesota Department of Natural Resources

The Significance of Wetlands

A significant percentage of the study area and its surroundings is comprised of wetlands, predominately tidal wetlands. Historically, wetlands formed in areas that flooded or were wet much of the time. For this reason, wetland plants are particularly adept to flood conditions, and exist in naturally occurring floodplains.[2] Wetland plants have special properties that enable them to survive in persistently wet or flooded soils, making them particularly effective 'natural technologies' to manage stormwater and improve overall environmental quality. For this reason, wetlands serve as both an indicator of a flood-prone area and as critical stormwater management infrastructure with additional ecosystem benefits.

The additional benefits of wetlands include:

- Buffering businesses and communities from the effects of flooding and storm surges;
- Preventing erosion, because wetland plants hold together soil systems;
- Improving water quality by filtering pollutants and stabilizing nutrient levels;
- Preventing subsidence, or the reduction in sea level elevation.

Tidal Wetlands & the Arthur Kill

Tidal wetlands hold a particularly important role in supporting a healthy ecosystem. Tidal wetlands provide a nursery for fish and other oceanic creatures, which supports a significant percentage of commercial fishing; they also provide a habitat, nesting, and feeding area for birds. Tidal wetlands

are among the most biologically productive environment in the world, similar to rainforests. Tidal wetlands also stabilize the shorelines in areas prone to erosion from coastal storms.[3] The stringent regulations by the New York State DEC of tidal wetlands reflect their significant ecological services.

The Arthur Kill watershed, including the study area, has an important role in local ecology. According to the interagency NYC Wetlands Transfer Task Force,

> "The Arthur Kill watershed contains some of the most productive wetland habitat within NYC, with Arlington Marsh, Staten Island, alone supporting approximately fifty species of water birds. Both the Arthur Kill and Jamaica Bay watersheds support significant habitat and spawning grounds for large number of resident and migratory fish species, including those that have federal or state- listed rare, threatened, or endangered status."[4]

Development Challenges of Wetlands

Developing on wetlands presents numerous challenges from a stormwater management perspective. For example, on dry days, water may flow from neighboring wetlands onto actively used business properties and roads. The water table of wetland areas is typically very high, so water may flood from below the ground, particularly after rain events. Moreover, it can be challenging to infiltrate (i.e. use rain gardens or other ground-level vegetation) as a storm water management strategy on former wetlands because of the high water table.

Site-specific Stormwater Management Challenges

While the scale of the watershed is critical, individual sites may also have elevated and depressed areas that contribute to site-specific flooding. For this reason, site-specific data – for example, elevation data and soil drainage properties – may help to explain flooding for particular sites. The importance of these data is further discussed in Chapter 4.

Climate Change: Sea Level Rise & Storms

New York City's changing climate increases the likelihood of flooding in the years to follow. The subsequent sections describe the expected sea level rise, which increases flood risk, and the expected increase in frequency of moderate and extreme storm events.

The City of New York, through PlaNYC, released the report in June, 2013, *Climate Risk Information 2013: Observations, Climate Change Projections, and Maps*, which synthesizes many anticipated impacts of New York City's changing climate. The study notes that the relative sea level in New York City has risen 1.1 feet since 1900, primarily a consequence of climate change. Researchers are more than 95% certain that sea levels will rise in the coming decades, expecting the following increases in sea level:

- 4 to 8 inches by the 2020's, based on mid-level estimates, with up to an 11 inch increase based on the high estimate;
- 11 to 24 inches by the 2050's, based on mid-level estimates, with up to a 31 inch increase based on the high estimate.

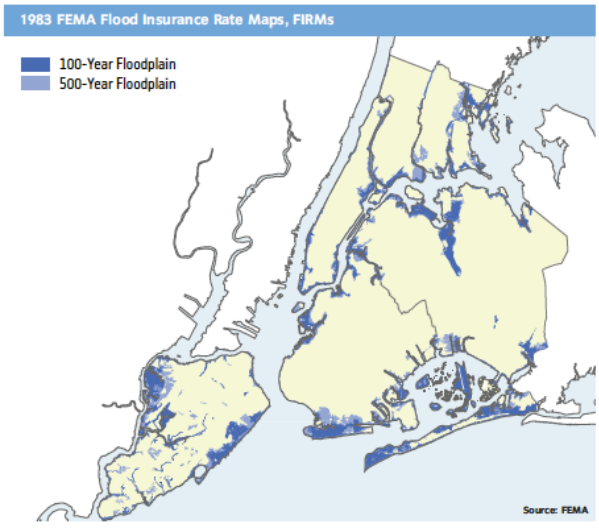
Sea level rise will cause an increase in the frequency, extent, and height of coastal flooding. Researchers project that, by 2050, the 1-in-10 year storm may occur as frequently as every three to six years, and the 1-in-100 year storm may occur every two decades. These changes in flood frequency are based on sea level rise alone. Researchers also anticipate an increase in the number of downpours, intense hurricanes, extreme hurricane winds, and intense hurricane precipitation in the North Atlantic Basin by 2050, further increasing the regional risk of flooding.[5]

Impact on Study Area

These changes are important with respect to the study area. Depending on elevation, some areas within the West Shore may actually be under-water due to sea level rise in the following decades. Moreover, the risk of flooding in the study area may worsen in the following decades due to sea level rise and the increased frequency and intensity of storms; subsidence could further increase the risk of flooding. Further research is necessary to understand the specific sites within the study area most vulnerable to sea level rise.

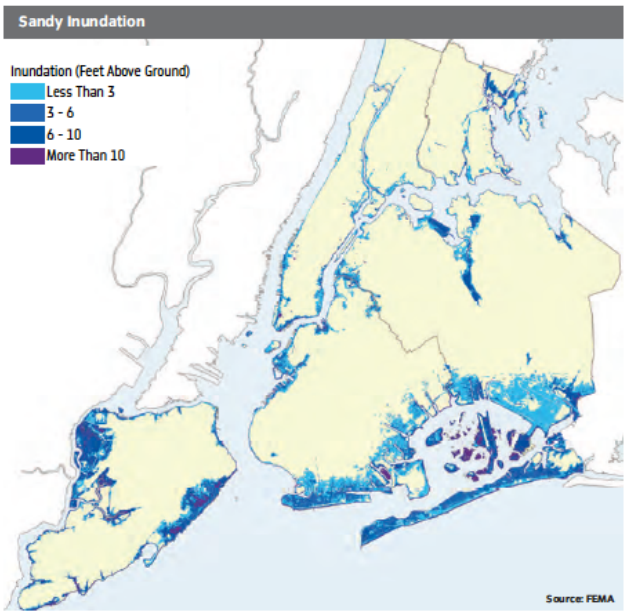
Preliminary Analysis of Flood Maps

Although further analyses should map the flood zone with respect to the study area, this section uses existing maps to provide preliminary, informal estimates of flood risk. From the below FEMA flood insurance rate map, it appears that nearly the entire WS-IBID area may lie within the 100-year floodplain. A 1-in-100 annual risk of flooding means there is at least a 26% chance of flooding within a 30 year timeframe, such as a mortgage. The 1-in-100 year estimate is conservative given (1) that the area may actually be at greater risk than 1-in-100 years, but this is the finest grain map readily available; and (2) the maps are based on 1983 flood risk, but climate changes and subsidence over the past 30 years have increased the risk of flooding.



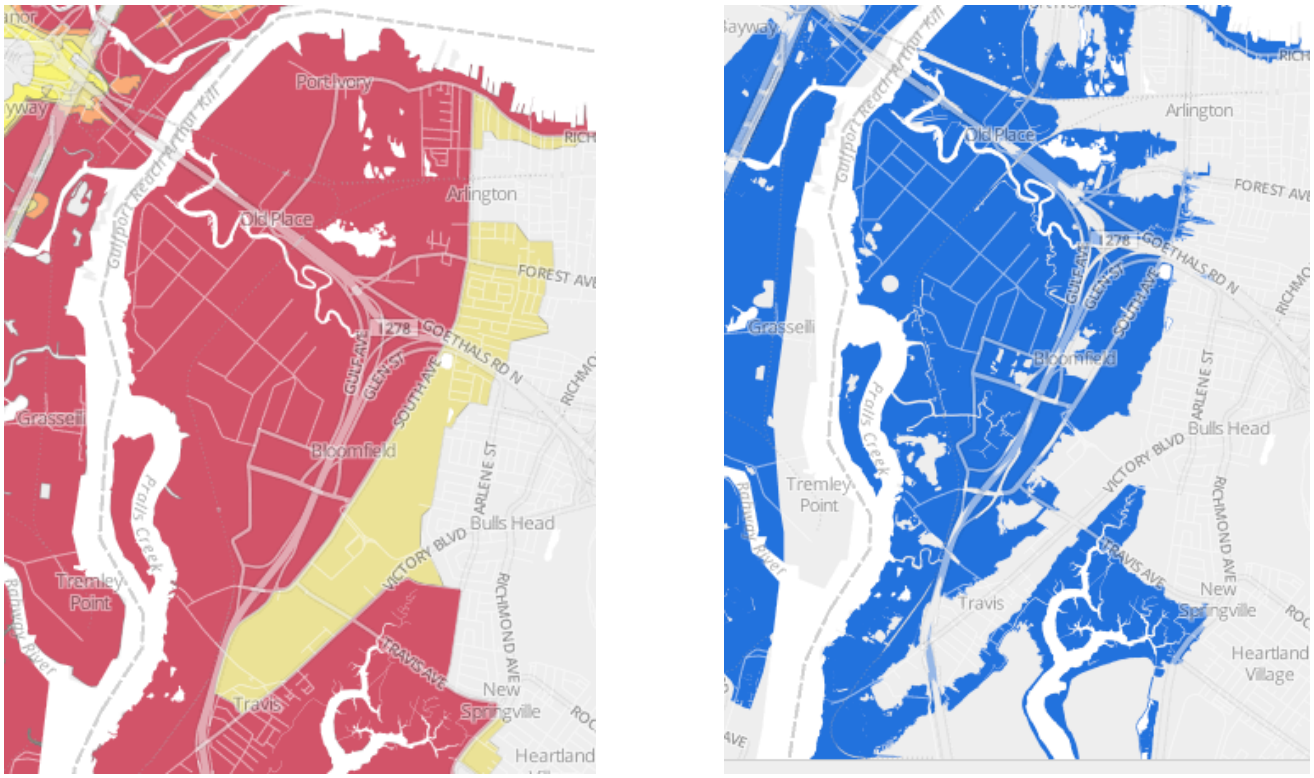
Flood insurance rate maps. Source: NYC SIRR report, p. 23.

Most of the study area is within the 100-year flood zone, zone AE, based on this year's FEMA preliminary work maps, as well. (See Appendix E for a map including the study area based on these flood hazard maps). The study area also is at high risk for storm surge. As the below map demonstrates, the study area was highly impacted by Sandy, experiencing storm surges of around six to ten feet.



Sandy inundation map. Source: NYC SIRR report, p 14.

The following two images illustrate projected and actual storm surges for the study area, respectively. The red zones demonstrate predicted flood zones for a Category 1 hurricane.[6] In addition to demonstrating the vulnerability of the study area to flooding, these maps also demonstrate the accuracy of scientific estimates. The scientific projections provided a very good idea of where to anticipate storm surge impacts.



Predicted storm surges (red) vs. actual flooding (blue) in the study area. Source: WNYC.

Green Infrastructure vs. Gray Infrastructure

Two main types of infrastructure can support stormwater management: green infrastructure and gray infrastructure. Watershed- and site-specific analyses are critical in identifying appropriate storm water management strategies, as discussed in Chapter 4.

Green Infrastructure

Green infrastructure, frequently considered 'low impact development,' maintains or mimics the natural flow of water by utilizing vegetation and/or allowing for infiltration. Green infrastructure technologies can be classified as 'ground-level' and 'roof-level'. Rain gardens, which capture and infiltrate stormwater, are one example of ground-level green infrastructure. The below example of a rain garden is designed so water drains down hill, through gravity, from both the building and the street into the rain garden. The same design principles could be applied to commercial or industrial properties.

Rain garden. Source: The US Environmental Protection Agency.

While ground-level green infrastructure has many benefits, it is more difficult to implemented as stormwater management on built-up sites where the water table is high. As previously mentioned in this report, infiltrating water where the water table is high could actually worsen flooding problems. In developed areas with high water tables, such as many areas formerly covered by wetlands, green roof and gray infrastructure technologies may be most appropriate, along with efforts to preserve existing wetlands/vegetated areas. Green roofs capture stormwater where it falls, reduce the rate of runoff, and filter the rainwater. The above 20,000 square foot green roof in Ft. Greene, Brooklyn was funded by the NYC DEP through its Green Infrastructure Grant Program, eligible for applicants located in combined sewer areas of the city. [7]

Bishop Loughlin Memorial High School Green Roof. Source: Highview Creations.

Existing wetlands also are green infrastructure. The Staten Island Bluebelt both restores and preserves wetlands, while strategically using gray infrastructure best management practices. The importance of preserving existing wetlands has increased given the impacts climate change. As the NYC Wetlands Transfer Task Force noted in 2007,

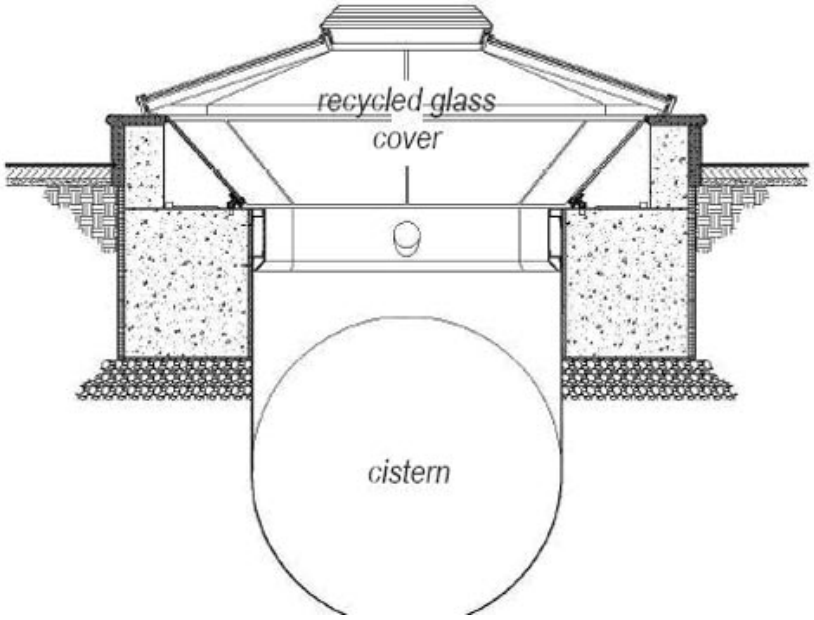
> "Increased wetland protection and enhancement will help New York City prepare for and reduce the impacts of future sea-level rise and increased intensity and frequency of storms. Opportunities to allow for the upland migration of the wetland as sea-level rises should be identified. Such adaptive measures will decrease the vulnerability of nearby residential communities and transportation infrastructure to flooding."[8]

This statement is particularly noteworthy given the range of task force members. Not only were environmental organizations, such as the NYC Audubon and the Department of Parks & Recreation, members of the task force; so too were growth-oriented organizations such as the NYC EDC and the Regional Plan Association.

Gray Infrastructure

Gray infrastructure detains or channels stormwater rather than utilizing it as a resource on site. Gray infrastructure may be more appropriate for areas that are difficult to manage stormwater through infiltration. One common type of gray infrastructure is the cistern. Cisterns are large underground tanks that store water. Because cisterns do not seek to infiltrate water into the ground, they may be more effective at managing storm water from rain events. Cisterns can be used to water rain gardens or other vegetation during dry weather, or they can drain off-site, to maintain capacity for wet weather events.

The below diagram depicts one typical cistern design.[9]



Cistern diagram. Source: US EPA

Force Main Analysis

Existing businesses, such as the extreme sports complex at 501 Industry Road, have expressed concern around the lack of sewage infrastructure. One potential method of managing wastewater in the study area is via force main. Force mains use pumps to convey wastewater. Force mains may be used when gravity is not sufficient to convey wastewater to a treatment facility.

Discussions with DEP indicate that a force main could potentially be a viable solution to manage wastewater within the study area. The system would need to be privately financed by the participating businesses. For example, businesses within the IBID could collectively agree to pay a fee to finance the construction of the IBID. For a back-of-the envelope figure, the DEP estimates a force main could cost from several hundred dollars to one thousand dollars per linear foot under normal conditions. A $1,000/linear foot system would cost approximately $5.3 million per linear mile. A force main is generally install three to four feet below ground. Because the water table is likely less than two feet below ground in many areas within the IBID given the typical water table of wetland areas, costs could be still higher due to the additional costs associated with installing a system below the water table. A pump station also would need to be sited and installed, and additional costs would be required to maintain the system. It would not be economical for a single business to construct a force main. Although force mains may be technically feasible, they are not a common practice by the DEP. Further research should be conducted to consider the interest of existing businesses in a force main. Additional discussions should be pursued with DEP if businesses express conceptual interest in investing in force main infrastructure. Specific design considerations, and examples of other force mains in the city, should be discussed at that point in time.

Endnotes

[1] U.S. Environmental Protection Agency. (2013). *Watershed*. Accessed September, 2013 from http://water.epa.gov/type/watersheds/

[2] Tiner, R. (2000). *Wetlands of Staten Island, New York: valuable vanishing urban wetlands. U.S. Fish and Wildlife Service, Ecological Services, Northeast Region, Hadley, MA. Prepared for U.S. Environmental Protection Agency, Region II, New York, NY. Cooperative National Wetlands Inventory publication.*

[3] Connecticut Department of Energy & Environmental Protection. (2013). *Tidal wetlands – general information*. Accessed August, 2013 from http://www.ct.gov/deep/cwp/view.asp?A=2705&Q=323824; New York City Wetlands Transfer Task Force (WTTF). (September, 2007). *Recommendations for the transfer of City-owned properties containing wetlands*. New York..

[4] Ibid, p. 10.

[5] New York City Panel on Climate Change. (2013). *Climate risk information 2013: observations, climate change projections, and maps*. (eds, Rosenzweig, C. & Solecki, W.). Prepared for use by the City of New York Special Initiative on Rebuilding and Resiliency. New York, NY.

[6] WNYC. (2013). *Flooding & flood zones*. Accessed August, 2013 from http://project.wnyc.org/flooding-sandy-new

[7] Highview Creations. (2013). *Highview Creations*. Accessed September, 2013; http://www.hvcnyc.com/projects/greenroofs/; for photo credit, see: http://www.hvcnyc.com/media/hvc/project_photos/IMG_0046.JPG

[8] WTTF, 2007 (p. 3-2).

[9] U.S. EPA. (2013). Accessed September, 2013. Photo credit, http://www.epa.gov/oaintrnt/images/lid/cistern_cc_lg.jpg

Chapter 4: Data Inventory

Introduction: Watershed Characterization at Various Scales

It is important to characterize a watershed both at small and large scales. Watershed characterization provides an analytical framework for assessing the condition of the watersheds and enabling the development of appropriate stormwater management plans. The watershed as a whole provides a context for understanding smaller sub-watersheds and land parcels within them, and how sub-watersheds and land parcels function within this watershed as a whole. These scale gradients allow for characterizing baseline conditions, identifying and targeting priority or problem areas, and infrastructure solutions. For example, if a particular lot floods and the cause is on the watershed-scale, a stormwater management system on the lot may not alleviate flooding. In other words, it is likely that off-site conditions are causing this site to flood. Site-scale assessments, in the context of a larger watershed, are needed for appropriate management, planning and implementation. Conversely, multiple sites with common problems or problem sources can be analyzed collectively to define a larger geographical management area.

Data and analysis are needed to inform assessment for stormwater management potential and strategies. A data inventory identifies what data are readily available and what data need to be acquired. The data inventory will inform subsequent analyses, which will lead to potential stormwater management strategies.

Data Inventory

A data inventory has been collected for defined target data categories necessary to complete a full stormwater assessment. Table 1 provides a summary of the target data categories, their brief descriptions and corresponding potential uses and analyses (see Appendix A for descriptions of each data category). The data search involved identifying primary sources from reports, studies, literature reviews, plans and proposals for the area. A broad and comprehensive search was conducted for data sources from the federal, state and local governments and organizations. Investigations were made through online data depositories and through interviews. The data inventory contains tabular data and GIS data. More than 50 key datasets were identified. These are listed with their sources, descriptions and their related data categories in Appendix C and Appendix D. A list of sources, contacted by phone or email, are listed in Appendix B.

Data category	*Description*	*Possible analyses/uses*
Topography	watershed boundaries, elevation contours, terrain, land cover, geographic regions, watershed sub watershed and site-scale delineations	• delineate sub watershed boundaries for storm water management areas • Identify appropriate scale for source control • delineate exiting and proposed drainage at targeted scale
Hydrology	watershed boundaries, flow, surface water bodies, water body and type delineations, groundwater, geomorphology, seasonal water table, aquifers, water features, water drainage structures, tides, flood zones, flood plains, coastal delineations, regulations, wetlands	• locate and identify water bodies and features • delineate spatial and flow relationships (sources and contributors) • establish hydrographs • delineate sub watershed boundaries for storm water management areas/source control • delineate exiting and proposed drainage at targeted scale • identify zones and delineate flood severities • define existing conditions under variable climate • predict conditions
Climate	precipitation, temperature, relative humidity, ,	• calculate water quantity • establish hyetographs • assess/model climate conditions for targeted areas and design (e.g., rain-runoff modeling, calculations)
Land Use (including all above-ground infrastructure)	land use, existing management, development, zoning, governmental jurisdictions, ownership, man-made infrastructure, conserved/preserved areas, public/private properties, proposed land use changes, regulations	• identify and compute connected and unconnected runoff sources and total acreage • identify existing and future land use changes and model these effects on current and proposed management strategies • identify potential or unavailable areas for management strategies
Soils	Infiltration rates, characteristics types, percolation rates, hydric groups, resource status	• identify erosion and erosion potential • use in hydrological modeling for runoff and volume capture • characterize existing conditions and model effects of management • identify potential contamination problems
Water Conditions	water quality of surface and subsurface water bodies, designated statuses, water assessments, pollutant sources, chemical and biological data	• identify protected uses, regulations of water bodies and surrounding areas • identify protected water bodies • identify current water quality conditions of water bodies • model improvement or effect on water quality conditions • identify pollutant sources and potential source control areas • identify permit requirements for use or discharge to water body
Subsurface Geology	aquifers, depth to bedrock, underlying bedrock, outcrops,	• identify depth to bedrock and bedrock type • use in hydrological assessment and modeling of flow and contamination potential
Underlying infrastructure	septic, sewers, drains, electric, communications, dry well (all manmade infrastructure)	• identify subsurface structures to inform design and management • identify problems and conditions of infrastructure • identify existing and possible management strategies
Wildlife and Natural Resources	wildlife conditions, diversity indices, regulations, conservation/preservation/protection status, habitats, habitat status/quality	• identify protected species (endangered, threatened, rare status)and/or resources • find stressors to wildlife and habitat • identify threats to wildlife or natural resources • identify habitat types • identify designated wildlife and preservation/conservation • identify restoration projects

Target data categories, descriptions and possible uses.

Key Findings

Available Data

The data collected are readily accessible to conduct delineation and characterization of the watershed encompassing the study area. The available data allow for a coarse, low-resolution analysis which will help target and prioritize sub-watershed delineations and will determine the assessment and analysis needs on the site-specific level.

Data Gaps

This data inventory is a living document. It should be supplemented and updated during the stormwater management assessment, analysis and implementation phases. Even though we gathered data and identified gaps, not all gaps will be known until some analyses and modeling are conducted. Data gaps can occur at various scales and may be different for analyses versus implementation. The most significant data gaps are at the site-specific scale. We anticipate that, over the course of this multi-phased project, the following data need to be collected at the site-level at a minimum (the list is by no means all inclusive):

- ground elevation (field) surveys to the nearest foot for site-based drainage delineation
- site by site evaluation of pollutant sources
- site conditions during dry, wet and extreme weather, as well as by season (data recording through observation and photographs)
- field surveys and ground-truthing of land cover and land use
- field surveys of sites for ground flow routes/conditions (i.e., curbs, failed infrastructure due to flooding/flows, extreme weather etc.)
- groundwater monitoring wells, models to calculate hydrographs and incorporate precipitation data and trends
- ground penetrating radar surveys for verification and calculation for: depth to water table, bedrock, subsurface infrastructure
- verify existing street grading and proposed street changes and runoff values
- local precipitation data (either existing or specifically collected for our purpose)
- evaluate site-specific standing water conditions
- site-specific pictures detailing water conditions during wet, dry, storm conditions
- site evaluation of environmentally hazardous site condition history

When all necessary data are collected, they can be used to delineate sub watershed boundaries for stormwater management areas; to delineate existing and proposed drainage at targeted scales; to assess the possible use for stormwater management of existing natural and designed systems; to assess the effects on natural systems and receiving water; to outline problem and potential areas for storm water management; and to propose possible designs and mitigation strategies on a variety of criteria and scales (in size, effectiveness and cost).

Chapter 5: Conclusion & Next Steps

Report Summary

This study evaluated ongoing development practices in the study area with respect to stormwater management, and developed a framework for further analysis. The study area, approximately 230 acres, has 20 to 25 active businesses that lack basic infrastructure services such as storm and wastewater management and modern transportation infrastructure. Several key existing sites within the study area that experience stormwater challenges include the Faztec Industries and the Island Charter Bus Company; the extreme sports facility at 501 Industry Road seeks solutions for wastewater as it plans to expand. Surrounding uses, such as the future use of the GATX site and the Saw Mill Creek, may increase or mitigate storm water runoff challenges in the study area, depending on their future land uses and site-specific designs.

Numerous development strategies have emerged from public agencies and the SIEDC suggesting both further growth and the use of a Bluebelt. The EDC and DCP's *Working West Shore 2030* plan identified the study area and its broader region as a strategic area for development; this plan was consistent with the DCP's *Vision 2020* waterfront plan. The Staten Island Green Zone includes the study area, and the SIEDC is working with the NYC DCP to create the West Shore Business Improvement District for the area.

At the same time, the land use of the area is highly regulated by the DEC and EPA due to the presence of tidal wetlands throughout the study area, and has been identified as a key ecological area by several citywide and borough-based analyses. The wetlands support stormwater management within the study area while buffering surrounding neighborhoods from extreme weather events, which are anticipated to become more severe in the near future due to climate change. The wetlands also provide key ecosystem services, such as water quality improvement and providing habitat for commercial fish and birds. Although numerous studies recommend a Bluebelt for the area, the NYC DEP presently prioritizes other areas of Staten Island and Queens for Bluebelt infrastructure investments.

This study developed a framework for assessing stormwater management at the watershed scale. Green infrastructure, such as existing and constructed wetlands, rain gardens, and green roofs, could assist with the management of stormwater in the study area. Ground-level green infrastructure, however, could worsen flooding at built-up sites where the water table is high, although wetland preservation is one key strategy for managing stormwater in the short and long terms. Gray infrastructure technologies (for example, cisterns) could be more appropriate for some existing properties with high water tables.

Finally, a data inventory identified more than 50 data sources that could help with further analysis, and identified data gaps requiring further research.

Next Steps

The following three recommendations utilize the watershed scale to assess the area in terms of stormwater management, utilizing existing data and filling in data gaps:

1) Characterize the watershed
Through a characterization of the watershed, the connections between land use, development trends and plans, existing regulations, environmental conditions and hydrology can be understood; sites that impact the study area in terms of stormwater can

also be identified. This characterization includes developing a catalogue of land use and land cover, and determining soil conditions, water quality, and seasonal depths to water table. GIS analyses would characterize the interplay between and among the environmental, development, management, regulatory and policy aspects/features/parameters. The watershed characterization would conclude by drawing big-picture trends across the watershed to target problem areas and feasible areas with respect to stormwater management. From this analysis, we could ascertain areas that would merit further investigation and site-level assessment. A menu can then be developed of suites of potential green and gray infrastructure that may be useful within the watershed. It is important to note that site-specific solutions cannot be identified through this watershed characterization study. However, the watershed characterization is a necessary first step.

2) Commission an engineering assessment for the Faztec Industries site

This site may benefit from short-term, site-specific interventions. Given that flooding has been worse post-Sandy, this site should be prioritized for an initial engineering assessment. A preliminary assessment could keep costs down by identifying what types of on-site infrastructure may merit a full engineering study.

3) Conduct a joint business environmental and economic analysis

A survey of existing businesses and their sites would be most helpful in understanding stormwater challenges and potential development trends. Through field visits, a finer grain of analysis would help to develop a stormwater strategy for the study area with respect to individual sites, in the context of broader development objectives.

The joint assessment would seek to answer the following three questions:

1. What are the conditions of the land of active businesses in the IBID?
2. What types of site-specific stormwater strategies should be further considered for the study area?
3. What development needs and opportunities exist for active businesses in the study area?

This study should include an environmental conditions survey: environmental issues, impacts and concerns, septic/sanitary sewage challenges, a hydrology delineation (including flooding, erosion and soil conditions), and stormwater related expenses such as loss of property and reduced clientele. A preliminary environmental engineering site visit and assessment would complement this analysis to consider relevant stormwater and flood proofing techniques.

We suggest the survey also assess the state of businesses in the area, shedding light on their development needs. Given the land use restrictions in the area, these survey results could help the SIEDC to understand how to best support business growth in the context of the watershed characteristics. Growth trends of businesses, such as employment and expansion plans, as well as the area and type of built-up land, existing infrastructure needs, and expansion plans, would help the SIEDC to characterize this area.

Finally, an initial consideration of key surrounding properties with either clear green infrastructure or development potential, such as the GATX site and Saw Mill Creek, should be included in this analysis.

Below are the brief descriptions for the data categories identified for the characterization of the watershed.

Topography

Topography defines geographic areas and delineates watersheds and sub watersheds. Slopes offer information on pollutant transport and possible sources. Elevations can help in determining flood impacts and can influence precipitation.

Hydrology

To address storm water runoff, flooding and erosion, it is imperative to comprehensively define and understand the existing natural and built hydrological and hydrogeological systems, their network (connectivity) and storm water conditions. These characteristics define watersheds and sub watersheds and their relationships. Storm water management involves manipulation or alteration of existing surface flow. Groundwater can be impacted by alteration of recharge or contaminant loading through infiltration. Groundwater and surface water base flows and elevations serve as indicators of flooding and therefore influence storm water management. Water systems carry pollutants and volume. Current conditions help evaluate the potential for storm water management, the effectiveness and its impact on the surrounding areas.

Climate

Climate data are a large part of defining the water budget of a system (natural or designed). It is an important factor in precipitation-runoff calculations and modeling for storm water management.

Land Use (including all above-ground infrastructures)

Land use data and zoning play an important part in storm water management assessment because they affect land cover (connected and not connected pervious and impervious land cover), which in turn affects storm water runoff and runoff rates. When considering areas for storm water management, it is also important to understand the zoning and land use as these will dictate feasibility of implementation in terms of policy, partnerships and land availability.

Soils

Erosion and storm water runoff conditions are heavily contingent upon soils and their characteristics, such as their infiltration and percolation capacities, stability, texture, and contamination levels. Soils govern pollutant fate and water transport.

Water Conditions

Designations and regulations of water bodies are important considerations. Water bodies are either directly or indirectly affected by storm water runoff and storm water management. Water bodies can be the direct receiver of runoff or management design overflow. Water bodies can be the contributor of pollutants under certain conditions; they may also be considered to be part of the storm water management design through incorporation or alterations (e.g., the Staten Island Bluebelt). Water bodies are indirect recipients when they are affected by nonpoint source pollution. In any case, when considering storm water management, regulations and designations of the surrounding waters must be met and in the degradation of water conditions should be avoided to the extent feasible. Pollutant loading to and out of storm water management systems vary with sites and conditions and their effect on surrounding water bodies must be considered. Assessing source loads of existing and proposed conditions is important to meeting watershed and water quality goals.

Subsurface Geology

Geology features of the area, such as depth to bedrock, bedrock type and outcrops can define the original topography, water table line and flow characteristics, groundwater, and infiltration capacity for runoff. Depth to bedrock is also important when considering excavation as part of the storm water management design.

Underlying Infrastructure

Underlying infrastructure can have effects on the water drainage and on the design possibilities for runoff management.

Wildlife and Natural Resources

Protection plans, preservation, conservation and status designations for wildlife and other natural resources play a role in determining geographic locations, feasibilities and benefits of storm water management by prohibiting certain areas or defining areas in need.

Appendix B: List of Contacted Interviewees

Richard Shaw, State Soil Scientist	USDA-Natural Resources Conservation Service
John McLaughlin, Director	Bureau of Environmental Planning and Analysis, Office of Ecological Services, NYC Department of Environmental Protection
Alan I. Benimoff Ph.D., Lecturer	Department of Engineering Science and Physics, College of Staten Island/CUNY
James Garin, Director of Engineering	NYC Department of Environmental Protection
Narayana Venugopalan*	NYC Department of Design and Construction
Mikelle Adgate, Project Manager	Green Infrastructure Partnerships, NYC Environmental Protection
Barry Dinerstein, City Planner	NYC Department of City Planning
Michele McInnes, Deputy Director	Geographic Systems Section, NYC Department of City Planning
General outreach *	NYC Economic Development Corporation
David Clausnitzer*	Regional Ecological Site Specialist, USDA-Natural Resource Conservation Service
Steve Falcone	Difazio Industries
Fred DiGiovanni	Island Charter
Dana Gumb, Director	Staten Island Bluebelt Program, NYC Department of Environmental Protection
Mike Nagy, Consulting Engineer*	Staten Island Borough President's Office

* identifies sources that were contacted but did not responded

AppendixC: Data inventory matrices of the datasets (GIS and tabular)

GIS Data	Category	Topography	Hydrology	Climate	Flood Maps	Land Use	Soil	Water Conditions	Geology	Subsurface Infrastructure	Wildlife & Natural Resources
1981-2010 Annual Average Maximum Temperature by State	Climate			x							
1981-2010 Annual Average Precipitation by State	Climate			x							
1981-2010 Annual Average Raster Precip and Temp by State	Climate			x							
2009 Cartographic Boundaries	Zoning					x					
2010 Cartographic Boundary File	Geographical boundaries					x					
2013 Boundary and Annexation Survey (BAS)	Geographical boundaries					x					
303(d) Listed Impaired Waters	Water Quality							x			x
305(b) Assessed Waters	Water Quality							x			x
Clean Watersheds Needs	Water Quality							x			
Common Resource Areas by State	Geographical boundaries										x
Digital Ortho County Mosaic of 7.5' quads by APFO	Basemap layers (See description)	x									
Digital Raster Graphic County Mosaic by NRCS	Basemap layers (See description)	x									
Facilities that Discharge to Water	Pollutant Sources/Regulations							x			
Federal, State, Tribal, etc. Protected Areas Land Ownership	Landownership					x					
Fish Consumption Advisories and Fish Tissue Sampling Stations	Water Quality							x			
Geographic Names - Populated Places	Geographical boundaries					x					
National Elevation Dataset 3 Meter	Topography/Elevation contours	x									
National Hydrography Data All Mid Atlantic Region	Hydrological Systems		x								
National Hydrography Dataset 1:24,000	Hydrological Systems		x								
National Hydrography Dataset Mid Atlantic Region 2b	Hydrological Systems		x								

GIS Data	Category	Topography	Hydrology	Climate	Flood Maps	Land Use	Soil	Water Conditions	Geology	Subsurface Infrastructure	Wildlife & Natural Resources
National Land Cover Dataset by State	Terrain/Land Cover	x									
National scale Geology by State	Subsurface Geology								x		
No-Discharge Zones for Vessel Sewage	Pollutant Sources/Regulations							x			
Nonpoint Source Projects	Pollutant Sources/Regulations							x			
NRCS Conservation Easement Points by State	Land Use (including all above-ground infrastructure)					x					
Orthoimagery 2008, .3 Meter resolution	Basemap layers (See description)	x									
Orthoimagery 2012	Basemap layers (See description)	x									
Quadrangle Index 1:12,000	Basemap layers (See description)	x									
Severe Weather Data -GIS-County Warning Area	Climate			x							
Soil Survey Spatial and Tabular Data (SSURGO 2.2)	Soils						x				
STORET Water Quality Monitoring Stations	Water Quality							x			
The Beaches Environmental Assessment and Coastal Health (BEACH) Program	Water Quality							x			x
TIGER 2010 County Social, Economic, Housing Stats by State	Demographics					x					
TIGER 2010 Primary and Secondary Roads	Land Use (including all above-ground infrastructure)					x					
TIGER 2010 State and County Demographic Statistics by State	Demographics					x					
TIGER 2010 Streets	Land Use (including all above-ground infrastructure)					x					
TMDLs on Impaired Waters	Water Quality							x			
US Basemap layers	Basemap layers (See description)	x									
Watershed Boundary Dataset Lines for HUC2-12	Soils						x				

GIS Data	Category	Topography	Hydrology	Climate	Flood Maps	Land Use	Soil	Water Conditions	Geology	Subsurface Infrastructure	Wildlife & Natural Resources
SI Businesses Green NAICS status	Land Use (including all above-ground infrastructure)					x					
SI Businesses Match Status	Land Use (including all above-ground infrastructure)					x					
SI Businesses Match Status-Green Status	Land Use (including all above-ground infrastructure)					x					
SI PLUTO tax lot	Land Use					x					
SI Mapping Lot	Land Use (including all above-ground infrastructure)					x					
Flood-Frequency Hydrologic Regions for New York, Excluding Long Island	Flood Maps				x						
Flood hazard zone areas used in FEMA's Digital Flood Insurance Rate Map.	Flood Maps				x						
Digital Elevation Model NY State	Topography/Elevation contours	x									
New York State Large Scale Hydrography (1998)	Hydrological Systems		x								
Historical Wetland Data	wetlands		x								x
Wetland and Riparian mapping area	wetlands		x								x
NYC Waterfront Parks	Land Use/Zoning					x					
Waterfront Spaces NYC with Jurisdiction and Construction Status	Land Use/Zoning					x					
Publically Accessible Waterfront Spaces NYC	Land Use/Zoning					x					
Waterfront Access Plan	Land Use					x					
Coastal Boundary for Waterfront Revitalization Program	Land Use/Zoning					x					
LION single street base map	Land Use					x					

GIS Data	Category	Topography	Hydrology	Climate	Flood Maps	Land Use	Soil	Water Conditions	Geology	Subsurface Infrastructure	Wildlife & Natural Resources
Lower Density Growth Management Area	Land Use/zoning					x					
Stream flow	Hydrological Systems		x								
1 foot Digital Elevation Model (DEM)	topography/Elevation contours	x									
Shoreline	Topography/Elevation contours	x									
Roadbed	Land Use	x									
Hydrography	Hydrological Systems		x								
Contours Lines (2 foot)	topography/Elevation contours	x									
Sea Level Rise Maps (2050s 500-year Floodplain)	Climate and Hydrography			x	x	x					
NYC DPR Parks	Land Use										

Tabular Data	Category	Topography	Hydrology	Climate	Flood Maps	Land Use	Soil	Water Conditions	Geology	Subsurface Infrastructure	Wildlife & Natural Resources
Areas of Critical Environmental Concern	General										x
Designated Use and Class Data by State Waterbody	Water Quality							x			
National Water Information System Station Monitoring	Water Quality							x			
NYC detailed Basemap	Land Use					x					
STORET	Water Quality							x			
Topographic Maps for Arthur Kill	Topography/Elevation contours	x									
USGS National Water Quality Assessment	Water Quality							x			
WATERS, My WATERS Mapper	Water Quality							x			
Staten Island Soil Survey	Soils						x				
Green Zone-IBID Boundary maps	Geographical boundaries					x					
West Shore IBID Property Information Database	Landownership					x					
West Shore IBID by Property Assessment Value	Landownership					x					
West Shore IBID by Public & Private Parcel Ownership	Landownership					x					
West Shore IBID Owner Map	Landownership					x					
West Shore IBID Public Street	Land Use					x					
West Shore IBID Request for Cameras	Land Use					x					
West Shore IBID Streets to Service	Land Use					x					
Site Aerials West Shore IBID	Terrain/Land Cover					x					
West Shore IBID Wetlands Map	Wetland					x					
West Shore IBID Land Use Map	Land Use					x					
West Shore IBID Parks Map	Land Use					x					
West Shore IBID Zoning Map	Land Use and Zoning					x					
Green Goods and Services Industries by NAICS Code	Land Use and Zoning					x					
West Shore IBID Zoning Map	Land Use and Zoning					x					
Green Goods and Services Industries by NAICS Code	Land Use and Zoning					x					
Richmond County Businesses	Landownership					x					
SIBusinesses	Landownership					x					
Significant Habitats and habitat complexes of the NY Bright Watershed, Arthur Kill Complex	Habitat					x					
City Owned and Leased Property	Landownership					x					
NYC DPR Capital Projects	Land Use					x					
Awarded Construction Contracts	Land Use					x					
DSNY collection											

Appendix D: Data inventory of the datasets (GIS and tabular): sources and brief descriptions

GIS DATA			
Dataset ID	**Source**	**Source2**	**Descriptive Comments**
1981-2010 Annual Average Maximum Temperature by State	National Oceanic and Atmospheric Administration's National Climate Data Center	NOAA's NCDC	annual Temp average maximum by State
1981-2010 Annual Average Precipitation by State	National Oceanic and Atmospheric Administration's National Climate Data Center	NOAA's NCDC	annual precipitation averages by State
1981-2010 Annual Average Raster Precip and Temp by State	PRISM Climate Group, Oregon State University	PRISM Climate Group, Oregon State University	annual average precipitation and temp by state
2009 Cartographic Boundaries	U.S. Census Bureau	U.S. Census Bureau	basemap: simplified representations of selected geographic areas from the Census Bureau's MAF/TIGER geographic database 1990
2010 Cartographic Boundary File	U.S. Census Bureau	U.S. Census Bureau	basemap: simplified representations of selected geographic areas from the Census Bureau's MAF/TIGER geographic database
2013 Boundary and Annexation Survey (BAS)	U.S. Census Bureau	U.S. Census Bureau	legal boundary of governments effective as of January 1, 2012 and include boundary updates submitted to the Census Bureau during the 2012 BAS cycle
303(d) Listed Impaired Waters	Environmental Protection Agency	EPA	waterbodies under 303(d) listing
305(b) Assessed Waters	Environmental Protection Agency	EPA	waterbodies under 305(d) listing
Clean Watersheds Needs	Environmental Protection Agency	EPA	combined sewer overflow data and features, comprehensive assessment of the capital needs to the water quality goals set in the Clean Water Act
Common Resource Areas by State	U.S. Dept. of Agriculture	USDA	common resource areas
Digital Ortho County Mosaic of 7.5' quads by APFO	APFO(Aerial Photography Field Office), U.S. Dept. of Agriculture	USDA APFO	Ortho mosaics- 7.5' quads
Digital Raster Graphic County Mosaic by NRCS	Natural Resources Conservation Services	NRCS	topographic images
Facilities that Discharge to Water	Environmental Protection Agency	EPA	locations and their status of pollutant discharge permits (NPDES)
Federal, State, Tribal, etc. Protected Areas Land Ownership	U.S. Geological Survey Gap Analysis Program	USGS Gap Analysis Program	fed, state, tribal, protected areas land ownership
Fish Consumption Advisories and Fish Tissue Sampling Stations	Environmental Protection Agency	EPA	areas designated for fish consumption, fish consumption advisories and fish tissue sampling locations
Geographic Names - Populated Places	U.S. Geological Survey	USGS	geographic names of populated places
National Elevation Dataset 3 Meter	U.S. Geological Survey National Elevation Dataset	USGS NED	elevation dataset-3meter
National Hydrography Data All Mid Atlantic Region	U.S. Geological Survey, Environmental Protection Agency	USGS, EPA	hydrography features & watershed boundaries of Subregion 2
National Hydrography Dataset 1:24,000	U.S. Geological Survey, Environmental Protection Agency	USGS, EPA	flow, drainage and catchment 1:24,000 scale
National Hydrography Dataset Mid Atlantic Region 2b	U.S. Geological Survey, Environmental Protection Agency	USGS, EPA	flow, drainage, catchments, relief, elevation, topography, watershed boundaries, also contains features such as lakes, ponds, streams, rivers, canals, dams and stream gauges
National Land Cover Dataset by State	MRCL Consortium, U.S. Geological Survey	MRCL,USGS	21 different land cover categories with 30 meters spatial resolution
National scale Geology by State	U.S. Geological Survey	USGS	State-scale geological maps with mineral resource and geo-environmental assessments
No-Discharge Zones for Vessel Sewage	Environmental Protection Agency	EPA	zones of prohibited vessel discharge allowed

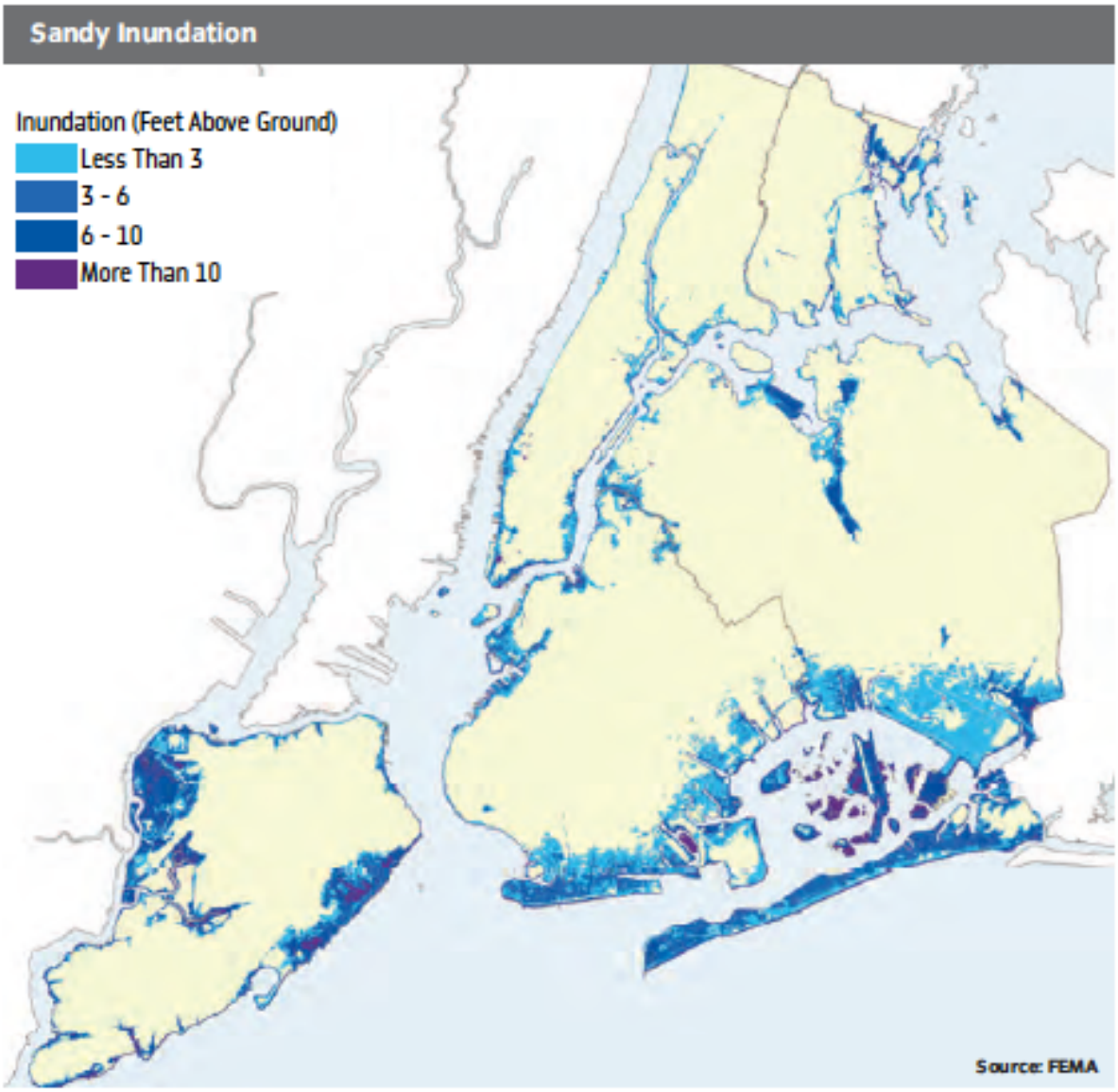
Nonpoint Source Projects	Environmental Protection Agency	EPA	locations of nonpoint source pollutant projects
GIS DATA (continued)			
NRCS Conservation Easement Points by State	Natural Resources Conservation Service	NRCS	conservation easements received from each state
Dataset ID	Source	Source2	Descriptive Comments
Orthoimagery 2008, .3 Meter resolution	Oracle, U.S. Geological Survey	Oracle, USGS	high resolution orthoimagery
Orthoimagery 2012	U.S. Geological Survey	USGS	high resolution ortho imagery
Quadrangle Index 1:12,000	USDA/NRCS - National Geospatial Center of Excellence	USDA/NRCS - National Geospatial Center of Excellence	quadranglebasemap
Severe Weather Data -GIS-County Warning Area	National Weather Service, Department of Commerce	National Weather Service, Dept. of Commerce	reports of severe weather
Soil Survey Spatial and Tabular Data (SSURGO 2.2)	Natural Resources Conservation Services, Soil Survey Geographic Database	NRCS	spatial and tabular soil survey
STORET Water Quality Monitoring Stations	Environmental Protection Agency	EPA	volunteer water quality monitoring stations
The Beaches Environmental Assessment and Coastal Health (BEACH) Program	Environmental Protection Agency	EPA	water quality reports and advisories for beaches
TIGER 2010 County Social, Economic, Housing Stats by State	U.S. Census Bureau	U.S. Census Bureau	social, economic, housing stats
TIGER 2010 Primary and Secondary Roads	U.S. Census Bureau	U.S. Census Bureau	primary and secondary roads
TIGER 2010 State and County Demographic Statistics by State	U.S. Census Bureau	U.S. Census Bureau	demographic statistics
TIGER 2010 Streets	U.S. Census Bureau	U.S. Census Bureau	streets
TMDLs on Impaired Waters	Environmental Protection Agency	EPA	areas under regulation of TMDLs on 303(d) listed impaired waters
US Basemap layers	Bureau of Land Management, Dept. of the Interior	Bureau of Land Management, Dept. of the Interior	base map layers of states, interstate and U.S. highways, major roads, 100k quads, county boundaries, urban areas, BLM administrative boundaries, and UTM zones.
Watershed Boundary Dataset Lines for HUC2-12	US Dept. of Agriculture	USDA	hydrologic watershed boundaries by subbasin 12-digit HUC
SI Businesses Green NAICS status	InfoUSA, Staten Island Economic Development Corporation	InfoUSA, SIEDC	final maps layers of matched business with green NAICS status
SI Businesses Match Status	InfoUSA, Staten Island Economic Development Corporation	InfoUSA, SIEDC	businesses that match and don't match georeferences and green zone
SI Businesses Match Status-Green Status	InfoUSA, Staten Island Economic Development Corporation	InfoUSA, SIEDC	businesses that match georeferences and green status
SI PLUTO tax lot	Dept. of City Planning	Dept. of City Planning	tax lot and building characteristics and geographic, political and administrative information for each tax lot in New York City.
SI Mapping Lot	Dept. of City Planning	Dept. of City Planning	DCP Mapping Lots includes features not on the Tax Map. There are three kinds of Mapping Lots: street center 'malls'; Traffic islands; streets through parks
Flood-Frequency Hydrologic Regions for New York, Excluding Long Island	U.S. Geological Survey	USGS	surface water, watershed boundaries, hydraulic regions, 50yr peak discharge response variable. Regionalization of Flood-Frequency Estimates: Regression analysis provides a means of relating peak discharge to basin characteristics.
Flood hazard zone areas used in FEMA's Digital Flood Insurance Rate Map.	Federal Emergency Management Agency (FEMA)	FEMA	flood risk information and supporting data used to develop the risk data 2007. The primary risk classifications used are the 1-percent-annual-chance flood event, the 0.2-percent-annual-chance flood event, and areas of minimal flood risk
Digital Elevation Model NY State	U.S. Geological Survey	USGS	10- by 10-m data spacing, elevations in decimeters. Can be used as source data for digital orthophotos and as layers in geographic information systems
New York State Large Scale Hydrography (1998)	NYS Dept. of Conservation	NYS DEC	Hydrography layer of the 7.5'x7.5' digital line graphs

GIS DATA (continued)			
Dataset ID	**Source**	**Source2**	**Descriptive Comments**
Historical Wetland Data	U.S. Fish and Wildlife Service	USFWS	historical wetland maps (scanned and referenced) for IBID area
Wetland and Riparian mapping area	U.S. Fish and Wildlife Service	USFWS	mapped wetlands types and riparian fro IBID area
NYC Waterfront Parks	NYC Dept. of City Planning	NYC Dept. of City Planning	parks on the water's edge-NYC
Waterfront Spaces NYC with Jurisdiction and Construction Status	NYC Dept. of City Planning	NYC Dept. of City Planning	publically accessible waterfront spaces NYC with jurisdictional and construction status and ULURP approval
Publically Accessible Waterfront Spaces NYC	NYC Dept. of City Planning	NYC Dept. of City Planning	publically accessible waterfront spaces in NYC with details
Waterfront Access Plan	NYC Dept. of City Planning	NYC Dept. of City Planning	framework of Zoning Resolution for waterfront bulk regulations and public access requirements to the specific conditions of a particular waterfront.
Coastal Boundary for Waterfront Revitalization Program	NYC Dept. of City Planning	NYC Dept. of City Planning	all land and water with direct impact on coastal waters defining geographic areas of WRP
LION single street base map	NYC Dept. of City Planning	NYC Dept. of City Planning	streets, shorelines, rails, boardwalks and addresses
Lower Density Growth Management Area	NYC Dept. of City Planning	NYC Dept. of City Planning	zoning for development-resolutions and requirements for new development
Stream flow	U.S. Geological Survey, College of Staten Island	USGS, College of Staten Island	monitoring data of stream gauge data-flow/elevation changes
1 foot Digital Elevation Model (DEM)	NYC Dept. of Environmental Protection	NYC DEP	DEM to nearest ft.
Shoreline	Department of Information Technology & Telecommunications (DoITT)	DoITT	Planimetricbasemap layer containing shorelines
Roadbed	Department of Information Technology & Telecommunications (DoITT)	DoITT	Planimetricbasemap layer containing the roadbed
Hydrography	Department of Information Technology & Telecommunications (DoITT)	DoITT	Planimetricbasemap layer containing hydrography
Contours Lines (2 foot)	Department of Information Technology & Telecommunications (DoITT)	DoITT	Planimetricbasemap layer containing 2 foot contour lines for the full City.
Sea Level Rise Maps (2050s 500-year Floodplain)	Mayor's Office of Long-Term Planning and Sustainability (OLTPS) on behalf of CUNY Institute for Sustainable Cities (CISC) and the New York Panel on Climate Change (NPCC).	Mayor's Office OLTPS, CUNY ISC, NPCC	500-Year Floodplain for the 2050s based on FEMA's Preliminary Work Map data and the New York Panel on Climate Change's 90th Percentile Projects for Sea-Level Rise (31 inches).
NYC DPR Parks	Department of Parks and Recreation (DPR)	NYC Dept. of Parks and Recreation	Parks under jurisdiction of DPR

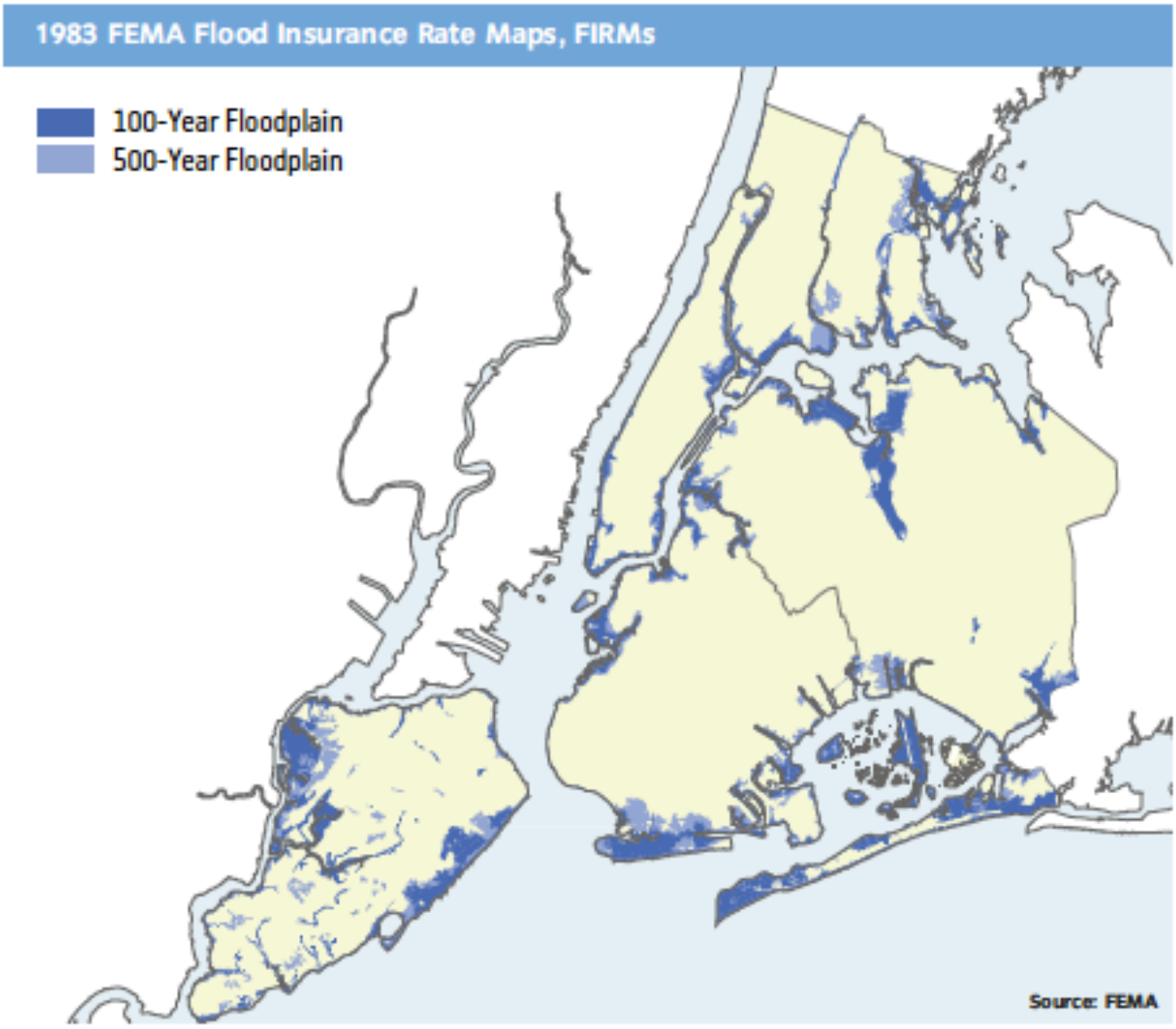
Tabular Dataset ID	Source	Source2	Descriptive Comments
Areas of Critical Environmental Concern	Bureau of Land Management, Department of the Interior	Bureau of Land Management, Dept. of the Interior	areas within the public lands requiring special management to protect historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes, or to protect life and safety from natural hazards
Designated Use and Class Data by State Waterbody	Environmental Protection Agency	EPA	designated status of waterbody for use
National Water Information System Station Monitoring	U.S. Geological Survey	USGS	surface and groundwater stations
NYC detailed Basemap	Federal Emergency Management Agency (FEMA)	FEMA	geotagged photos, contours, buildings and landmarks (map view)
STORET	Environmental Protection Agency	EPA	ground and surface water quality stations and data including physical and chemical data, includes biomonitoring
Topographic Maps for Arthur Kill	U.S. Geological Survey	USGS	historical and present topographic maps with elevation contours, 1:24,000 scale, contours 10 ft.
USGS National Water Quality Assessment Warehouse	U.S. Geological Survey	USGS	all data pertaining to stations monitoring of surface and ground water quality
WATERS, My WATERS Mapper	Environmental Protection Agency and others	EPA and others	contains EPA's Water Quality Standards Database and EPA's TMDL database as well as other watershed characteristics
Staten Island Soil Survey	Natural Resources Conservation Services, U.S. Dept. of Agriculture	NRCS, USDA	all soils information pertaining to soil survey
Green Zone-IBID Boundary maps	Staten Island Economic Development Corporation	SIEDC	IBID boundary maps and proposed boundaries
West Shore IBID Property Information Database	Staten Island Economic Development Corporation	SIEDC	Property ownership, location, tax lot etc
West Shore IBID by Property Assessment Value	Staten Island Economic Development Corporation	SIEDC	map of IBID by property assessment value
West Shore IBID by Public & Private Parcel Ownership	Staten Island Economic Development Corporation	SIEDC	map of public and private parcel ownership in IBID
West Shore IBID by Public & Private Parcel Ownership	Staten Island Economic Development Corporation	SIEDC	map of public and private parcel ownership in IBID
West Shore IBID Owner Map	Staten Island Economic Development Corporation	SIEDC	map by parcel ownership in IBID
West Shore IBID Public Street	Staten Island Economic Development Corporation	SIEDC	map of publically owned streets in IBID
West Shore IBID Request for Cameras	Staten Island Economic Development Corporation	SIEDC	map of target locations for security cameras
West Shore IBID Streets to Service	Staten Island Economic Development Corporation	SIEDC	map of streets that need servicing in IBID
Site Aerials West Shore IBID	Staten Island Economic Development Corporation	SIEDC	aerial photos of IBID properties
West Shore IBID Wetlands Map	NYC OASIS, Staten Island Economic Development Corporation	NYC OASIS, SIEDC	map of National Wetland Inventory of wetlands in WS IBID
West Shore IBID Land Use Map	NYC OASIS, Staten Island Economic Development Corporation	NYC OASIS, SIEDC	map of land use types in IBID
West Shore IBID Parks Map	NYC OASIS, Staten Island Economic Development Corporation	NYC OASIS, SIEDC	map of green spaces, parks, recreational outdoor spaces, gardens etc in IBID
West Shore IBID Zoning Map	NYC OASIS, Staten Island Economic Development Corporation	NYC OASIS, SIEDC	major zoning districts in IBID
Green Goods and Services Industries by NAICS Code	Bureau of Labor Statistics	Bureau of Labor Statistics	categorized industries as being or contributing to the green goods and services industries
Richmond County Businesses	InfoUSA	InfoUSA	businesses in Richmond county and their pertinent information
SI Businesses	InfoUSA	InfoUSA	matched business with georeferencing and NAICS categories

Tabular Dataset ID	Source	Source2	Descriptive Comments
Significant Habitats and habitat complexes of the NY Bright Watershed, Arthur Kill Complex	National Oceanic and Atmospheric Administration	NOAA	important nesting and foraging areas for several species of herons, egrets, and ibises, gulls and waterfowl; freshwater wetland areas and forested buffers
City Owned and Leased Property	NYC Dept. of Citywide Administrative Services	NYC Dept. of Citywide Administrative Services	city owned and leased property, searchable by zip code
NYC DPR Capital Projects	Department of Parks and Recreation (DPR)	NYC Dept. of Parks and Recreation	Capital projects in New York City Department of Parks & Recreation properties.
Awarded Construction Contracts	Department of Design and Construction (DDC)	NYC DDC	construction contracts awarded by DDC
DSNY collection	NYC Dept. of Sanitation	DSNY	Community District2, the tons of Refuse, Paper Recycling and Metal, Glass & Plastic Recycling that were collected 2011

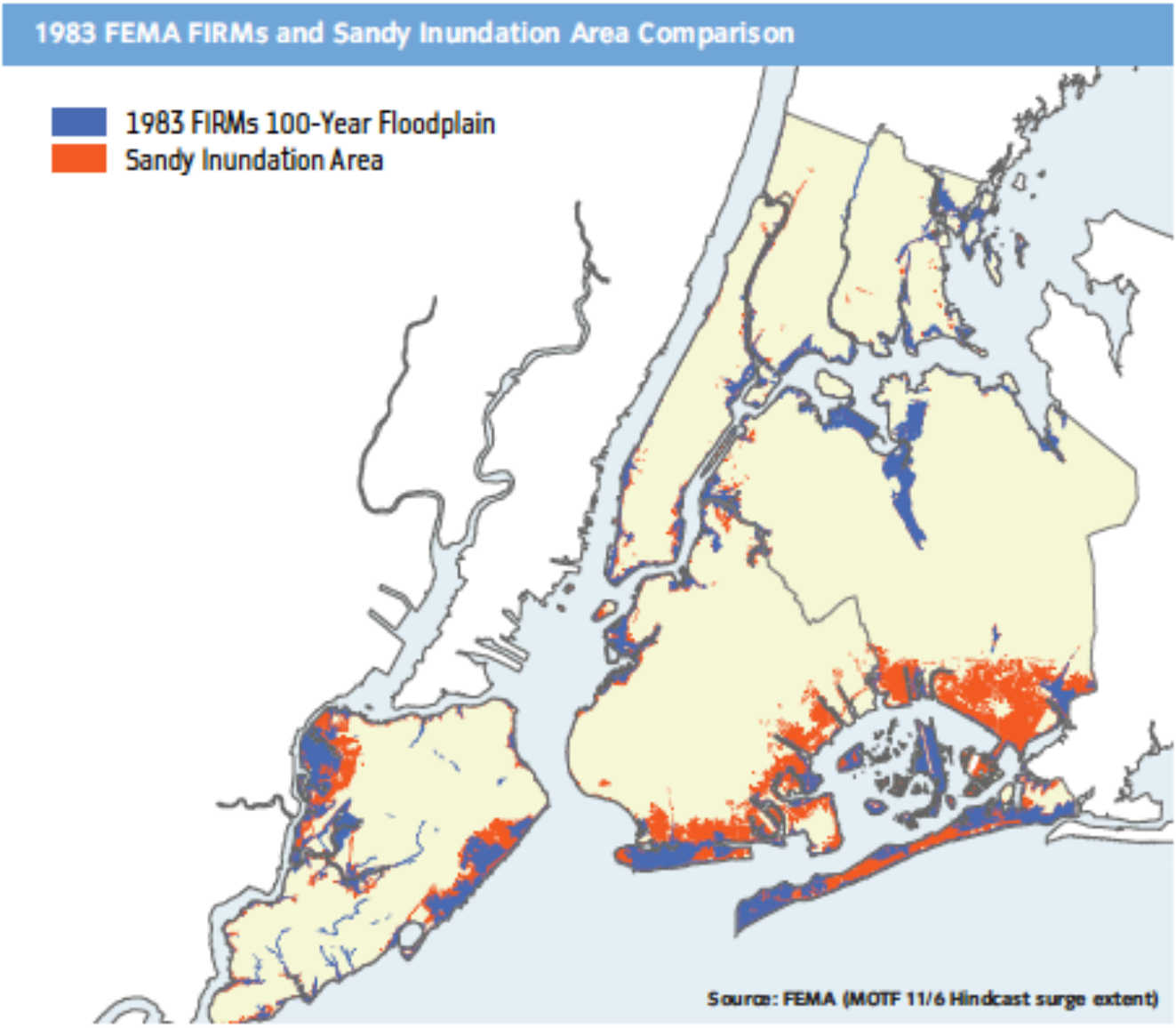
E.1. Sandy inundation and flood maps



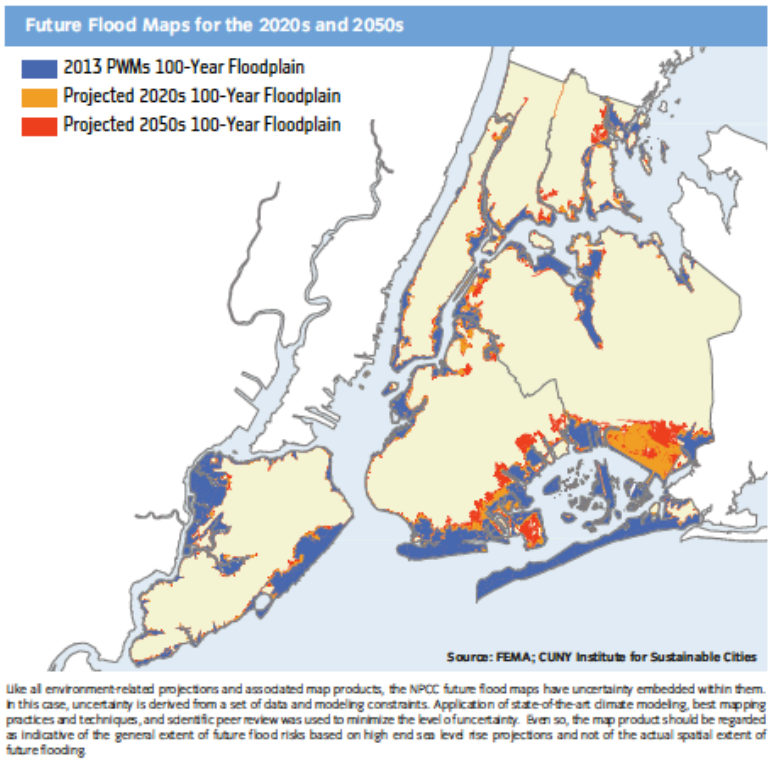
Sandy inundation. Source: p. 14, City of New York (2013).



Flood 1983 FEMA Flood Insurance Rate Maps, FIRMS. Source: p. 23 City of New York (2013).

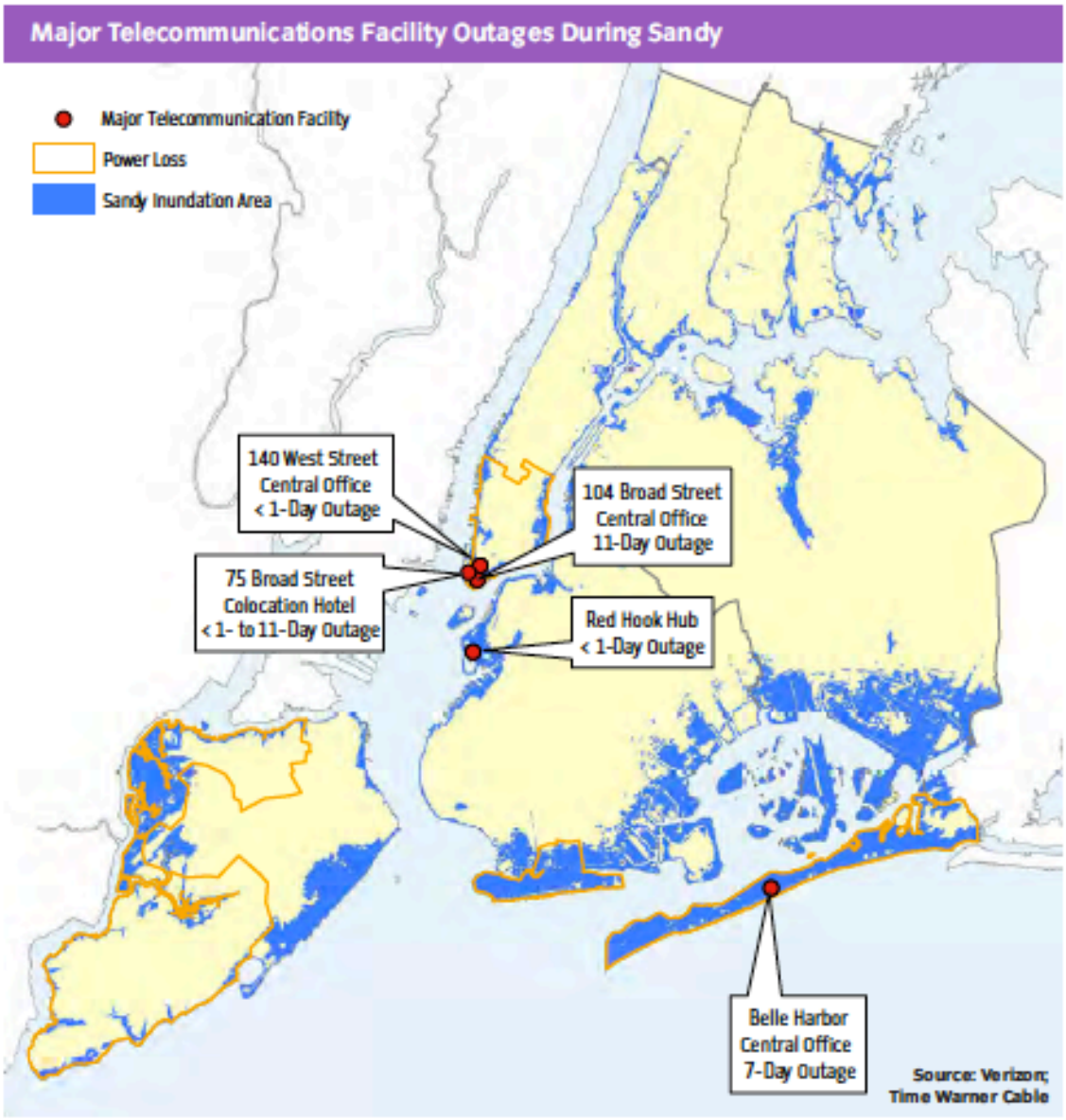


1983 FEMA FIRMS and Sandy Inundation Area Comparison. Source: p. 24 City of New York (2013).



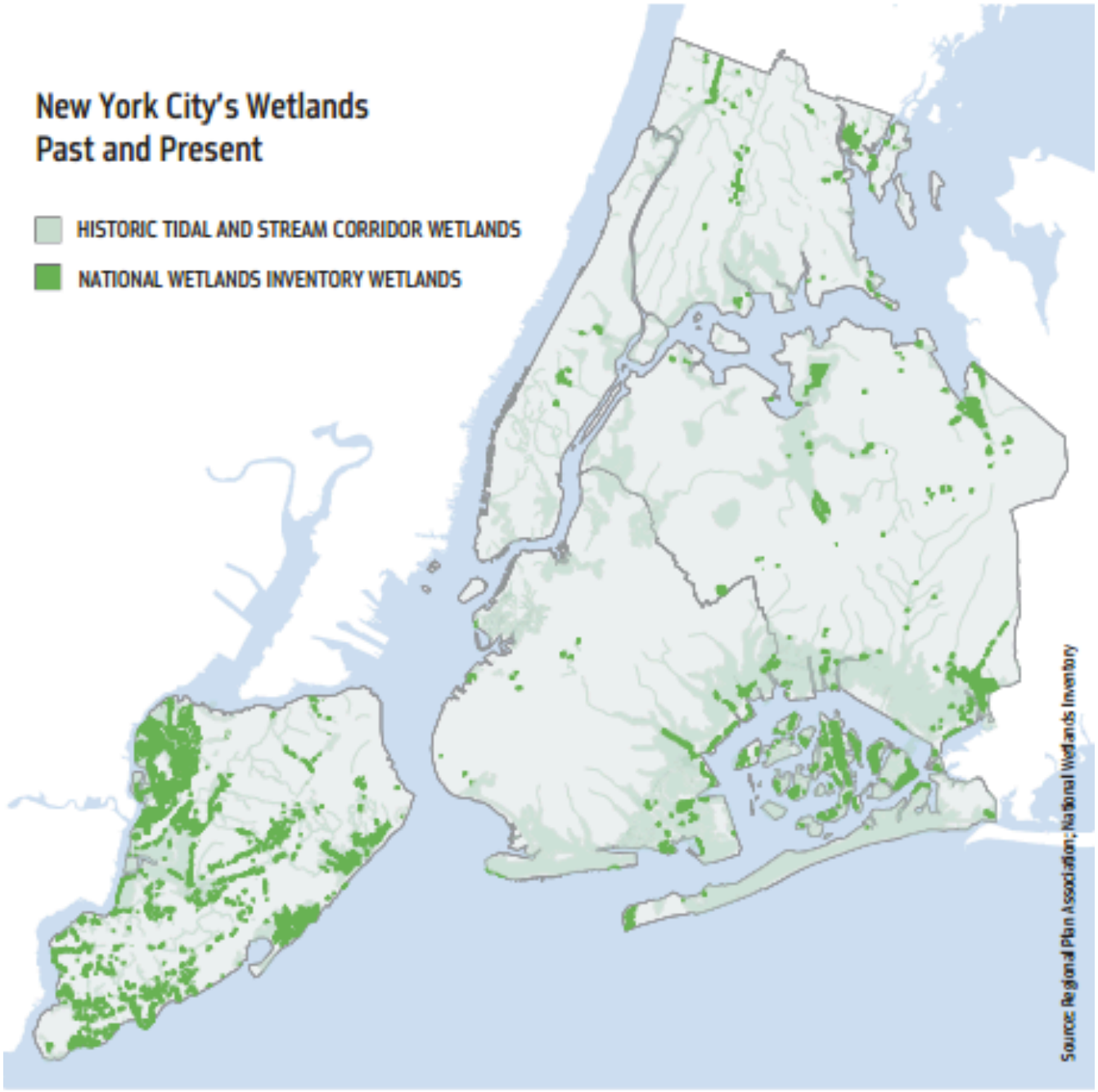
Future Flood Maps for the 2020s and 2050s. Source: p. 30 City of New York (2013).

FEMA best available flood hazard maps. The yellow area represents the 100-year flood zone, zone AE. Source: FEMA region II.



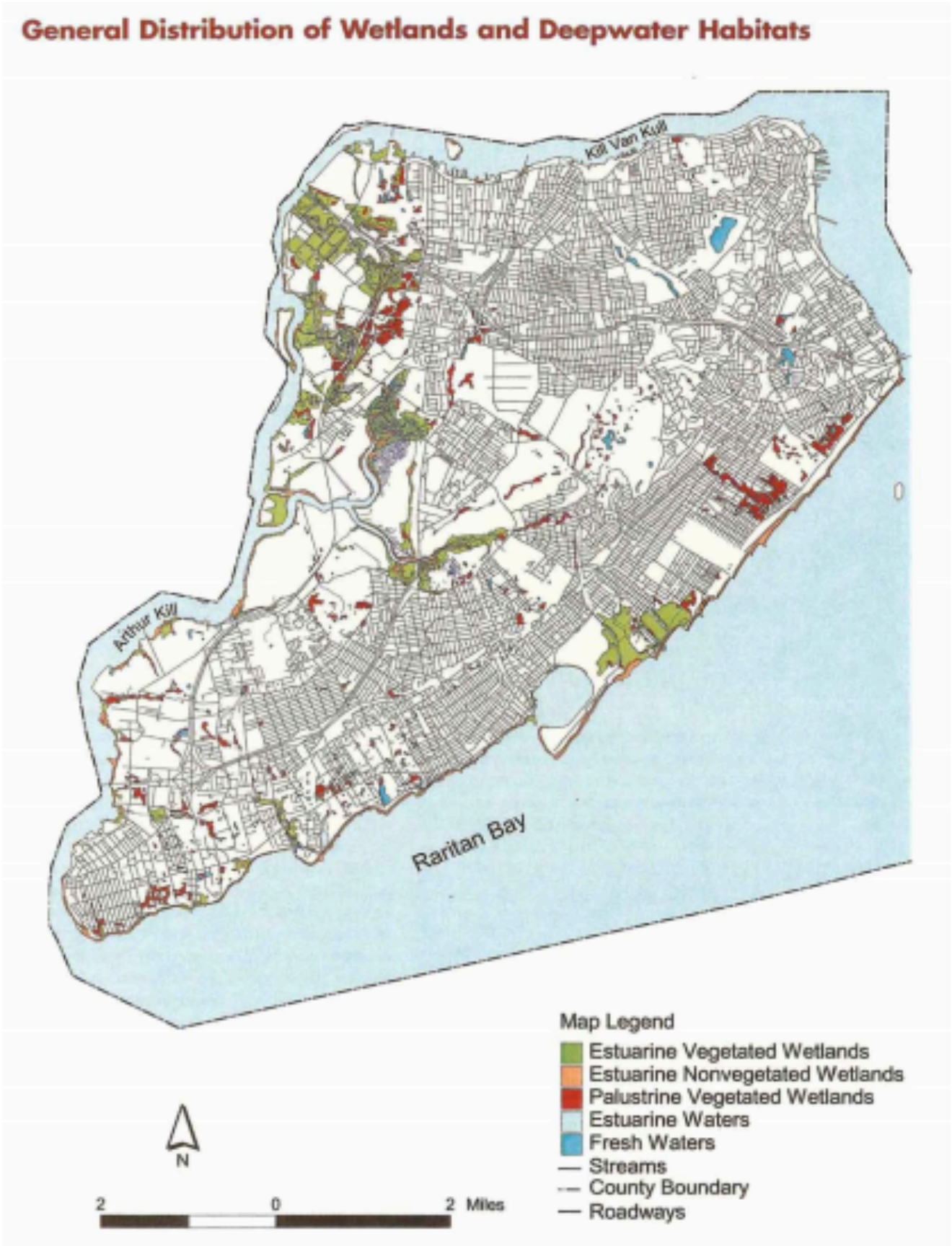
Major telecommunications facility outages during Sandy. Source: p. 165 City of New York (2013).

E.2. Wetland maps



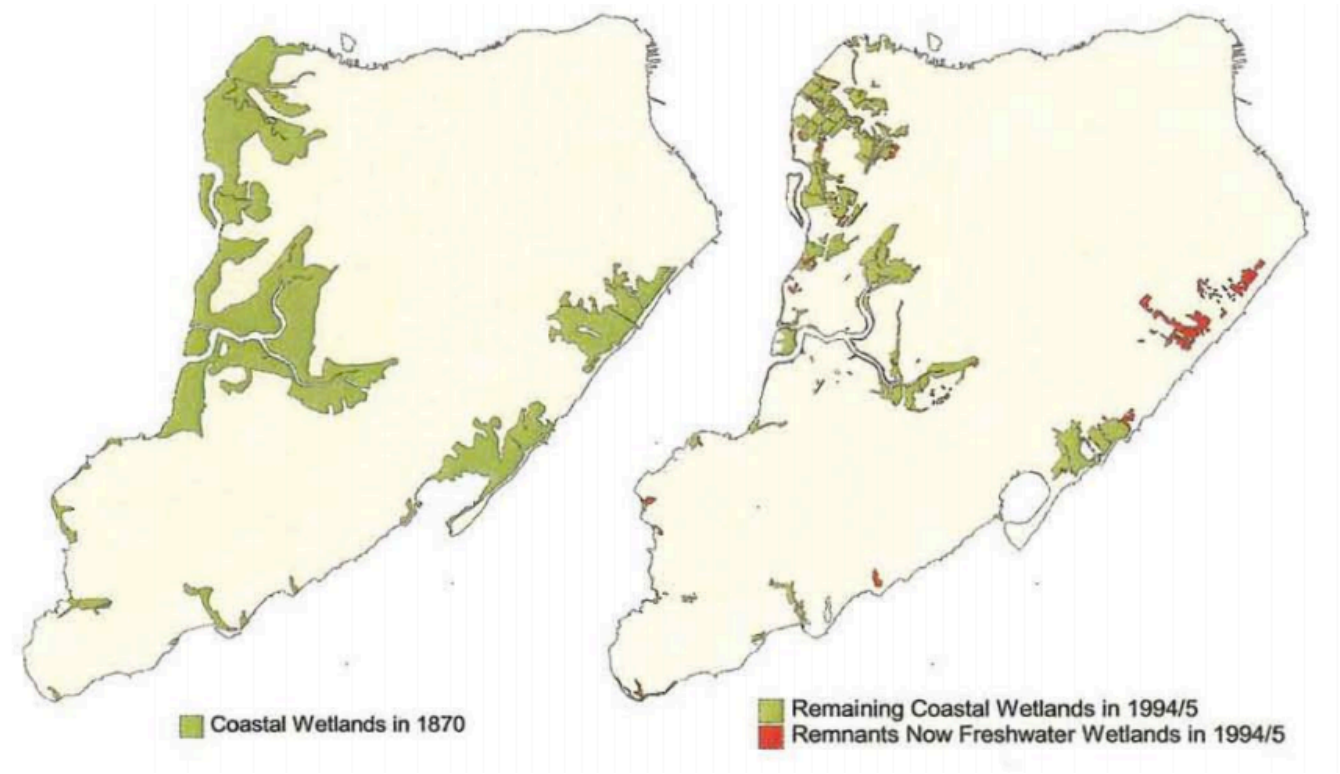
New York City's wetlands, past and present. Source: p. 10 City of New York (2012).

Staten Island freshwater wetlands not mapped by the NYS Department of Environmental Conservation. Source: p. 49 City of New York (2012).



Staten Island wetlands map. Source: p. 9 Tiner, R. (2000).

Staten Island wetlands map (close up of previous map, including study area). Source: p. 9 Tiner, R. (2000).



Historical wetlands map along Staten Island, 1870 and 1994/95. Source: p. 14 Tiner, R. (2000).

Tidal wetlands of the study area, along the Arthur Kill, including an oil tank facility on former wetlands. Source: p. 14 Tiner, R. (2000).

E.3. References

City of New York. (2012). *New York City wetlands strategy*. Accessed August, 2013 from http://www.nyc.gov/html/planyc2030/downloads/pdf/nyc_wetlands_strategy.pdf

City of New York. (2013). *A stronger, more resilient New York.* Accessed August, 2013 from http://nytelecom.vo.llnwd.net/o15/agencies/sirr/SIRR_singles_Lo_res.pdf

FEMA Region II. *What is my base flood elevation (BFE)? Address lookup tool*. Accessed September, 2013 from http://www.region2coastal.com/sandy/table

Tiner, R. (2000). *Wetlands of Staten Island, New York: valuable vanishing urban wetlands. U.S. Fish and Wildlife Service, Ecological Services, Northeast Region, Hadley, MA. Prepared for U.S. Environmental Protection Agency, Region II, New York, NY. Cooperative National Wetlands Inventory publication.*

4.2.1.4. *Saw Mill Creek*

Recommended Action for Properties

There are nineteen individual lots in the high priority Saw Mill Creek Assessment Area. Eight lots are recommended for transfer to DPR to extend preservation of the Harbor Herons Complex. The lots recommended for transfer include Block 2800 Lots 32 (4 acres), 150 (2.5 acres), 163 (0.9 acres), 171 (0.6 acres) and 300 (1.7 acres), and Block 1815 Lots 135 (1.5 acres), 150 (0.4 acres) and 375 (1 acre).

The remaining eleven lots should remain under current jurisdiction. Block 2600 Lot 250 (13 acres) should remain with DSNY; however it will eventually be transferred to DPR as part of the Fresh Kills Park master plan.

Site Characteristics and History

Saw Mill Creek and nearby Merrill's Creek have been designated Significant Coastal Fish and Wildlife Habitat by DEC. Pralls Island Nature Preserve lies just offshore in the Arthur Kill and they have all received priority wetland site status under the Federal Emergency Wetlands Resources Act of 1986. Since the release of the Harbor Herons Report by NYC Audubon in 1990, approximately 120 acres of this wetland complex have been transferred to DPR. DSNY manages a site currently being reviewed as part of the Fresh Kills Landfill Master Plan. DOT manages two sites that include highway easements. EDC manages two sites that include pipeline easements and the ROW for the re-activated Staten Island Railroad.

Environmental Criteria: Summary Description

The transfer of eight sites identified in this area to DPR would support its current efforts to assemble and preserve a large, contiguous wetland complex.

Technical Criteria: Summary Description

There are technical issues associated with the transfer of active properties that still need to be addressed separately.

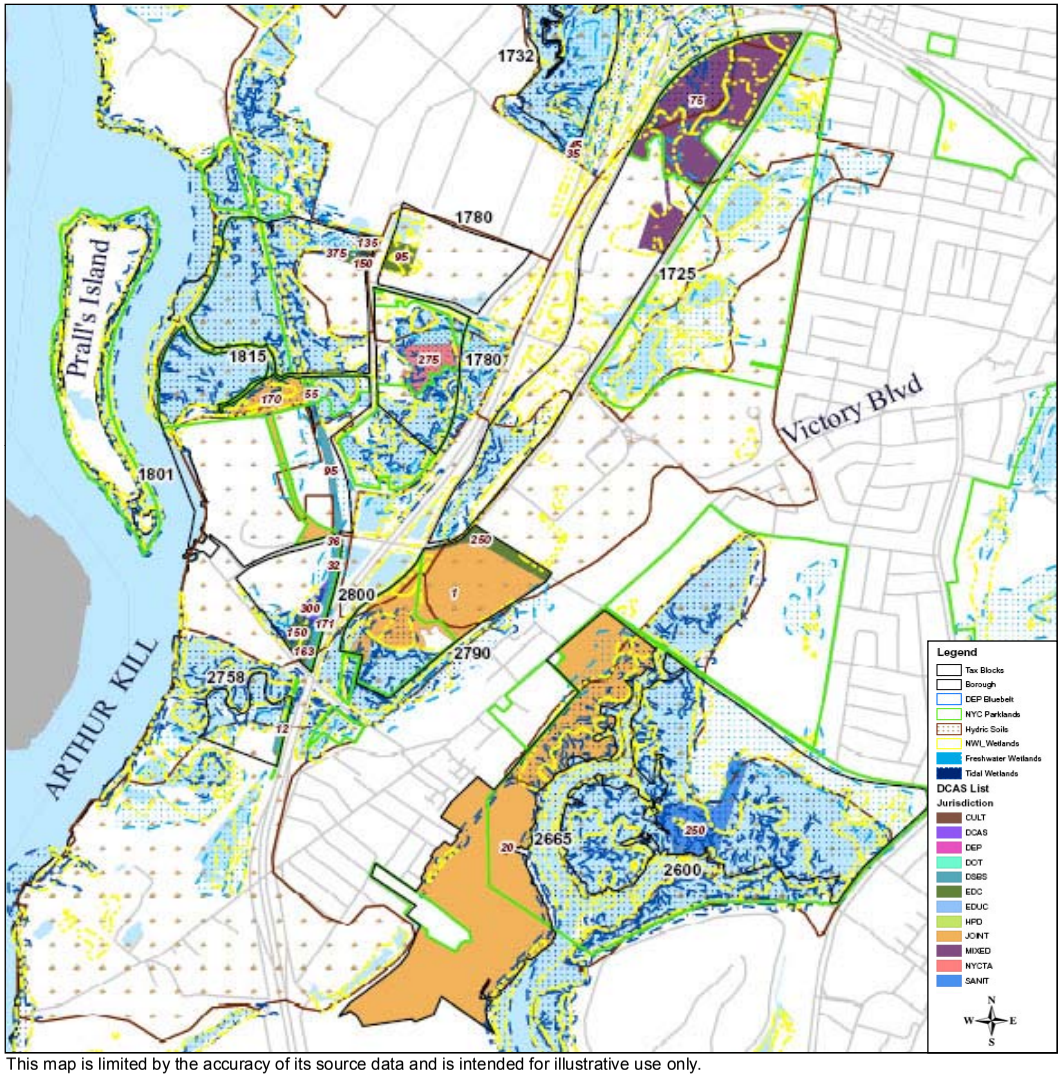
Economic Criteria: Summary Description

There are no apparent economic reasons precluding the transfer of the sites identified in this area.

Legal Criteria: Summary Description

There are legal issues associated with the transfer of active properties that still need to be addressed separately.

SAW MILL CREEK ASSESSMENT AREA



This map is limited by the accuracy of its source data and is intended for illustrative use only.

#	B	P	O	Borough	Assess Area	Block	Lot	Juris	MGMT	CD	Acres	Acre Range	Land Use	Property Status	Recommendations
4	5	a	O	Staten Is.	Saw Mill Creek	1732	35	DOT	DOT	2	0.13	<0.25		Highway easement	No change
4	5	a	O	Staten Is.	Saw Mill Creek	1732	45	DOT	DOT	2	0.49	0.25 to 0.49		Highway easement	No change
4	5	a	O	Staten Is.	Saw Mill Creek	1780	95	EDC	EDC	2	3.05	1 to 9.99			No change
4	5	a	O	Staten Is.	Saw Mill Creek	1780	275	MTA	MTA	2	7.70	1 to 9.99		Tidal wetlands and meandering channel, btwn Chelsea Rd and West Shore Expy	No change
4	5	a	O	Staten Is.	Saw Mill Creek	1801	55	DSBS	EDC	2	0.91	0.5 to 0.99			Special Review
4	5	a	O	Staten Is.	Saw Mill Creek	1801	95	DSBS	EDC	2	3.65	1 to 9.99			Special Review
4	5	a	O	Staten Is.	Saw Mill Creek	1815	135	EDC	EDC	2	1.48	1 to 9.99		proximity to parkland	Transfer to DPR
4	5	a	O	Staten Is.	Saw Mill Creek	1815	150	EDC	EDC	2	0.44	0.25 to 0.49		proximity to parkland	Transfer to DPR
4	5	a	O	Staten Is.	Saw Mill Creek	1815	375	EDC	EDC	2	1.00	1 to 9.99		proximity to parkland	Transfer to DPR
4	5	a	O	Staten Is.	Saw Mill Creek	2600	250	DSNY	DSNY	2	13.86	10 to 50		P/o Fresh Kills master plan	No change
4	5	a	O	Staten Is.	Saw Mill Creek	2758	12	DSBS	EDC	2	1.52	1 to 9.99		SIRR corridor	No change
4	5	a	O	Staten Is.	Saw Mill Creek	2790	1	JOINT	DRES	2	43.20	10 to 50		Occupied leased site	No change
4	5	a	O	Staten Is.	Saw Mill Creek	2790	250	EDC	EDC	2	4.64	1 to 9.99			No change
4	5	a	O	Staten Is.	Saw Mill Creek	2800	32	DSBS	EDC	2	3.95	1 to 9.99		proximity to parkland	Transfer to DPR
4	5	a	O	Staten Is.	Saw Mill Creek	2800	36	EDC	EDC	2	0.03	<0.25			No change
4	5	a	O	Staten Is.	Saw Mill Creek	2800	150	EDC	EDC	2	2.50	1 to 9.99		proximity to parkland	Transfer to DPR
4	5	a	O	Staten Is.	Saw Mill Creek	2800	163	EDC	EDC	2	0.87	0.5 to 0.99		proximity to parkland	Transfer to DPR
4	5	a	O	Staten Is.	Saw Mill Creek	2800	171	DCAS	DRES	2	0.63	0.5 to 0.99		proximity to parkland	Transfer to DPR
4	5	a	O	Staten Is.	Saw Mill Creek	2800	300	DCAS	DRES	2	1.70	1 to 9.99		proximity to parkland	Transfer to DPR
					Saw Mill Creek Count										19

Source: New York City Wetlands Transfer Task Force. (September, 2007). *Recommendations for the transfer of City-owned properties containing wetlands*. pp. 4-15 through 4-17. New York, NY.