North Shore of Staten Island Habitat Restoration and Green Infrastructure Plan

Parks

Acknowledgements

This habitat restoration and green infrastructure plan for Staten Island's North Shore was made possible with funding from the Hudson River Estuary Program (HRE) of the New York State Department of Environmental Conservation.

NYC Parks thanks its partners and community members that provided feedback throughout the planning process.

The Plan was prepared between 2016 - 2018 by the
NYC Parks Division of Forestry, Horticulture, and Natural Resources

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Hudson River Estuary

NYC Parks

Executive Summary

NYC Parks' Division of Forestry, Horticulture, and Natural Resources (FHNR), with community support and input, developed a planning framework for habitat restoration and green infrastructure in parkland on Staten Island's North Shore.

The planning process entailed reviewing existing plans, characterizing the existing conditions of the North Shore study area, identifying opportunities for habitat restoration and green infrastructure on parkland, and working with the community and partner organizations to refine and evaluate opportunities and priorities.

Additional resources were devoted to Harbor Brook, which is one of the last remaining intact stream systems on the North Shore. Harbor Brook originates in Goodhue Park, flows through Allison Pond Park, and through the grounds of Snug Harbor before it becomes tidal and empties into the Kill Van Kull. Conceptual designs for a small tidal wetland restoration at the banks of the furthest downstream reach of Harbor Brook were prepared and presented in Chapter 5.

In total, we identified 34 opportunities for habitat restoration and 12 for green infrastructure. This effort is the first plan that exclusively focuses on habitat restoration and green infrastructure opportunities on the North Shore.

As of the completion of this plan, portions of the recommendations for forest restoration at Goodhue Park began and design funding for the Harbor Brook tidal wetland was acquired.

Cover Image: NYC Parks, Harbor Brook, Goodhue Park

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1.0 Overview

Hudson River Estuary Program
Planning Area

40 Miles

Staten Island

3 Miles

North Shore Study Area

1.5 Miles

1.1 Introduction

In recent years Staten Island's North Shore has been an area of interest for government and private entities, both planning for and implementing economic development that will have significant effects on how the North Shore population lives, works, recreates, and moves around.

These economic development plans have never considered habitat restoration and green infrastructure as a primary goal. However, significant natural areas including forests and wetlands exist on the North Shore. These natural areas have been recognized as community assets by several governmental agencies, including the New York City (NYC) Department of City Planning (DCP) through zoning overlays, the New York State (NYS) Department of State (DOS), the New York State Department of Environmental Conservation's (DEC) "Significant Coastal Fish and Wildlife Habitats" program, and the NYC Parks' Forever Wild program.

This plan aims to fill the gap for natural areas planning for the North Shore of Staten Island by identifying, characterizing, and prioritizing opportunities for habitat restoration within these natural areas. green infrastructure opportunities across North Shore parkland.

Study Area

The North Shore Study Area, as shown on the previous page, was designated by the NYS Department of Environmental Conservation's (NYSDEC) Hudson River Estuary Program (HRE). It follows the shoreline and is buffered inland by approximately one mile. NYC Parks expanded the planning area to encompass additional significant natural area parkland that bordered or was bisected by the HRE-designated planning area.

1.2 Visions and Goals

With the help of North Shore community members and partner organizations, NYC Parks compiled the following vision statement and long term goals, which will guide the habitat restoration and green infrastructure plan's recommendations and prioritizations.

Vision

Staten Island's North Shore is a valued ecological, economic, and social resource. The Snug Harbor Cultural Center and the Harbor Brook stream corridor, Mariner's and Arlington Marsh, and the waterfront of the Kill Van Kull provide a wealth of social, recreational, educational, and environmental opportunities to the area and its community.

Goals

i. *Restore, protect, and enhance natural resources to promote diverse, native ecosystems.*
ii. *Manage stormwater through green infrastructure to help alleviate local flooding and improve water quality.*
iii. *Consider climate change in all decision-making.*
iv. *Promote public engagement and invite stewardship.*

1.3 Context

Historical

Pre-European Settlement – Lenape inhabited Staten Island. Native American presence on Staten Island dates back over 10,000 years.

1600s – Europeans occupied Staten Island in the early part of the century as a fur trading outpost and formally settled on the island in the middle part of the century.

1788 – The State Legislature consolidated Staten Island into New York City.

1800s-1900s – North Shore experienced rapid industrialization and became the most densely populated region of Staten Island and a hub for maritime industry.

1836 – Veterans Park in Port Richmond becomes Staten Island's first designated park.

1913 – Construction of Silver Lake Reservoir.

1945-present – Following World War II, maritime industry declined. Combined with widespread use of the automobile and the opening of the Verrazzano-Narrows Bridge in 1964, economic hubs sprang up elsewhere on the island. These shifts in the North Shore's economy resulted in depression and large swaths of vacant land. Due to industrial uses, many North Shore properties contain legacy contamination that predates modern environmental laws.

1974 – Mariner's Marsh Park purchased by the city. It would not be transferred to the NYC Parks Department until 1997.

Snug Harbor Cultural Center and surrounding area in 1874.

Image Credit: Manuscripts and Archives Division, The New York Public Library. (1874).*Atlas of Staten Island, Richmond County, New York, from official records and surveys; compiled and drawn by F. W. Beers* Retrieved from http://digitalcollections.nypl.org/items/510d47e2-0b93-a3d9-e040-e00a18064a99

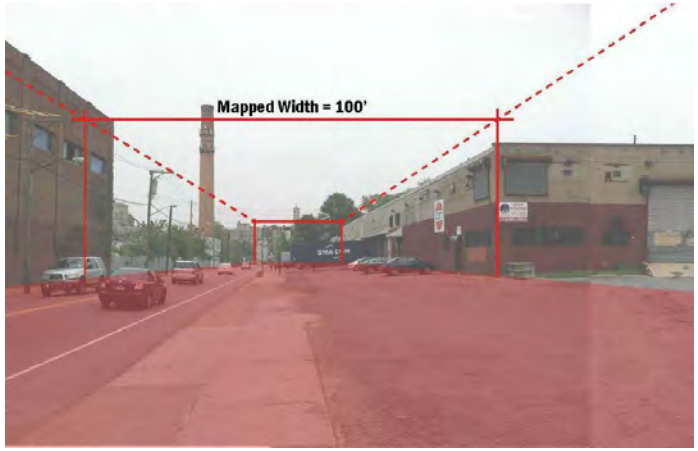
1.3 Context

Present

21st Century – A widespread, renewed interest in reclaiming urban waterfronts for residential, commercial, and recreational use results in a building boom on NYC shorelines and a desire to develop mixed-use waterfront projects on the North Shore.

Planning efforts by NYC DCP aim to enhance public transportation and bike transit infrastructure and to facilitate economic development. One example is the widening of Richmond Terrace, which frequently suffers from traffic congestion due to industrial trucking, bus, and commuter traffic.

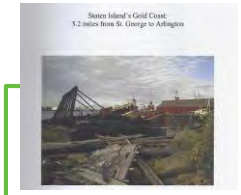
Right: Rendering of potential changes to Richmond Terrace from West Bright on Brownfield Opportunity Areas Nomination Report, 2016.



Bottom: Transportation Planning for the North Shore.

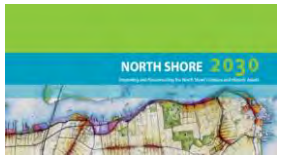
Image Credit: NYC Department of City Planning, North Shore 2030, 2011

1.4 North Shore Planning Efforts



Staten Island's Gold Coast
North Shore Waterfront Conservancy of Staten Island

- Identified 21 North Shore sites or projects containing environmental contamination or environmental conditions that affect the community.



North Shore 2030
NYC DCP, NYC Economic Development Corporation (EDC)

- Strategies geared toward helping create jobs, increasing waterfront access, improving mobility, and strengthening communities.

West Brighton Brownfield Opportunity Area Report
NYC DCP, NYS DOS, West Brighton Community Local Development Corporation

- A community driven neighborhood revitalization strategy for dozens of vacant or potentially contaminated properties.
- Vision for a modern maritime community that bolsters industry, encourages redevelopment, and enhances quality of life.

North Shore of Staten Island Habitat Restoration and Green Infrastructure Plan

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

Vision 2020 NYC Comprehensive Waterfront Plan
NYC DCP

- Vision for reclaiming NYC waterfront for redevelopment, job creation, improved access and water quality, and addressing climate change.
- Includes numerous priorities for the North Shore such as building out the Van Pelt/Van Name wetlands.

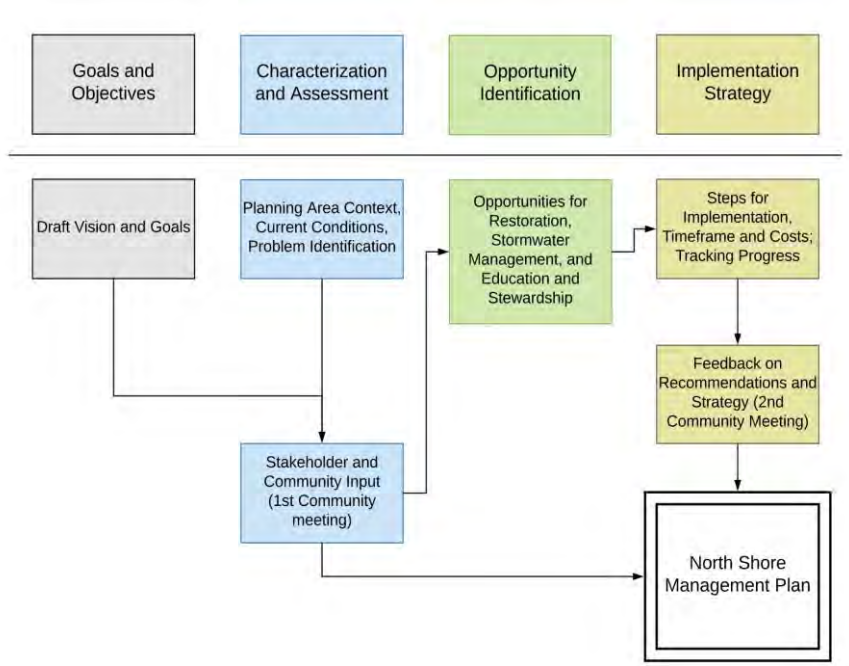
A Stormwater Management Framework for the Staten Island West Shore
Staten Island Economic Development Corporation, Crauderueff and Associates

- Focuses on properties adjacent to tidal marsh complexes on the West Shore of Staten Island. Some wetlands overlap with the North Shore Planning Area
- Establishes recommendations and priorities for stormwater management, redeveloping underutilized sites, and protecting natural areas.

Mariner's and Arlington Marsh Master Plan (Estimated Completion May 2020)
NYC Parks

- Community driven planning effort for reimagining Mariner's and Arlington Marsh parks.
- Proposes plans for phased re-opening of the parks in coordination with regulatory agencies.

1.5 Community Outreach



NYC Parks' watershed planning approach was presented to the North Shore community three times between 2016 and 2018.

- First Community Meeting on December 7, 2017 at Walker Park
- Community Board 1 Parks and Waterfront Subcommittees on March 1, 2018 at Edgewater Street
- Second Community Meeting on September 5, 2018 at Walker Park

Community members helped NYC Parks draft visions and goals and prioritize restoration opportunities. Some concerns included:

"Vacant or underused parks should be activated"

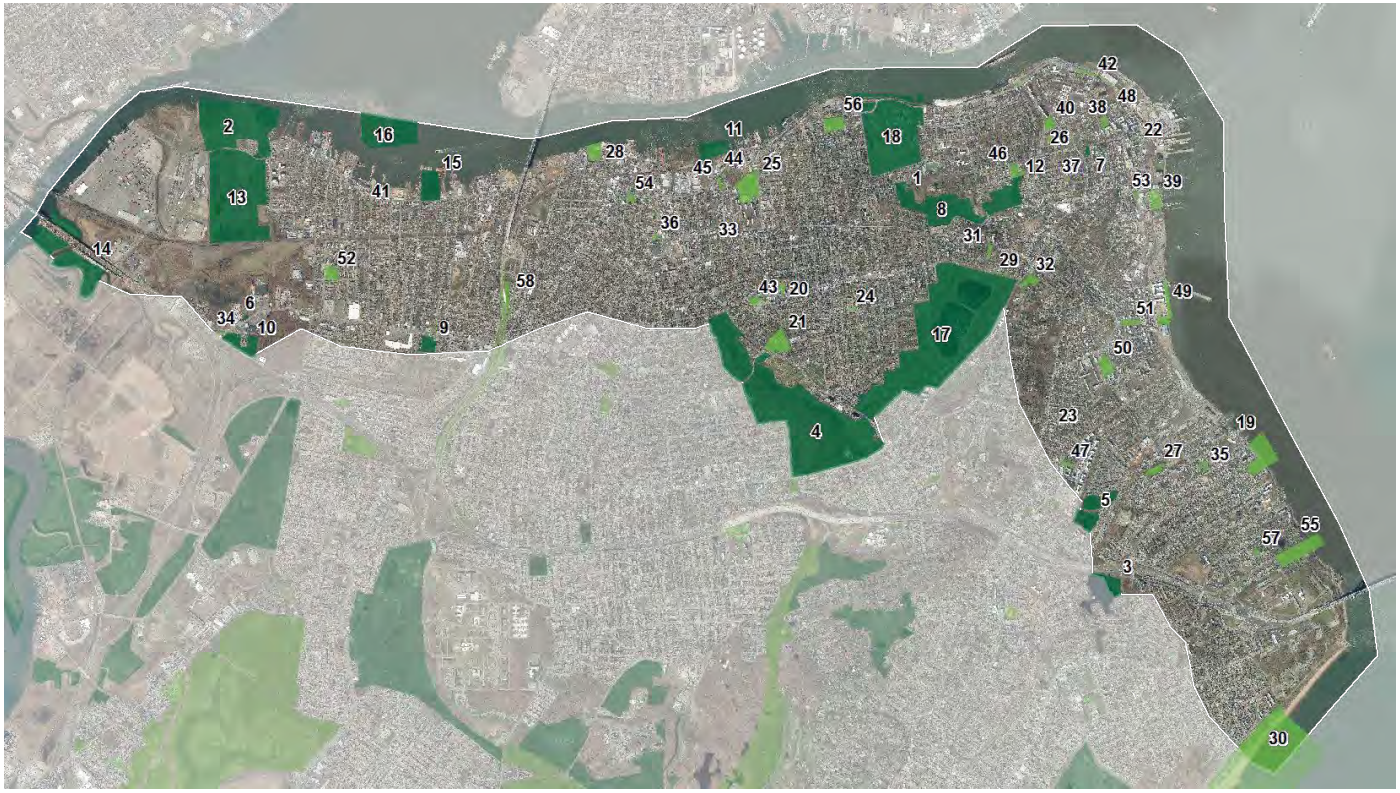
"More birding opportunities such as elevated paths or platforms"

"More work in Allison, Goodhue, and Jones"

"Cannot lose more greenspace or flooding will get worse"

Photos of the September 2018 community meeting at Walker Park.

2.0 Planning Area Characterization



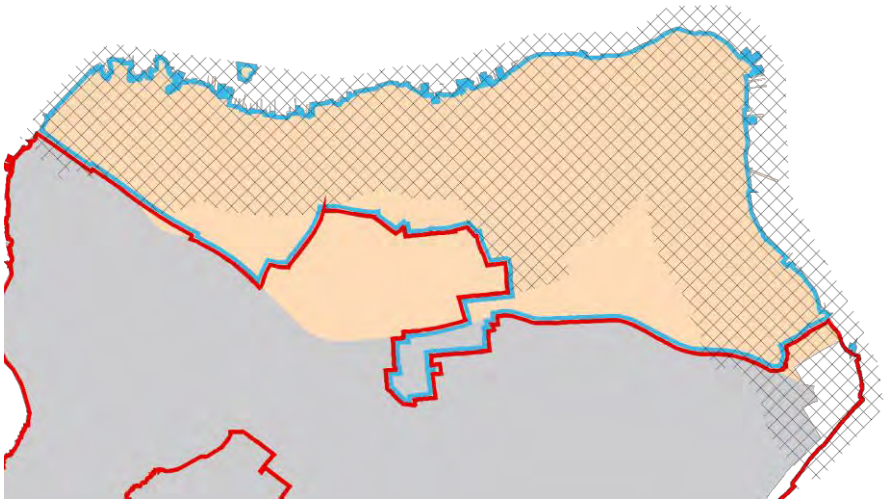
Map 2.A. New York City Parks Property on the North Shore of Staten Island.

Parkland with Natural Area
Other Parkland

1 Allison Pond Park
2 Arlington Marsh Park
3 Bradys Pond Park
4 Clove Lakes Park
5 Eibs Pond Park
6 Forest Grove
7 Fort Hill Park
8 Goodhue Park
9 Graniteville Quarry Park
10 Graniteville Swamp Park
11 Heritage Park
12 Jones Woods Park
13 Mariners Marsh Park
14 Old Place Creek Park
15 Richmond Terrace Wetlands
16 Shooters Island
17 Silver Lake Park
18 Snug Harbor Cultural Center
19 Alice Austen Park
20 Austin J. McDonald Playground
21 Barrett Park
22 Barrett Triangle
23 Bedford Green
24 Captain John R. Fischer Firefighter Michael C. Fiore Playground
25 CPL. Thompson Park
26 Davis Playground
27 De Matti Park
28 Faber Pool and Park
29 Forest Mall
30 Franklin D. Roosevelt Boardwalk and Beach
31 Haven Esplanade
32 Hero Park
33 Joe Holzka Community Garden
34 Joseph Manna Park
35 Kaltenmeier Playground
36 Levy Playground
37 Liotti Ikefugi Playground
38 Lt. Lia Playground
39 Lyons Pool
40 Mahoney Playground
41 Mariners Harbor Playground
42 North Shore Esplanade
43 Prall Playground
44 Richmond Terrace Cemetery
45 Richmond Terrace Storehouse
46 Skyline Playground
47 Sobel Court Park
48 St. George Park
49 Stapleton Esplanade
50 Stapleton Playground
51 Tappen Park
52 The Big Park
53 Tompkinsville Park
54 Veterans Park
55 Von Briesen Park
56 Walker Park
57 White Park
58 Willowbrook Parkway

2.1 Demographics, Environmental Justice, and Land Use

Political Boundaries

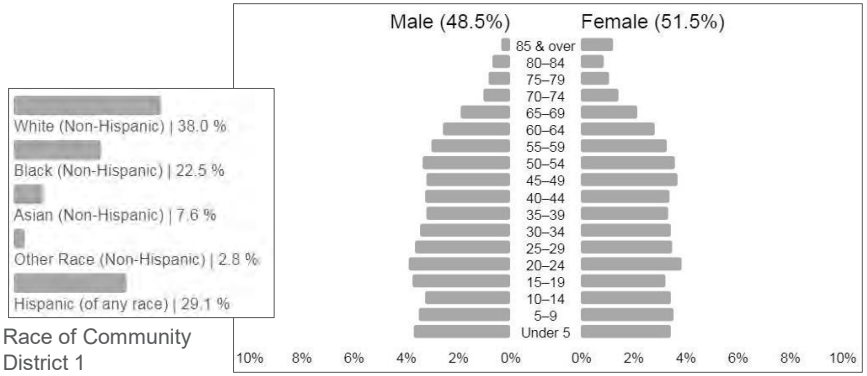


Map 2.B. Staten Island Community Districts and City Council Districts.

North Shore Planning Area
City Council District 49
City Council District 50
Community District 1
Community District 2

The North Shore Planning Area is largely encompassed within Community District (CD) 1. The southern edges contain parts of CD 2. In 2010, the population of CD 1 was 175,800, an increase from 162,600 in 2000.

Figure Credits: New York City Department of City Planning – Staten Island Community District 1 Profile – Population, Population by Age, and Race and Hispanic Origin.



Race of Community District 1

Population of Community District 1 by Age and Gender

The North Shore is one of the most densely populated and ethnically diverse areas of Staten Island. The population is 60% minority and approximately 20% of residents live below the Federal Poverty Line - more than in any other Staten Island community.

Waterbody impairment and environmental degradation pose significant public health concerns and resulted in the Environmental Protection Agency (EPA) naming the North Shore as one of the nation's Environmental Justice Showcase Communities in 2010.

Based on the 2000 census, the New York State Department of Environmental Conservation (NYSDEC) designates the majority of the North Shore as a Potential EJ community based on demographic and economic indicators.

Environmental Justice

The EPA defines Environmental Justice (EJ) as: “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies.”

Based on the 2000 census demographic and economic indicators, NYSDEC designates the majority of the North Shore as a Potential EJ community.

With funding from NYSDEC, the North Shore Waterfront Conservancy (NSWC) completed an inventory of sites that contribute to an undue environmental burden in North Shore communities (Gold Coast Report, 2008).

- 21 key sites were identified as having significantly contributed to the North Shore's EJ status. The sites consist of private properties with more than a century of industrial activity, vacant or blighted properties with historic industrial uses, city owned properties, and individual projects that negatively affect communities.
- Four NYC parks were identified as contributing to the North Shore’s EJ burden. These were 1) Van Pelt/Van Name Shoreline, 2) Blissenbach Marina, 3) Mariner’s Marsh, and 4) Arlington Marsh.

Left: Aerial Image of Blissenbach Marina in 2007 when it was a vacant property following its use as a marina.

Right: Aerial image of Blissenbach Marina in 2017. The site was remediated and reopened as a public park now known as Heritage Park.

Map 2.C. North Shore Environmental Justice (EJ) Areas and Gold Coast Report Sites.

Since the release of the Gold Coast Report, NYC Parks has made progress rehabilitating all four parks:

- Van Pelt/Van Name Shoreline / Richmond Terrace Wetlands: Rehabilitating the waterfront through marine debris removal (2016) and upland enhancement to allow public access and restore views to the waterfront (estimated completion in 2019).
- Blissenbach Marina: Remediated and reopened as waterfront open space under new name Heritage Park in October 2017.
- Arlington and Mariner’s Marsh: A Master Plan is in progress (estimated completion in 2019) for these two large parks. Following completion NYC Parks will begin seeking funding to rehabilitate and re-open these parks in phases.

“Every business that is in a waterfront community should be environmentally aware and make sure that they are not just meeting the law’s expectations, but going beyond those expectations to maintain a clean, safe environment for everyone.”

– North Shore Waterfront Conservancy, 'Staten Island’s Gold Coast Report', 2008

Land Use and Zoning

The majority of the North Shore is zoned residential. The Kill Van Kull shoreline is still largely zoned for manufacturing and industrial uses. However, through the use of Special Zoning Districts, land use and zoning policies have recognized the importance of some of the natural areas and features that occur on the North Shore. These designations include:

Hillside Preservation District – Aims to prevent erosion, landslides, and excessive stormwater runoff; to preserve unique aesthetic value of hillsides; and to protect neighborhood character.

- Includes Snug Harbor Cultural Center, Allison Pond, Goodhue, Jones Woods, Silver Lake, and Clove Lakes Parks.

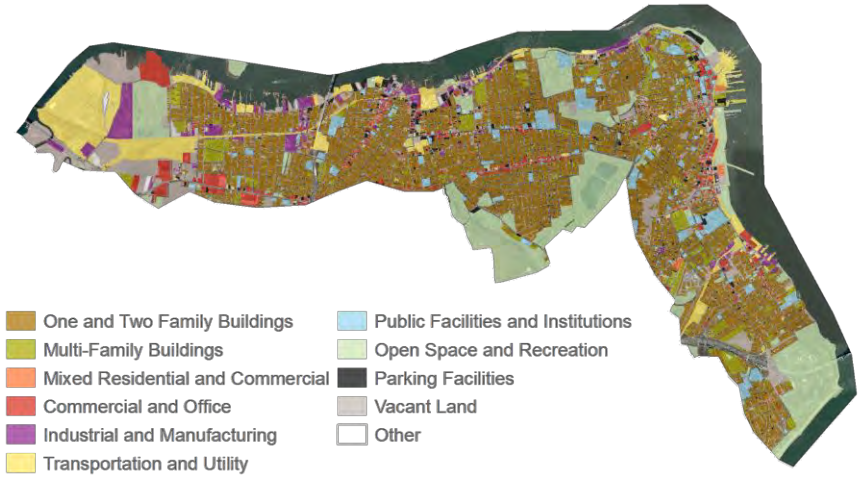
Special Natural Area District – Aims to protect areas of notable aquatic, biologic, botanic, geologic, or topographic features with ecological and conservation values and functions.

- Includes Von Briesen Park and private property.

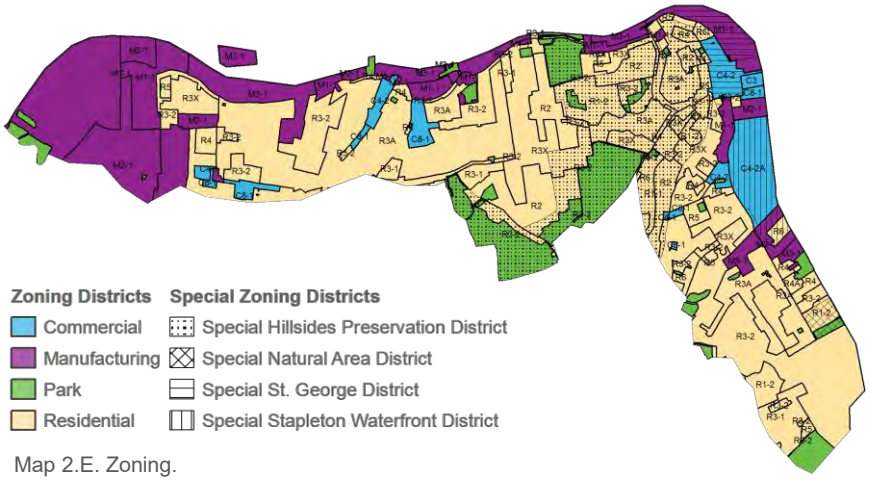
Additional policies and regulations on the city and state level have also recognized the importance of natural resources on the North Shore. The New York Department of State recognizes Significant Coastal Fish and Wildlife Habitats (Shooter's Island and Graniteville Swamp) and NYC DCP identifies Recognized Ecological Complexes (Mariner's Marsh and Goodhue/North Shore Greenbelt).

Table 2.1 Natural Resources Special Zoning Districts for the North Shore

	Special Hillside Preservation District	Special St. George District	Special Stapleton Waterfront District	Special Natural Area District	No Special Overlay	Total North Shore Planning Area
Area (Acres)	1,484	132	65	41	5,193	6,916
Percent of Total Area	21 %	2 %	1%	1 %	75 %	100 %



Map 2.D. Land Use.



Map 2.E. Zoning.

2.2 Physical and Environmental Characterization

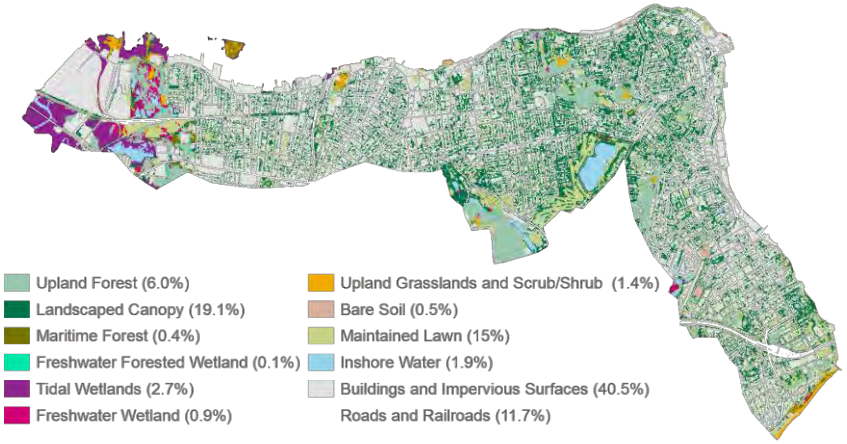
Land Cover

Impervious surfaces such as roads, buildings, parking lots, and railroads dominate the North Shore (52%). Maintained lawns and the landscaped tree canopy on streets and yards surround much of these spaces (34%). Natural habitat areas including forests, wetlands, and grasslands, encompass only 12% of the total North Shore area with about half occurring on parkland. The percentages of all the land cover types within the North Shore Planning Area are shown in Map 2.F.

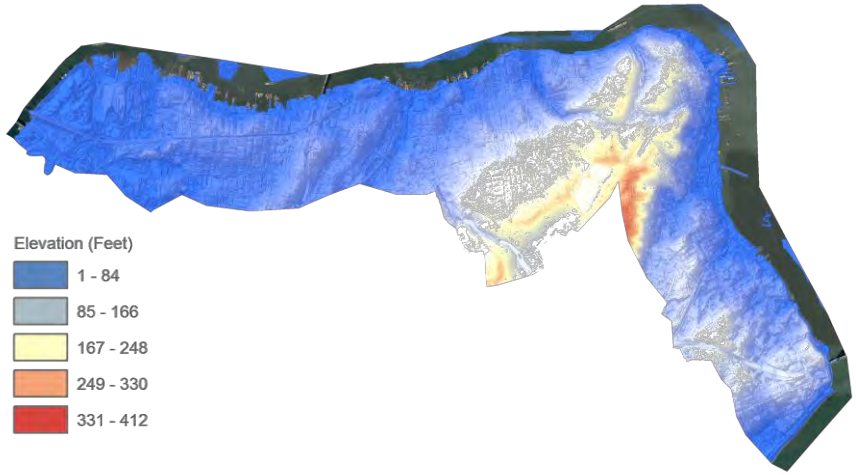
Table 2.2 Breakdown of Natural Area in Parkland on the North Shore

	Upland Forest	Maritime Forest	Freshwater Forested Wetland	Tidal Wetland	Freshwater Emergent Wetland	Upland Grasslands and Scrub /Shrub	Total Natural Area
Acres in Plan Area	402	24	7	177	58	91	**759**
Acres on North Shore Parkland	212	10	3	67	34	41	**367**

Approximately half of the natural area on the North Shore occurs in city-owned Parkland (367 acres, 48% of the total natural areas). Approximately 140 acres (18%) of natural area occurs on private property, and approximately 257 acres (34%) occurs on publically owned non-parkland property.



Map 2.F. Land Cover data from 2010 using LiDAR (Light Detection and Ranging) technology.

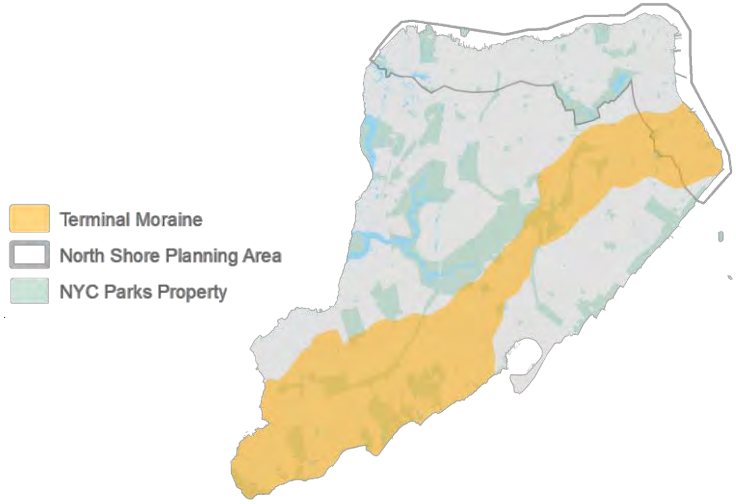


Map 2.G. Topography of North Shore.

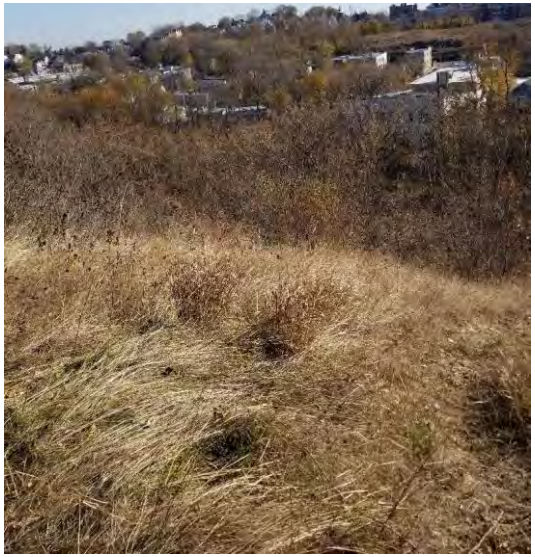
Geological Formations and Soils on the North Shore

Staten Island's geology and topography were dramatically influenced by the Wisconsin glaciation 11,000 to 75,000 years ago. The terminal moraine associated with the last glaciers in this region runs from the northeast of the island to the southwest. A terminal moraine is a mixture of unconsolidated material transported by the ice sheet and it marks the edge of a glacier's movement.

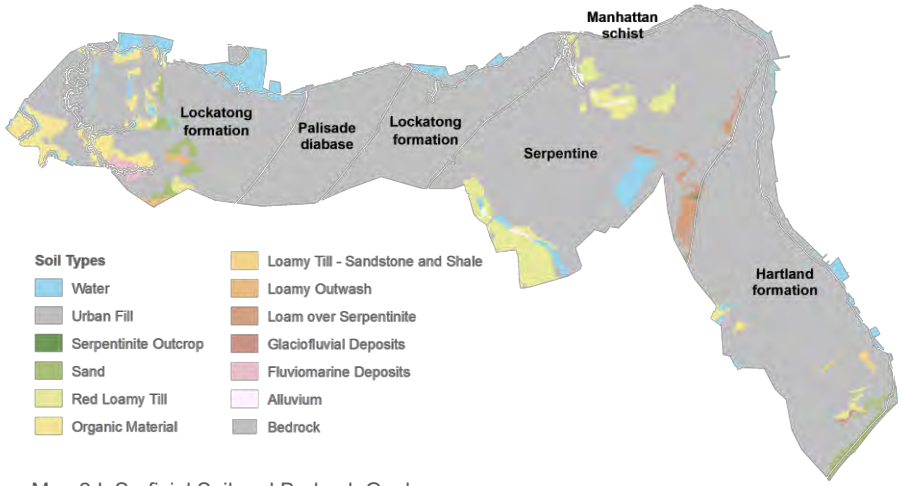
Staten Island's geology includes numerous formations, including serpentinite—a metamorphic rock with a greenish hue imparted by the mineral olivine. Serpentine soils are typically shallow, nutrient poor, and naturally high in metals such as nickel and chromium. Only some plants are adapted to grow in these conditions, and as a result the plant communities that inhabit serpentine soils are rare in New York City. In fact, serpentinite is a regionally rare geologic formation and in New York State, is only known from Staten Island.



Map 2.H. Terminal Moraine on Staten Island.
Data Source: New York State Museum



Jones Woods Park is one example of a park that contains serpentine soils and a serpentine barrens grassland community. Several rare plant species have been documented here.



Map 2.I. Surficial Soil and Bedrock Geology.
Data Sources: U.S. Department of Agriculture Natural Resources Conservation Service; Wildlife Conservation Service Welikia Project

Street Trees

Approximately 20,000 city-planted and maintained street trees line the roadways in the North Shore and 4,900 trees are found within landscaped areas of parkland. Street trees are planted within public right-of-ways and do not include trees on parkland or private property.

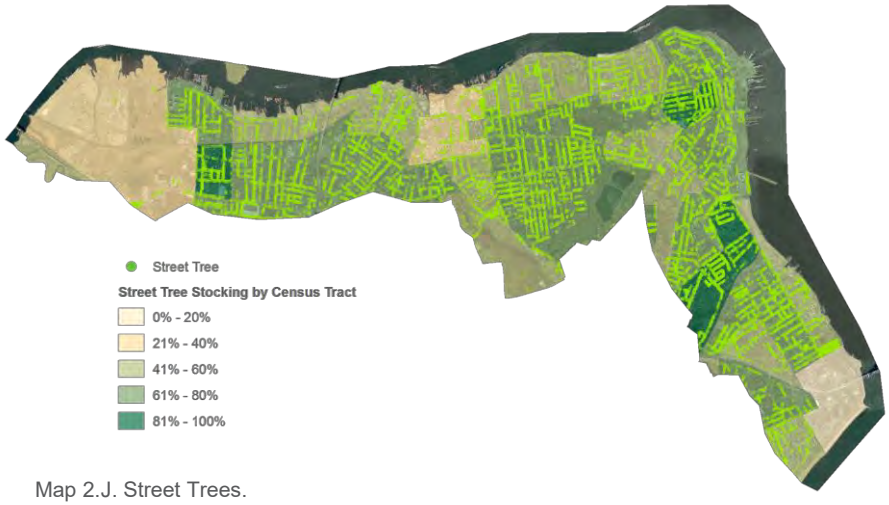
There are over 180 different species represented on the North Shore right-of-ways. The most dominant species, totaling over 10 percent of street trees, is the London planetree (*Platanus* x *acerifolia*). The largest street tree is a 77-inch diameter silver maple (*Acer saccharinum*), found on Belmont Place at the edge of Lt. Lia Playground.

Trees provide numerous benefits to environments and communities, including shading and cooling, energy savings, beauty, improved property values, carbon sequestration, and air and water filtration.

As part of the NYC Parks 2015 city-wide street tree census, stocking, or the potential for streets to have new trees planted, was assessed. On the North Shore, street tree stocking varies per census tract, but on average is approximately 64% stocked. This is a little below the citywide average of 74%.

Only one location in the Port Richmond Neighborhood has 21-40% tree density. The only areas with less than 50% density are Fort Wadsworth and the Port Authority Container Terminal, which do not contain significant amounts of plantable public right of way.

Swamp white oak (*Quercus bicolor*) planted in the right-of-way.



Map 2.J. Street Trees.
Data Source: NYC Parks Street Tree Census

Table 2.3 Most Common Street Trees on the North Shore

Common Name	Scientific Name	# of Trees Planted (% of Total)
London planetree	*Platanus x acerifolia*	2,024 (10.43%)
Callery pear	*Pyrus calleryana*	1,586 (8.18%)
'Green leaf' Japanese flowering cherry	*Prunus serrulata 'Green leaf'*	1,500 (7.73%)
Pin Oak	*Quercus palustris*	1,483 (7.65%)
Red Maple	*Acer rubrum*	979 (5.05%)
Thornless honeylocust	*Gleditsia triacanthos var. inermis*	951 (4.90%)
Japanese zelkova	*Zelkova serrata*	810 (4.18%)
Norway maple	*Acer platanoides*	668 (3.44%)
Sweetgum	*Liquidambar styraciflua*	539 (2.78%)
Littleleaf linden	*Tilia cordata*	477 (2.46%)

Upland Forests and Grasslands

Upland habitats provide myriad benefits including habitat for forest nesting birds, a sink for carbon, and stormwater capture in the tree canopy and soils. The largest expanses of mature upland forests that occur on parkland on the north shore are in Clove Lakes Park, Mariner's Marsh, and the chain of parks including Snug Harbor, Allison Pond Park, Goodhue Park, and Jones Woods Park.

Grasslands on the North Shore are mostly limited to Jones Woods Park and Graniteville Quarry Park. The Jones Woods grasslands contain rare serpentine soils which support a unique grassland community found in only a few locations in New York State.

Map 2.K. Upland Habitats from 2010 LiDAR.

Evaluating New York City's Forests using the Forest Management Framework

The Natural Areas Conservancy and NYC Parks developed a 25-year framework intended to guide the restoration and management of NYC Parks' 7,300 acres of forested natural areas. The forest management framework (FMF) is based on data collected from assessment plots spread out through 50 parks across all five boroughs. The data consisted of metrics for ecological health and threat and allowed for categorization of the condition of each forest. This information will be used to track changes in forest health over time and to predict the level of investment required to maximize ecological condition and visitor experience.

At the time it was published, the framework only included one park on the North Shore of Staten Island: Clove Lakes Park. In 2019, the framework was expanded to include Mariner's Marsh, Allison Pond Park, Goodhue Park, and Jones Woods Park. Data for these parks are provided on the following page.

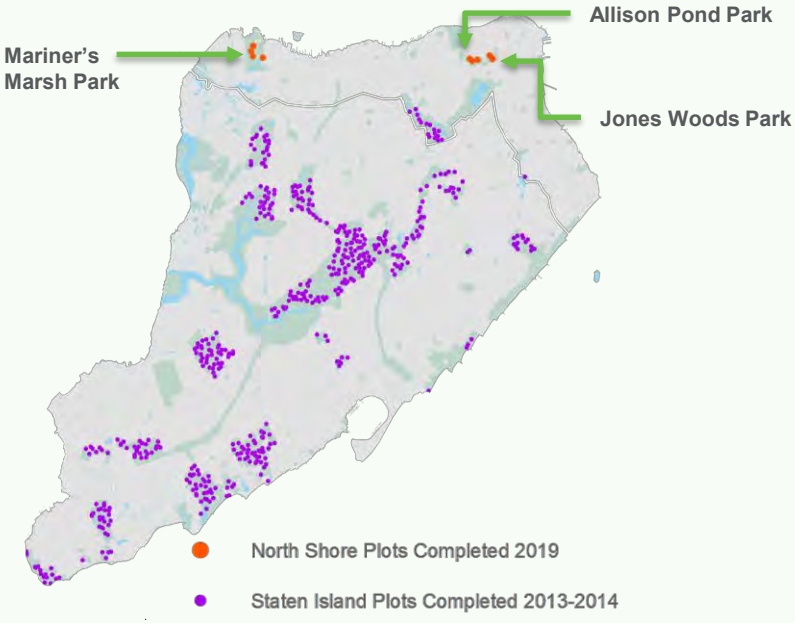
Table 2.4 Excerpt of FMF Data for Clove Lakes Park: Forest Type and Recommended Intensity of Management

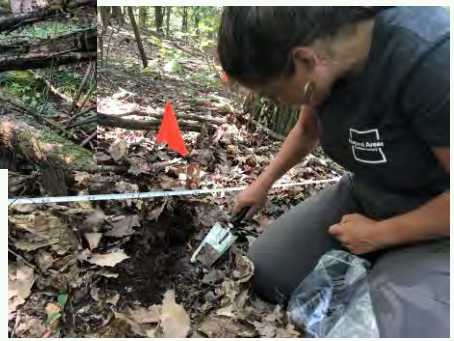
		Forest Type			
		Maritime Forest	**Northern Hardwood**	**Successional Forest**	**Totals**
Forest condition (acres)	**High Threat**	6.3 acres	0.0 acres	6.3 acres	**12.6 acres**
	Medium Threat	19.0 acres	0.0 acres	6.3 acres	**25.3 acres**
	Low Threat	12.6 acres	31.6 acres	6.3 acres	**50.6 acres**
	Very Low Threat	0.0 acres	12.6 acres	0.0 acres	**12.6 acres**
	Totals	**38.0 acres**	**44.3 acres**	**19.0 acres**	**101.3 acres**

Scientists at Work: Collecting Natural Areas Data in 2019

In 2019 with funding through a DEC HRE Local Stewardship Planning grant, scientists from the Natural Areas Conservancy completed an ecological assessment of 132 acres of natural area on the North Shore of Staten Island using a protocol that was previously used across 10,000 acres of natural area parkland citywide in 2014. The standardized method evaluated ecological health and threats as well as defined habitat types. Analysis of the ecological assessment data is used to:

- Inform high-level planning in a variety of NYC Parks' programs including the Forest Management Framework for New York City
- Identify management and restoration needs and stewardship opportunities for wetland and upland forests





Left: Plot being established in a swamp forest in Mariner's Marsh.

Right: Soil sample being taken in Goodhue Park.

Using the Forest Management Framework land managers are able to make short and long range decisions about where to work, how to allocate resources for restoration and land management, and how to identify appropriate and meaningful stewardship opportunities.

For example, Mariner's Marsh Park was determined to need low intensity forest management efforts in approximately 25% of the natural area in the park and the remaining 75% of the natural area needs medium-intensity restoration efforts that could be accomplished by in-house NYC Parks personnel or supervised community stewardship. It was found that Jones Woods Park requires an equal balance of medium intensity management and high intensity contractor-led restoration efforts.

In Goodhue Park, 21 acres of natural area were assessed and three forest types were identified: Oak-Heath Woodland Rocky Summit, Ruderal Norway Maple Forest, and Green Ash-Mixed Hardwood Floodplain Forest.

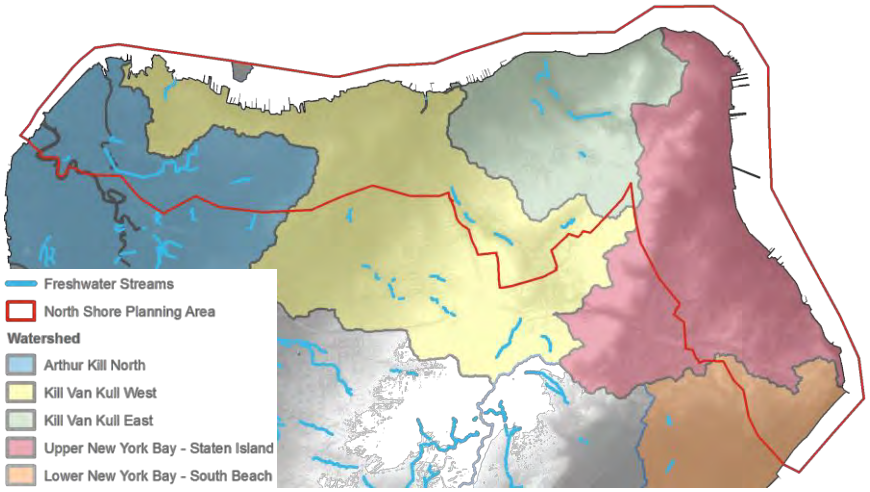
Watersheds and Freshwater Streams

Five watersheds intersect the North Shore study area. Historic stream maps from the Welikia Project reveal that development has caused loss or burial of approximately 52% (13.2 miles) of the original streams on the North Shore. Streams provide critical habitat for a diverse community of plants, fish and wildlife, and are critical in helping clean our water and convey flood waters. The remaining streams on the North Shore are largely straightened and armored, polluted by stormwater runoff, fragmented by streets and impoundments, and have degraded floodplains and riparian buffers.

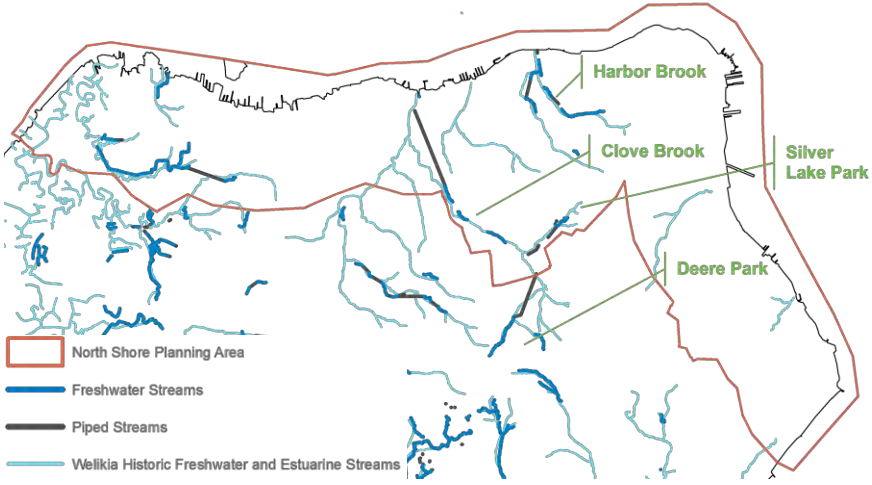
The most intact stream system is Harbor Brook, which lies within the Kill Van Kull East watershed. The stream's headwaters are in Goodhue Park and it flows through impoundments and freshwater wetlands until it reaches the Kill Van Kull. Only a small section of this stream is piped underground.

The Clove Brook system, located in the Kill Van Kull West watershed, is the largest stream system on the North Shore and is highly modified. Clove Brook's headwaters originate in Silver Lake Park and Deere Park. The brook flows through Clove Lakes Park where three impoundments form a series of lakes. From the northern edge of the park, the stream is piped for approximately 0.75 miles to an outfall in the Kill Van Kull. Historically Clove Brook was the main stem of several large tributaries in what are now the Castleton Corners, Westerleigh and Port Richmond neighborhoods. Fragmented aboveground reaches of these tributaries can be found in backyards and at road crossings.

Left: NYC Parks intern measuring stream substrate as part of a city-wide freshwater stream assessment in 2017.
Middle: Clove Brook in Clove Lakes Park; Kill Van Kull West Watershed.
Right: Harbor Brook in Goodhue Park; Kill Van Kull East Watershed.



Map 2.L. Watersheds of the North Shore.



Maps 2.M. Historic and Current Freshwater Streams.

Historic and Current Tidal Wetlands

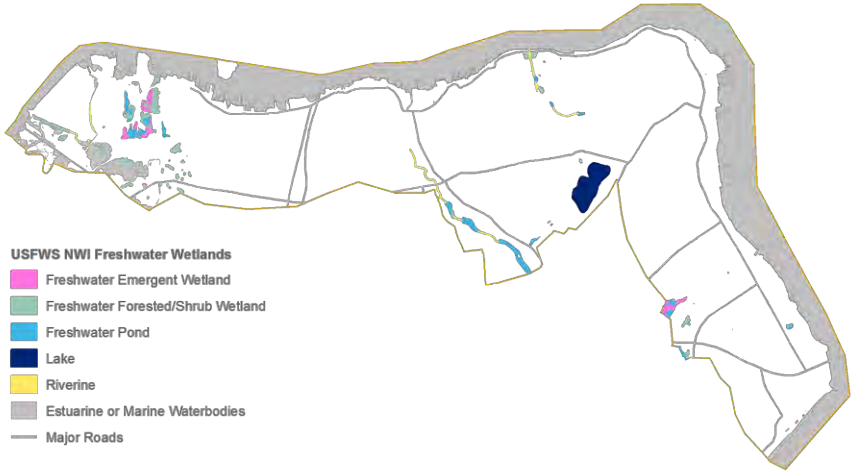
Most of the North Shore's tidal wetlands and shorelines have been modified by hundreds of years of filling to support industry. Estimates of historic tidal wetlands on the North Shore from the Welikia Project are 640 acres, whereas today we have less than 140 acres. Tidal wetlands, or salt marsh, are both historically and currently largely limited to the Arthur Kill and the western end of the Kill van Kull. Old Place Creek and Arlington Marsh are the two largest tidal wetlands systems on parkland. Due to the influence of industry, salt marshes on the North Shore have been heavily impacted by oil spills. Despite the industrial impacts, these salt marshes provide habitat as well as critical ecological services and functions, including water quality enhancement, wave attenuation, and storage of coastal stormwater. Smaller salt marshes are found at Van Pelt/Van Name Avenues (Richmond Terrace Wetlands), at the mouth of Harbor Brook adjacent to Snug Harbor, and on Shooter's Island.

Freshwater Wetlands

Freshwater wetlands and ponds are not abundant on the North Shore. The largest concentration of freshwater wetlands are in Mariner's Marsh, Eibb's Pond Park, and Graniteville Swamp. Eibbs Pond Park and Mariner's Marsh contain several high quality ponds that provide habitat for amphibians, reptiles, and birds. Freshwater ponds on the north shore are mostly impoundments including the 3 lakes in Clove Lakes Park, the ponds in Goodhue Park and Allison Pond, and Silver Lake. Small freshwater wetlands are found in the floodplains of Harbor Brook in Snug Harbor, Allison Pond Park, and Goodhue Park.

Left: Salt marsh at Arlington Marsh.
Right: Emergent freshwater wetland containing skunk cabbage on the floodplain of Harbor Brook in Goodhue Park.

Map 2.N. Tidal Wetlands.
Data Source: Wildlife Conservation Society's Welikia Project and NYSDEC



Map 2.O. National Wetland Inventory – Freshwater Wetlands.
Data Source: U.S. Fish and Wildlife Service National Wetlands Inventory

Past Habitat Restoration Projects

Wetland and upland restoration efforts within parkland on the north shore have been limited and spread out over time. Several wetland restoration projects were completed at Old Place Creek in the 1990's and early 2000's by various agencies, including NYC Parks, NYSDEC and the Port Authority. Other wetland restorations have been completed outside of NYC Parks property.

NYC Parks restored uplands in Clove Lakes Park and Jones Woods. These habitat restoration projects typically entail removal of invasive species and debris, and replanting native species.

NYC Parks plans to restore both upland and freshwater wetland habitat in Goodhue Park in 2019, with expected finish of 2020/2021. In addition, planning and/or design work for freshwater and tidal wetland restorations at Mariner's Marsh and Snug Harbor are underway.

Map 2.P. Completed Habitat Restorations

Large scale volunteer planting at Jones Woods Park.

Mariner's and Arlington Marsh

In 2017, NYC Parks, initiated a master planning effort for the approximately 135-acres of Mariner's and Arlington Marsh Parks with funding from the NYS Department of State. The master plan's objectives are to:

- Work with the community to assess short and long-term strategies for opening the park to the public;
- Assess site access, connectivity, and circulation; and
- Create both passive and active recreational opportunities.

Mariner's and Arlington Marsh are currently closed to the public because these parkland sites were home to industries that left a legacy of pollution a century ago. Parts of the parks have already been remediated in coordination with the U.S. Environmental Protection Agency, but the remainder of the site may still contain remnant contamination. Before the space can be safely re-activated for public use, NYC Parks is working with a consultant team, with input from the community, to develop a refined conceptual plan to share with regulatory agencies and receive their approval.

The Master Plan, which is expected to be finalized in May 2019, is the first step towards a phased re-opening of the parks. Following the release of the Master Plan, NYC Parks will seek funding to implement design and construction of the first phase of the plan. Throughout this and all future phases of the development of these flagship parks, the public will be engaged by Parks and kept informed of the process.

Mariner's and Arlington Marsh contain large swaths of freshwater wetlands and ponds, forests, and tidal wetlands, and are the largest natural habitat complexes on the North Shore. The community has repeatedly expressed that these natural areas are desirable features that should remain integral to the park's future use. As a result of this community feedback, the Master Plan makes a commitment to preserving and restoring natural areas throughout its phased re-opening. The North Shore Habitat Restoration and Green Infrastructure Plan recommends the same habitat conservation and restoration practices as those that will be included in the Master Plan.

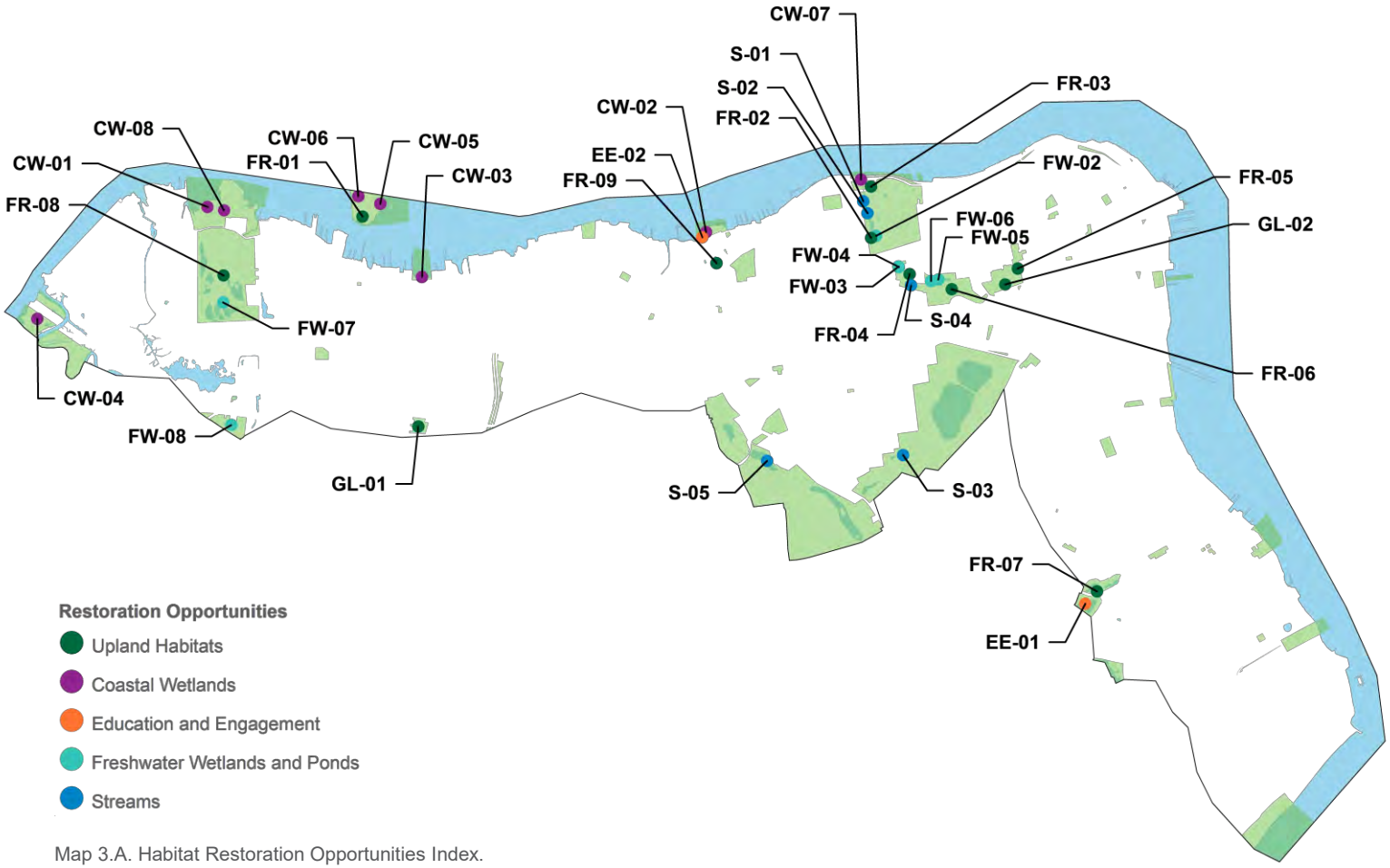
Mariner's Marsh and Arlington Marsh Parks.

Several ponds occur in the park, mostly surrounded by large stands of *Phragmites australis.*

Grassland where the U.S. EPA previously conducted an environmental remediation of legacy hazardous soils.

Freshwater forested wetlands.

3.0 Habitat Restoration Opportunities



Map 3.A. Habitat Restoration Opportunities Index.

3.1 Opportunity Identification

Habitat restoration opportunities were identified using a variety of methods including analysis of ecological data collected by NYC Parks and others, reviewing previous work in the planning area, consulting with the community and stakeholders through public community meetings, and through field reconnaissance.

Once inventoried, opportunities were prioritized based on support from partners and the community, ability to use the opportunity to leverage funding, and feasibility of implementation.

Table 3.1 Habitat Restoration Opportunities. Priority projects are shaded green.

	Park Name	Opportunity Code	Restoration Description	Involved Agencies/Stakeholders	Cost	Time Frame	Status
Coastal Wetlands	Arlington Marsh	CW-01	Marine Debris Removal. Marsh Planting	Parks, NY-NJ Port Authority, DEC, EPA	$$	> 5 Years	Identified
	Heritage Park	CW-02	Study Feasibility of Introducing Marsh Plane	Parks, DEP	$$$$	> 5Years	Identified
	Richmond Terrace Wetlands	CW-03	Low and High Marsh Buildout	Parks	$	< 5 Years	Identified
	Old Place Creek	CW-04	Invasive Species and Debris Removal	Parks, NY-NJ Port Authority	$$$$	> 5 Years	Identified
	Shooter's Island	CW-05	Low Marsh Buildout	Parks, NY-NJ Port Authority	$$$	> 5 Years	Identified
	Shooter's Island	CW-06	Marine Debris Removal	Parks, NY-NJ Port Authority	$$$	> 5 Years	Identified
	Snug Harbor	CW-07	Lower Grade, Invasive Species Removal, Planting	Parks, Snug Harbor Cultural Center, DEP	$$$	< 5 Years	Conceptual Design
	Arlington Marsh	CW-08	Historic Fill and Invasive Species Removal	Parks, NY-NJ Port Authority, Mariner's Marsh Conservancy	$$$$	> 5 Years	Identified
Freshwater Wetlands and Ponds	Snug Harbor Cultural Center	FW-01	Invasive Species Removal and Planting	Parks, Snug Harbor Cultural Center, DEP	$$$$	> 5 Years	Identified
	Goodhue Park	FW-02	Dredging Feasibility Study	Parks, Children's Aid Society	$	< 5 Years	Identified
	Allison Pond Park	FW-03	Dredging Feasibility Study	Parks, Friends of Allison Pond Park	$	< 5 Years	Identified
	Allison Pond Park	FW-04	Buffer Enhancement (Reduced Mowing, Planting)	Parks, Friends of Allison Pond Park	$	< 5 Years	Identified
	Goodhue Park	FW-05	Dam Reconstruction	Parks, Children's Aid Society	$$$$	> 5 Years	Identified
	Mariner's Marsh	FW-06	Invasive Species Removal	Parks, Mariner's Marsh Conservancy	$$$	> 5 Years	Identified
	Graniteville Swamp	FW-07	Invasive Species and Debris Removal, Planting, Addressing Encroachment	Parks	$$$	> 5 Years	Identified
Streams	Snug Harbor Cultural Center	S-01	Invasive Species Removal and Planting	Parks, Snug Harbor Cultural Center	$$	> 5 Years	Identified
	Snug Harbor Cultural Center	S-02	Bank Stabliization	Parks, Snug Harbor Cultural Center	$$$$	> 5 Years	Identified
	Silver Lake Park	S-03	Buffer Enhancement (Reduced Mowing)	Parks, Silver Lake Golf Course	$	< 5 Years	Identified
	Allison Pond Park	S-04	Buffer Enhancement (Invasive Species and Debris Removal, Planting)	Parks, Friends of Allison Pond Park	$$$	> 5 Years	Identified
	Clove Lakes Park	S-05	Invasive Species Removal	Parks	$$	< 5 Years	Identified
	Goodhue Park	S-06	Buffer Enhancement (Invasive Species and Debris Removal, Planting)	Parks, Children's Aid Society	$$$	> 5 Years	In Progress

Table 3.1 Habitat Restoration Opportunities. Priority projects are shaded green. (Continued)

	Park Name	Opportunity Code	Restoration Description	Involved Agencies/Stakeholders	Cost	Time Frame	Status
Education and Engagement	Eibb's Pond Park	EE-01	Stewardship Invasive Removals and Debris Cleanup	Parks	$	< 5 Years	Identified
	Heritage Park	EE-02	Stewardship Shoreline Cleanup	Parks	$	< 5 Years	Identified
Upland Habitats	Shooter's Island	FR-01	Invasive Species and Debris Removal and Planting	Parks, NY-NJ Port Authority	$$$	> 5 Years	Identified
	Snug Harbor Cultural Center	FR-02	Invasive Species Removal and Planting	Parks, Snug Harbor Cultural Center, DEP	$$	< 5 Years	Identified
	Snug Harbor	FR-03	Invasive Species and Debris Removal and Planting	Parks, Snug Harbor Cultural Center	$$	< 5 Years	Conceptual Design
	Allison Pond Park	FR-04	Invasive Species Removal and Planting	Parks, Friends of Allison Pond Park	$	< 5 Years	Identified
	Jones Woods Park	FR-05	Invasive Species Removal and Planting	Parks	$$	< 5 Years	In Progress
	Goodhue Park	FR-06	Invasive Species Removal and Planting	Parks, Children's Aid Society	$$	< 5 Years	In Progress
	Eibb's Pond Park	FR-07	Invasive Species Removal and Planting	Parks	$$	> 5 Years	Identified
	Mariner's Marsh	FR-08	Invasive Species Removal and Debris Removal	Parks, Mariner's Marsh Conservancy	$$$	> 5 Years	Identified
	Richmond Terrace Storehouse	FR-09	Vegetation Inventory and Site Reconnaissance	Parks	$	< 5 Years	Identified
	Graniteville Quarry	GL-01	Invasive Species and Debris Removal	Parks	$$	> 5 Years	Identified
	Jones Woods Park	GL-02	Invasive Species Removal	Parks	$$	< 5 Years	In Progress

Eibb's Pond Park. Invasive species in the uplands are degrading habitat quality.

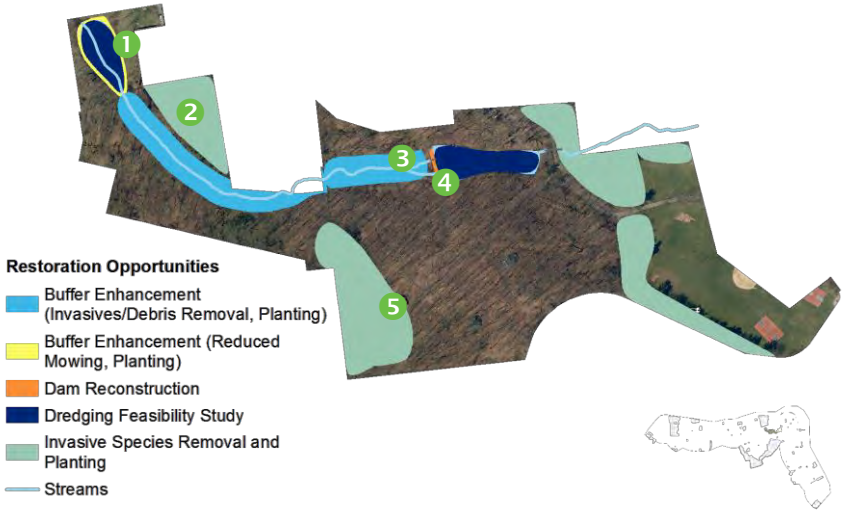
Graniteville Quarry. Grasslands can be enhanced with native plantings.

Silver Lake Park Golf course. Mowing right to the edge of a stream increases nutrients and threatens salamander populations.

3.2 Example Priority Projects: Allison Pond Park and Goodhue Park

Harbor Brook, the most intact stream on the North Shore, begins in Goodhue Park. Restoration actions along Harbor Brook can provide ecological and aesthetic benefits to wildlife and park users. Stormwater management and future planned restoration actions of this park include:

- Enhance riparian Buffer around Allison Pond by reducing mowing and installing additional native plants.
- Restore riparian forest along Harbor Brook in Allison Pond and Goodhue Parks though removing debris, invasive species, and planting native species.
- Explore benefits, impacts and feasibility of dredging Allison and Goodhue Ponds. Both ponds are impoundments on the stream and thus have trapped sediment over decades.
- Evaluate the need to rehabilitate the degraded dam in Goodhue Park.



Goodhue Park Restoration Opportunities

1. FW-04. Reduced mowing.
2. FR-04. Debris removal.
3. S-06. Riparian forest restoration.
4. FW-05. Dam rehabilitation.
5. FR-06. Upland forest restoration.

3.3 Example Priority Projects: Arlington Marsh

Restoration actions are constrained at this marsh by split property ownership, and the cost of removing contaminated fill. However, the following actions can provide ecological and aesthetic benefits to wildlife and park users:

- Remove several acres of large marine debris that has accumulated over decades. Debris removal will increase the available space for marsh to regrow.
- Remove select areas of historic fill. The filled shoreline can be re-graded in areas to enhance existing or re-establish new salt marsh while removing invasive *Phragmites australis*.

Arlington Marsh Restoration Opportunities

❶ CW-01. Marine debris removal partially on Port Authority Property.

❷ CW-01. Marine debris removal.

❸ CW-01. Marine debris removal and shoreline restoration.

4.0 Green Infrastructure Opportunities

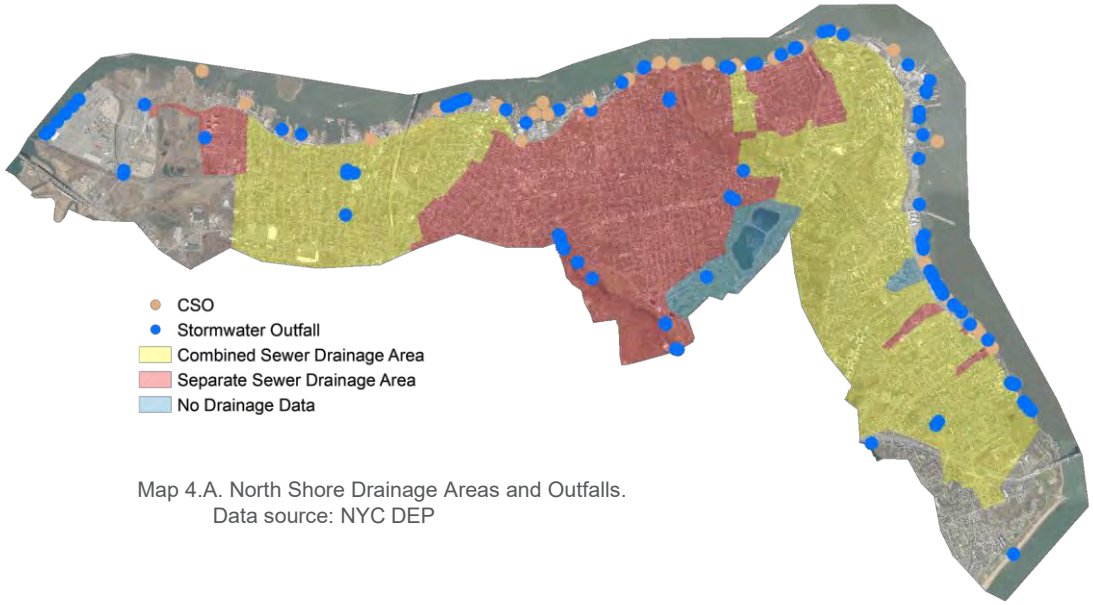
Green infrastructure (GI) is the practice of using vegetated systems to manage stormwater runoff through capture, detention, infiltration and evapotranspiration. In NYC, the primary goal for GI is to reduce the amount of stormwater runoff entering the combined sewer system. In large rainfall events (>1" rainfall) the capacity of the waste water treatment system is exceeded, and stormwater runoff contributes to combined sewer overflows (CSO). During CSOs stormwater and sanitary waste mix together and are discharged from pipes into NYC water bodies, impacting local water quality.

There are fewer combined sewer outfalls on Staten Island than in the rest of NYC because the sewer is newer. Most of these combined sewer outfalls (95%) are located on the North Shore. GI is one strategy for helping to reduce CSO events and improve water quality by helping to restore the natural stormwater capture capacity of the landscape.

Approximately half of the North Shore is separately sewered (shown in red in Map 4.A.), meaning sanitary waste and stormwater runoff are conveyed in separate pipes. These areas are also known as MS4 areas, or Municipal Separate Storm Sewer Systems. Stormwater picks up pollutants as it flows over impervious surfaces, therefore even in areas where CSO is not a concern, GI provides important water quality benefits.

Opportunities for GI on the North Shore were identified using the following approach:

1. Spatial modeling of topography, vegetation cover and built structures to locate potential GI sites on or near parkland;
2. Field verification of potential GI site to assess feasibility and site constraints;
3. Categorization of potential GI types in an inventory of opportunities on parkland.



Map 4.A. North Shore Drainage Areas and Outfalls.
Data source: NYC DEP

4.1 Green Infrastructure Typologies and Examples

Stormwater infrastructure can be green, grey, or a hybrid of both strategies. A rain garden or green roof use soil and vegetation to maximize ecological benefits, whereas permeable pavement and subsurface detention tanks are gray approaches that can be incorporated into parkland and GI systems.

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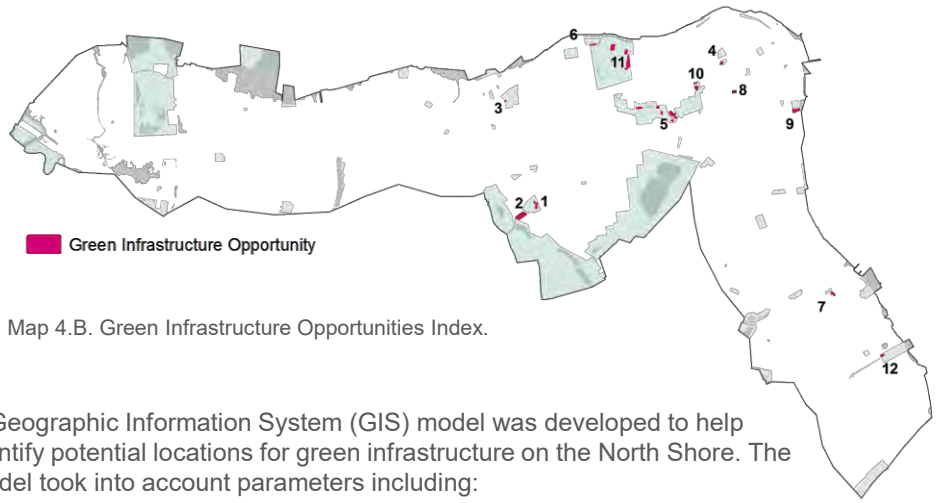
Top: A rain garden at Austin J. McDonald Playground.
Bottom Left: Permeable Pavers.
Bottom right: Subsurface Detention.

Some other benefits GI can provide are opportunities for stewardship and education, habitat for pollinators, and air quality benefits.

Top: Stormwater Greenstreet built at the intersection of Van Duzer Street and Targee Street.

Bottom: Green roof constructed at Lyon's Pool and Recreation Center.

4.2 Modeling for GI Opportunities



Map 4.B. Green Infrastructure Opportunities Index.

A Geographic Information System (GIS) model was developed to help identify potential locations for green infrastructure on the North Shore. The model took into account parameters including:

- Topography
- Slope
- Depth to Bedrock and Depth to Groundwater
- Canopy
- Community Parks Initiative Zones
- Impervious Area
- Flow Accumulation
- CSO vs MS4 Areas

The model assigned a score to areas based on how many of the above parameters were suitable for GI. Field assessments were conducted at the sites that scored high in the model. Sites determined to be most feasible for GI are listed in Table 4.1.

Table 4.1 Selection of North Shore Green Infrastructure Opportunities

ID #	Park	Proposed GI	Opportunity Description
1	Barrett Park	Permeable Pavement Subsurface Detention	Large paved parking area viable for permeable pavement or subsurface detention.
2	Clove Lakes Park	Rain Garden Permeable Pavement	Construct rain garden at base of large parking lot at corner of Clove Road and Martling Avenue.
3	CPL Thompson Park	Permeable Pavement Subsurface Detention	Small paved area near basketball courts viable for subsurface detention.
4	Davis Playground	Permeable Pavement Subsurface Detention	Blacktop retrofit with permeable pavement and/or subsurface detention.
5	Goodhue Park	Rain Garden Permeable Pavement Subsurface Detention	Sitewide stormwater study. Retrofit parking area and tennis courts with permeable pavement and/or subsurface detention. Potential for rain gardens or bioretention.
6	Harbor Brook	Rain Garden	Construct streetside rain gardens at Snug Harbor Road to prevent direct runoff into Harbor Brook.
7	Kaltenmeier Playground	Permeable Pavement Subsurface Detention	Retrofit play area with permeable pavement and/or subsurface detention.
8	Liotti Ikefugi Playground	Permeable Pavement Subsurface Detention	Retrofit play area and basketball court with permeable pavement and/or subsurface detention.
9	Lyon's Pool	Permeable Pavement Subsurface Detention	Large parking lot retrofit with permeable pavement and/or subsurface detention.
10	Skyline Playground	Rain Garden Permeable Pavement	Small rain garden at toe of tennis courts. Permeable pavement and/or subsurface detention opportunity under playground.
11	Snug Harbor Cultural Center	Permeable Pavement Subsurface Detention	Three parking lots viable for retrofit with permeable pavement and/or subsurface detention. Additional opportunity for rain gardens at Snug Harbor Road.
12	Von Briesen Park	Permeable Pavement Subsurface Detention	Retrofit parking area with permeable pavement and/or subsurface detention.

4.3 Green Infrastructure Opportunity Spotlight: Clove Lakes Park and Staten Island Zoo Parking Lot

An approximately 1.3 acre impervious parking lot at the corner of Martling Avenue and Clove Road currently flows to storm drains that connect via storm sewer to an outfall that discharges into Martling Lake. The storm sewer shown in the figure is an approximation of its path.

- Pervious area (approximately 5,000 square feet, shown shaded in green) exists adjacent to the lowest topographic point in the parking lot and could be modified to receive and retain runoff. It contains some native species but is currently being overtaken by mugwort.
- The area was once planted and does not appear to be currently maintained. Some native species are present, but mugwort is currently overtaking the area. Two Japanese pagoda trees are present.
- Conversion to a rain garden may be constrained by the two trees in the pervious area.

4.4 Green Infrastructure Opportunity Spotlight: Allison Pond Park and Goodhue Park

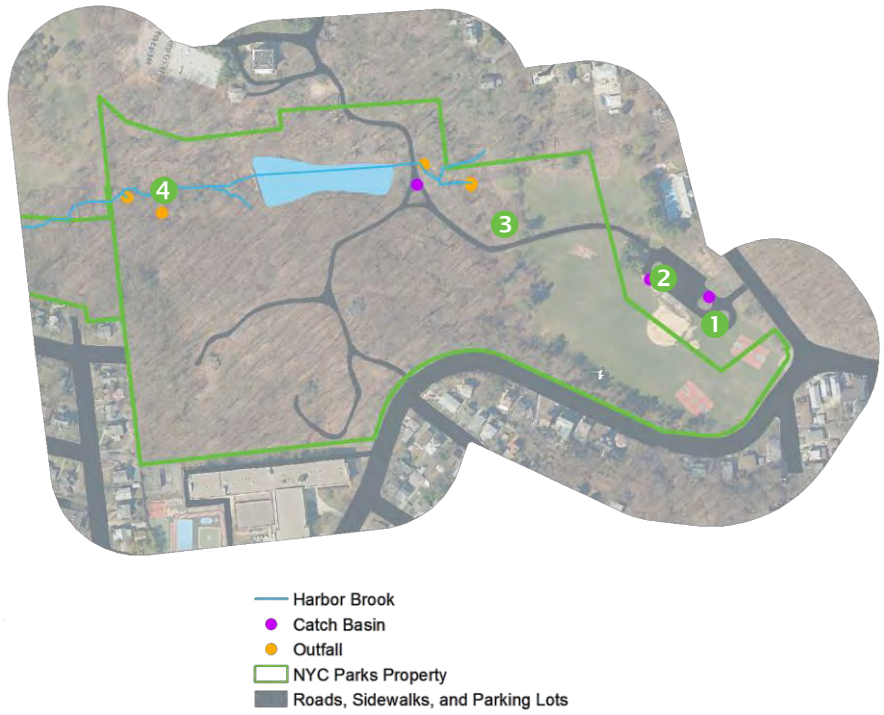
Goodhue and Allison Pond Parks together encompass a large mostly natural park containing mature forest, a freshwater stream, and some freshwater and riparian wetlands. The parks are positioned at the lowest point in an urbanized watershed, with the stream, Harbor Brook, receiving overland and piped flow from the watershed.

- Goodhue Park is a recent acquisition and contains stormwater discharge pipes whose drainage areas are unknown and which empty into the stream.
- Impoundments in both parks are influenced by the flow. They are both heavily silted in, and nutrient loading has caused algal blooms in Allison Pond.

GI Opportunities:

- Assess feasibility for right-of-way GI in upstream watershed.
- Conduct stormwater investigation within the park to determine source drainage area of all outfalls.
- Work with Children's Aid Society to retrofit ballfield and remove sand from storm drain.
- Investigate impoundments in both parks for their ability to retain sediment loading.

4.4 Green Infrastructure Opportunity Spotlight: Allison Pond Park and Goodhue Park



Goodhue Park Stormwater Management Opportunities

1. Sand trailing from the ballfield down gradient towards a stormdrain.
2. Sand from ballfield covering and clogging stormdrain that flows into Harbor Brook.
3. 36” inch stormwater outfall that drains stormwater from surrounding neighborhood.
4. Large outfall discharging into stream. Source drainage area unknown.

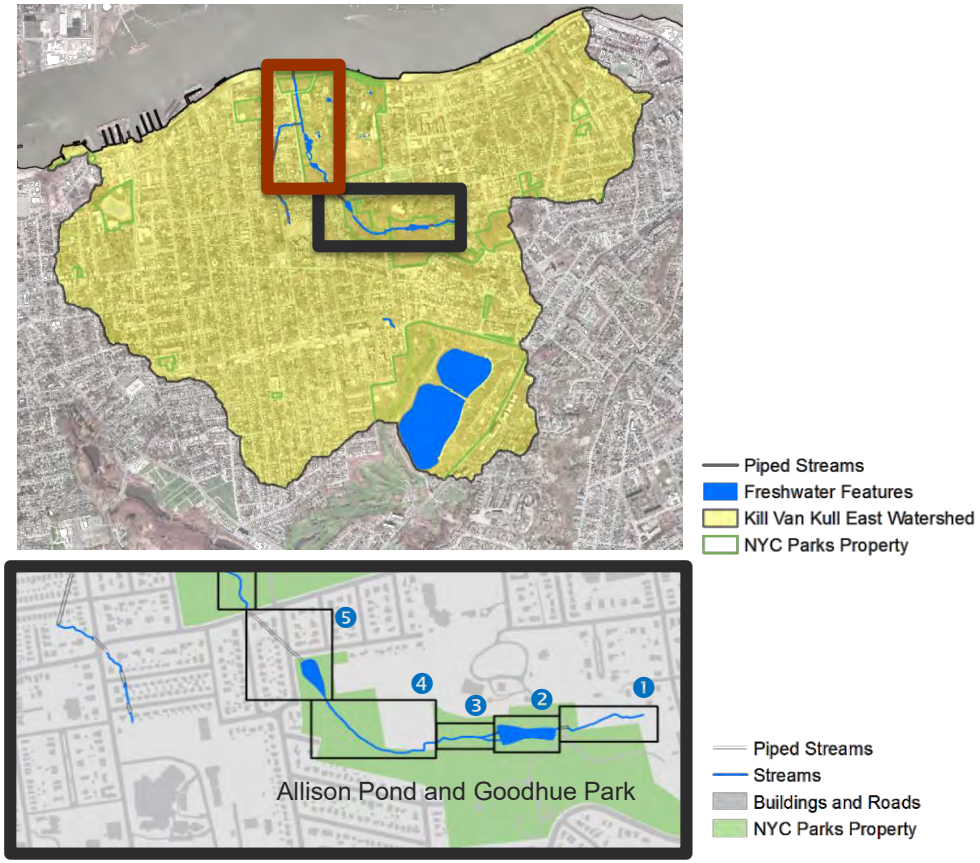
5.0 Harbor Brook Restoration Opportunity

Overview – Upstream Reaches

Harbor Brook is one of the last remaining intact stream corridors on the North Shore. The stream starts in Goodhue Park and flows through Allison Pond Park and Snug Harbor to the Kill Van Kull. Along its path it flows through floodplain forests, freshwater wetlands, and salt marsh vegetation.

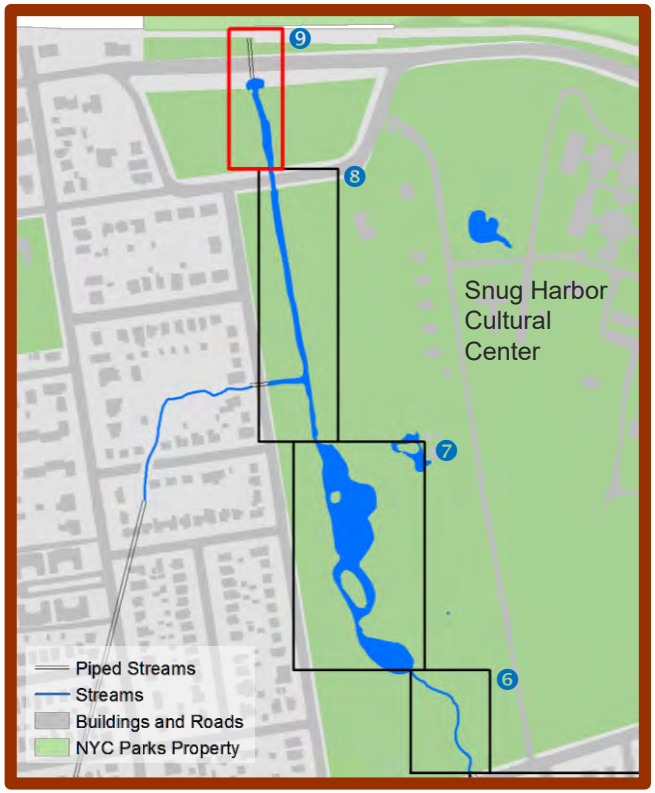
Starting in Goodhue Park, the stream's headwaters are fed by groundwater seeps and a stormwater outfall that drains stormsewers from the surrounding neighborhood (Stream Segment ❶). The stream flows into a pond maintained by a deteriorating dam (Stream Segment ❷). From the dam, Harbor Brook flows down through a riparian freshwater wetland (Stream Segment ❸) and into a moderately steep valley through Allison Pond Park (Stream Segment ❹). Throughout its course, Harbor Brook receives additional flow from groundwater, stormwater, and one perennially flowing spring that maintains an emergent wetland near the border of Goodhue and Allison Pond Park. The stream flattens as it reaches Allison Pond.

From Allison Pond, the stream is piped a short distance underneath Brentwood Avenue and across Henderson Avenue where it resurfaces from the pipe on the grounds of Snug Harbor Cultural Center (Stream Segment ❺).



Map 5.A. (Above). Index map for Harbor Brook stream segments.
Map 5.B. (Below). Close-up of the upstream Harbor Brook stream segments.

Overview – Downstream Reaches



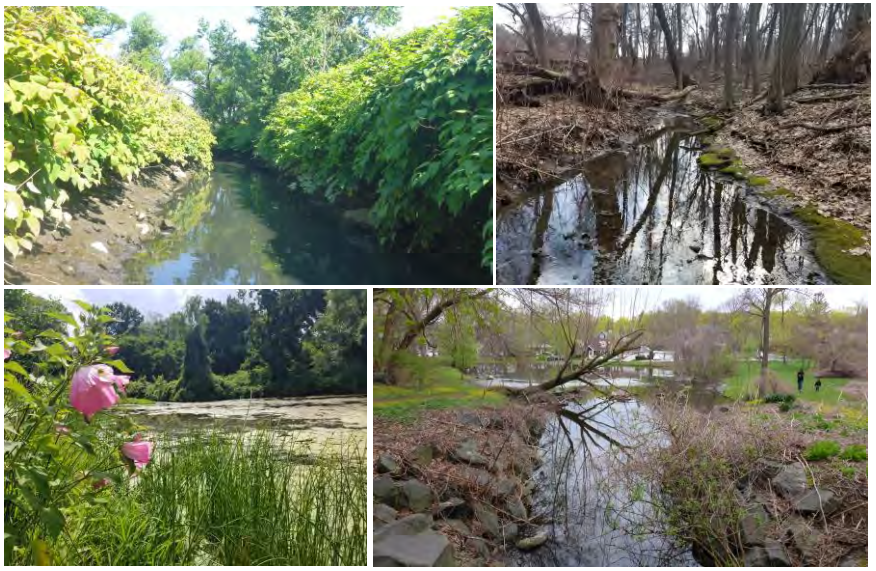
Map 5.C. Close-up of the downstream Harbor Brook stream segments.

Through Snug Harbor, Harbor Brook becomes a low gradient stream, meandering through riparian wetlands and past maintained lawn (Stream Segment 6) where it again flows into a pond (Stream Segment 7). Downstream of the pond there is at least one stormwater discharge pipe and a deteriorated concrete bridge.

After the pond, the Harbor Brook channel straightens and receives flow from a tributary now armored and piped through residential backyards. Harbor Brook then flows north to the Kill Van Kull. In this straight reach, the stream becomes tidal and brackish as freshwater mixes with saline water flowing in from the Kill Van Kull. The banks are steep and dominated by invasive species such as Japanese knotweed or *Phragmites* (Stream Segment 8).

Next, the stream is culverted underneath Snug Harbor Road and continues north through the approximately 4-acre natural area that contains degraded woodland and is the site for the conceptual plan in this chapter (Stream Segment 9).

Finally, the stream flows through another culvert underneath Richmond Terrace where it meets the Kill Van Kull.



Top Left: Japanese Knotweed on the banks of Stream Segment 8.
Top Right: Stream Segment 4.
Bottom Left: Freshwater Pond in Stream Segment 7.
Bottom Right: Inflow to Allison Pond Park, Stream Segment 5.

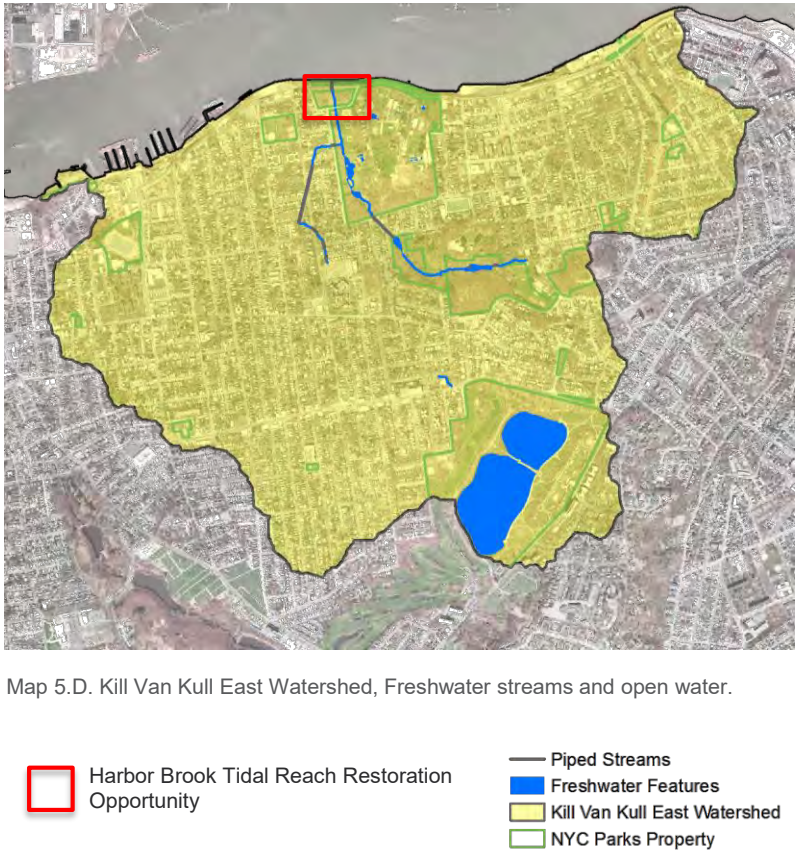
5.1 Tidal Reach Restoration Conceptual Plan

Goals

- Enhance habitat diversity and increase extent of native plant community at the mouth of the last intact freshwater stream systems on the North Shore.
- Increase opportunities for outreach and stewardship of a coastal natural area and leverage the proximity to a well-established educational institution.
- Increase opportunities for resilience of one of the last remaining tidal wetland habitats along the primarily hardened North Shore coastline.

Site Specific Objectives

- Re-establish 0.75-acres of salt marsh.
  - Remove historic fill and *Phragmites australis* and mitigate against future *Phragmites* growth;
  - Lower the grade of the existing banks to suitable salt marsh elevations;
  - Plant native salt marsh grasses.
- Enhance 3.25-acres of upland maritime forest.
  - Clear site of surficial fill and debris;
  - Remove invasive species;
  - Plant native trees adapted to maritime conditions.



Map 5.D. Kill Van Kull East Watershed, Freshwater streams and open water.

Existing Conditions Summary

The site contains the tidal reach of Harbor Brook through the middle of the parcel and has successional woodland on either side. The lowest wetland areas contain primarily *Phragmites* and the uplands contain a heterogeneous mix of native and non-native tree species.

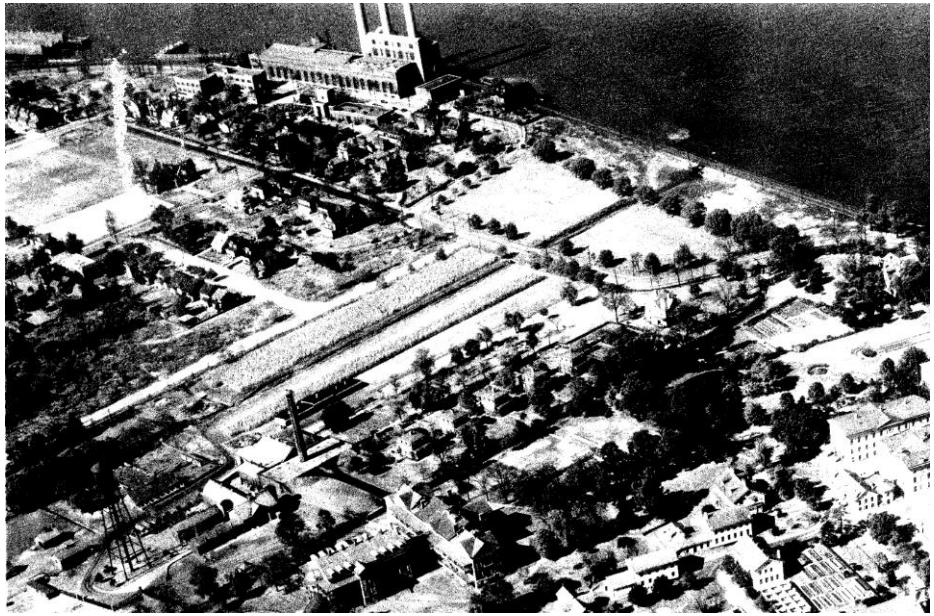
Mouth of Harbor Brook. 2010 aerial photography.
Source: NYC Parks

Top: Site looking north towards the Kill van Kull Kill.
Bottom: Site looking south from Richmond Terrace.

5.2 Site History

For over a century and a half, the mouth of Harbor Brook was heavily altered. The 1874 Atlas of Staten Island, Richmond County, New York shows this section of the stream straightened, much as it is today. In 1924, the furthest downstream section of stream flows through farmland. Richmond Terrace followed the path of what is now Snug Harbor Road, while the Staten Island Railway delineates the shoreline. There appears to have been a short, unconfined tidal section of channel before the stream enters a culvert under the railroad. By 1951 Richmond Terrace was constructed in its current alignment along the shoreline, replacing the Railway and the stream flows to the Kill van Kull through a longer culvert. The farmland on either side of the channel was filled, and naturally converted to a woodland with an abundance of invasive species. Ball fields were constructed on the east bank of the channel floodplain south of Snug Harbor Road. The fill and armored banks have largely prevented re-naturalization of the stream channel.

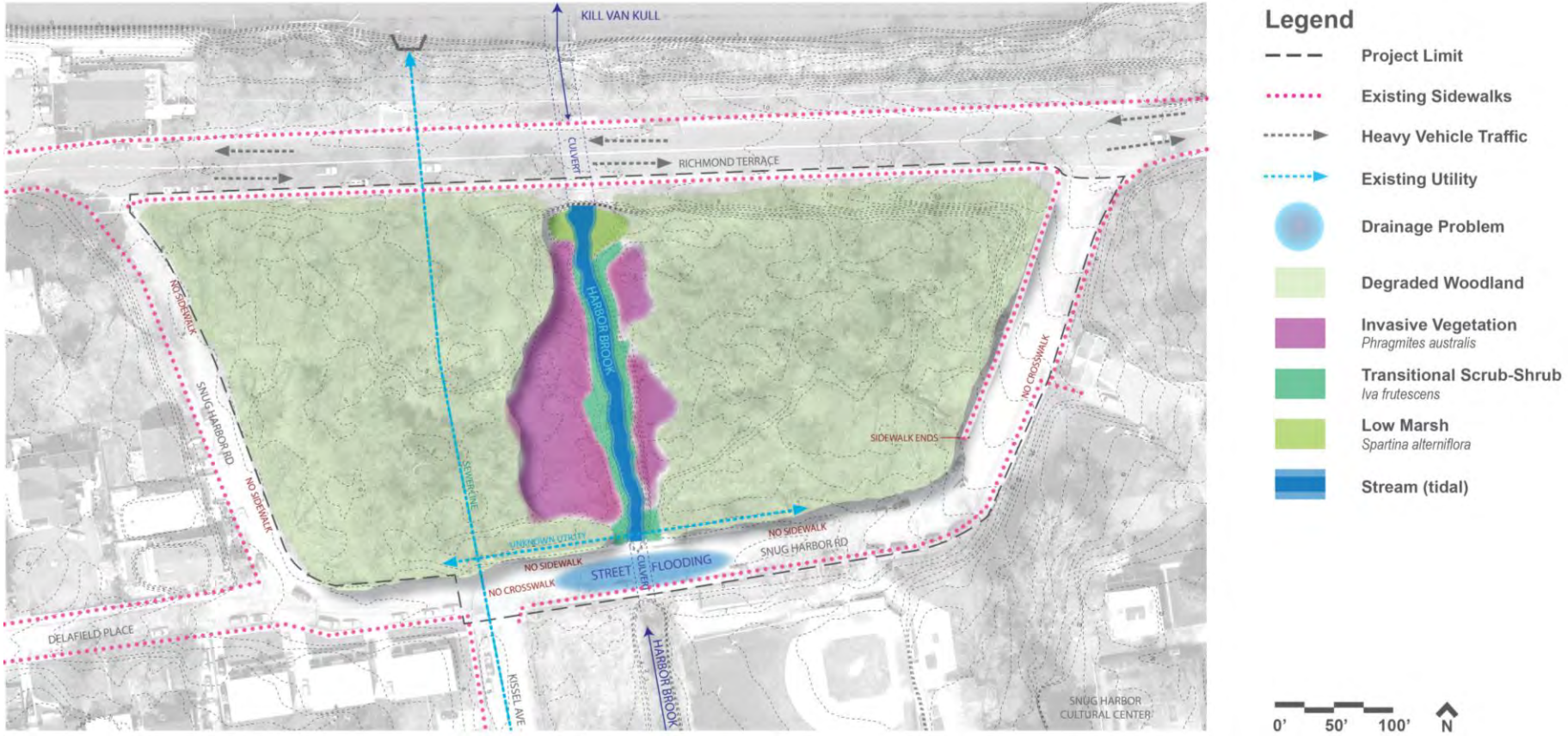
Mouth of Harbor Brook at Snug Harbor in 1951.
Source: NYCityMap, New York City Department of Information Technology



Mouth of Harbor Brook at Snug Harbor taken circa 1938.
Source: Image courtesy of Snug Harbor Cultural Center

5.3 Site Analysis

A small patch of native salt marsh grasses is found at the mouth of the brook. Invasive species dominate the rest of the site including some of the tidally influenced area and fill soils. A sewer line traverses the upland west of the brook. A second concrete encased utility line of unknown origin and function crosses perpendicular to the bed of Harbor Brook at the upstream end of the site. Routine street flooding at the Snug Harbor Road culvert is evident by sediment buildup on the sidewalk and debris clogging the storm drains.



5.3 Site Analysis

Habitat Characterization

A rapid ecological assessment of the site in 2017 and 2018 documented species diversity, relative cover, and disturbances to the site.

Woodland

The woodland along Harbor Brook contains a mix of maritime, hardwood forest, and ornamental trees that reflect the area's disturbed fill soils. The dominant trees species is Norway maple (*Acer platanoides*) (Table 5.1). At the edges of the site where disturbance is greatest, large stands of Japanese knotweed (*Fallopia japonica*) thrive. Across the site, other invasive species including multiflora rose (*Rosa multiflora*), mugwort (*Artemisia vulgaris*), and black locust (*Robinia pseudoacacia*) are common. In the interior of the site, herbaceous cover is sparse, and dominated by American pokeweed (*Phytolacca Americana*), poison ivy (*Toxicodendron radicans*), and garlic mustard (*Alliaraia petiolate*).

Top Left: Dense monoculture of Japanese knotweed dominates the west side of the parcel at Snug Harbor Road.
Bottom: Degraded woodland east of Harbor Brook in the background. Tree canopies are partially defoliated, a sign of unhealthy trees possibly caused by invasive vines.
Right: London Planetrees line the edges of Snug Harbor Road.

Table 5.1 Woodland Assessment Data from 2018. U = Understory, M = Midstory, C = Canopy.

Species	Native/ Non-Native	Strata Present*	Average Coverage (%)
Acer platanoides	Non-Native	C	62.5
Fallopia japonica	Non-Native	U, M	62.5
Rosa multiflora	Non-Native	U, M	62.5
Phytolacca americana	Native	U	50
Toxicodendron radicans	Native	U, M, C	50
Acer negundo	Native	C	37.5
Artemisia vulgaris	Non-Native	U	37.5
Phragmites australis	Non-Native	M	37.5
Platanus × acerifolia	Non-Native	C	37.5
Robinia pseudoacacia	Non-Native	M, C	37.5
Aesculus hippocastanum	Non-Native	U, C	25
Alliaria petiolata	Non-Native	U	25
Ampelopsis glandulosa var. brevipedunculata	Non-Native	U, M	25
Celtis occidentalis	Native	M	25
Fraxinus sp.	Native	C	25
Lonicera sp.	Non-Native	U, M	25
Ulmus americana	Native	M, C	25
Acer rubrum	Native	C	12.5
Acer saccharinum	Native	C	12.5
Ageratina altissima	Native	U	12.5
Ailanthus altissima	Non-Native	C	12.5
Apocynum cannabinum	Native	U	12.5
Boehmeria cylindrica	Native	U	12.5
Celastrus orbiculatus	Non-Native	M, C	12.5
Fallopia sachalinensis	Non-Native	U, M	12.5
Juglans nigra	Native	C	12.5
Ligustrum vulgare	Non-Native	M	12.5
Morus alba	Non-Native	C	12.5
Oxalis acetosella	Native	U	12.5
Parthenocissus quinquefolia	Native	U	12.5
Rubus sp.	Native	U	12.5
Rumex crispus	Non-Native	U	12.5
Hedera helix	Non-Native	U	0.01
Malus sp.	Native	M	0.01

5.3 Site Analysis

Habitat Characterization (continued)

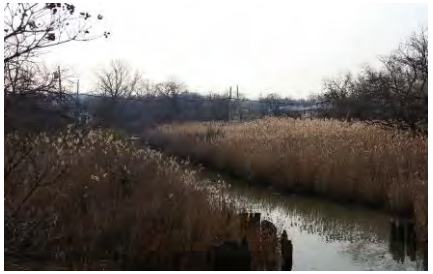
Upland - Wetland Transitional Area
Due to straightening and filling, Harbor Brook has steep banks and a very narrow extent of tidal inundation beyond the channel. Consequently, there is a rapid transition from the channel to the upland and typical high marsh grasses such as *Spartina patens* and *Distichlis spicata* cannot establish. Instead, there is a mix of native and invasive plants including marsh elder (*Iva frutescens*), groundsel bush (*Baccharis halimifolia*), and common reed (*Phragmites australis*). As the elevation increases further from the channel, likely due in part to historic fill, the vegetation community is dominated by *Phragmites*.

Tidal Wetland – Salt Marsh
Despite being tidally influenced through out the site reach, there is very little low marsh vegetation along the stream. The only area of low marsh with saltmarsh cordgrass (*Spartina alterniflora*) is found at the furthest downstream end of the brook, where it enters the final culvert upstream of the Kill Van Kull. This salt marsh grass typically grows between mean low water and mid-tide elevations. The only other vegetation growing in this elevation zone was annual seablite (*Sueda linearis*).

Hydrologic Assessment – Biobenchmarking
When restoring a salt marsh, biobenchmarking is the process of determining the elevation of existing tide-dependent low and high marsh plants. These plants provide biological benchmarks, surveyed in the field, that are used together with regional tide gage data to determine what elevations are needed at the site to achieve appropriate tidal inundation to support a larger expanse of salt marsh plants.

Table 5.2 Biobenchmarking Elevations

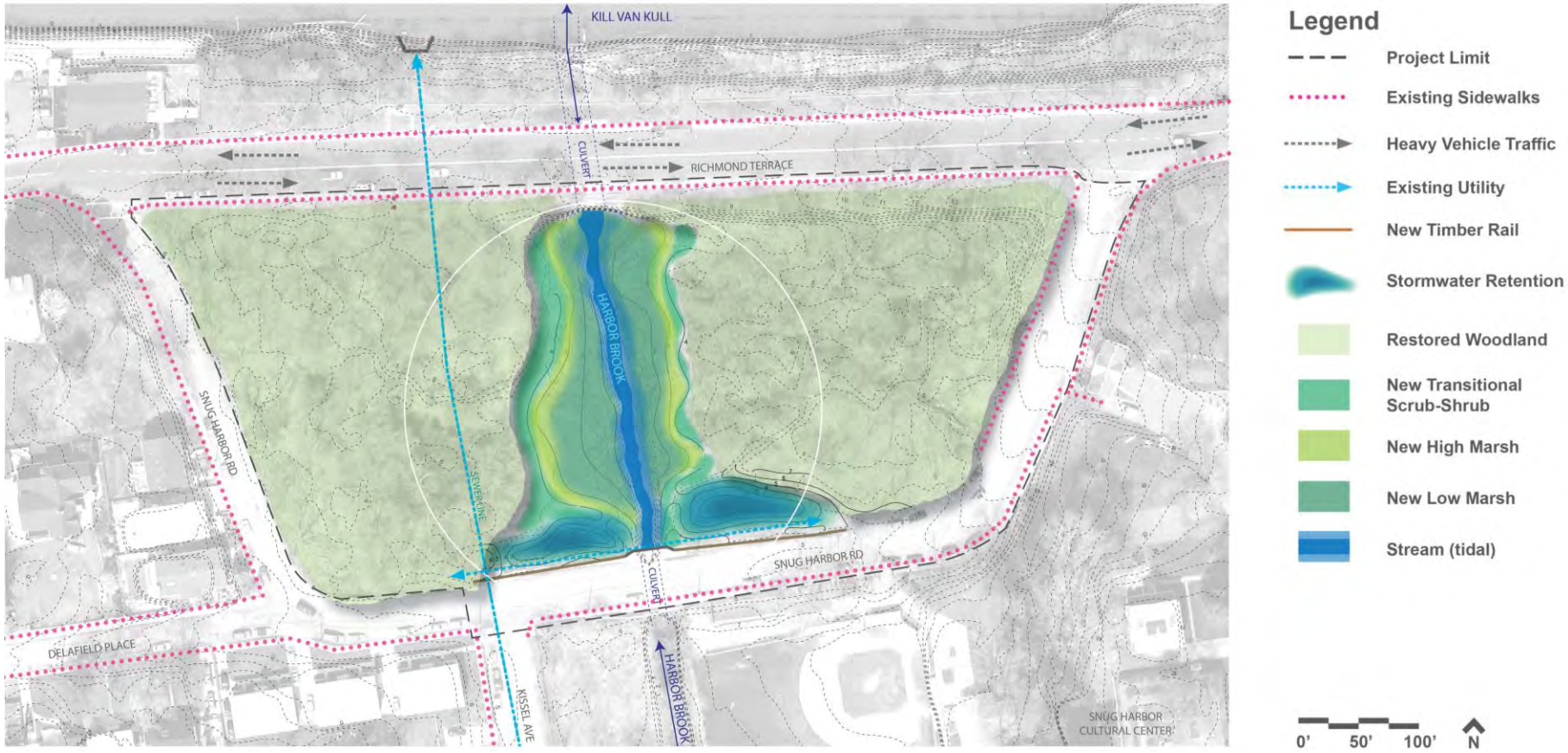
Habitat and Tidal Range	Elevation (feet)
Low Marsh – Mean Tide Level to Mean High Water	4.19
High Marsh – Mean High Water to Mean Higher High Water	-0.13
Upland – Mean Higher High Water +	2.28



Topmost Right: NYC Parks staff holds a survey rod to biobenchmark elevations for salt marsh design.
Top Left: The small remaining pocket of *Spartina alterniflora* at the mouth of Harbor Book.
Top Right: Annual seablite (*Sueda linearis*) growing on a mudflat at Harbor Brook.
Bottom Left: Eroded channel banks with *Phragmites* growing where high marsh could grow.
Bottom Right: View of the *Phragmites* growing on the west bank of Harbor Brook.

5.4 Restoration Concept

The proposed schematic design includes excavating historic fill and invasive species, placing clean sand, and grading to restore native salt marsh. In the uplands, restoration includes removing debris and invasive species, replanting native vegetation communities, and installing street side green infrastructure to reduce localized flooding along Snug Harbor Road.



5.4 Restoration Concept

Tidal marsh

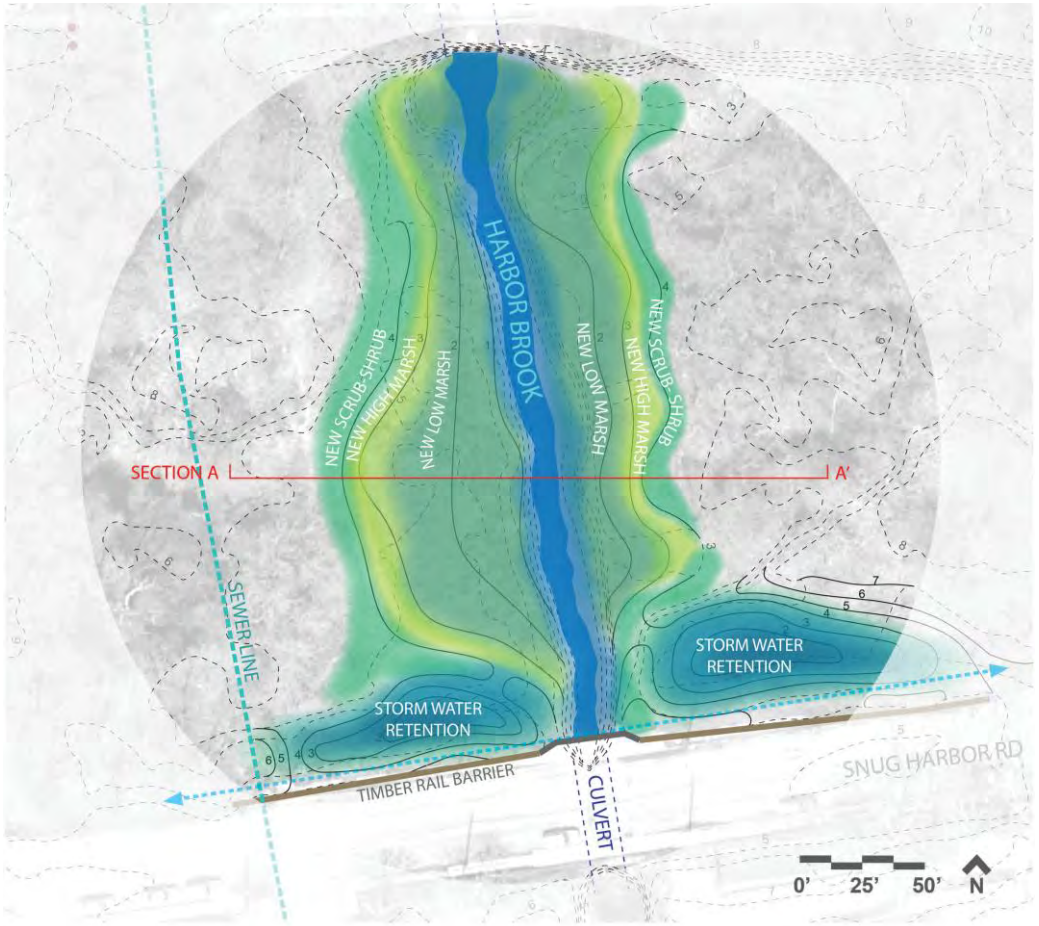
Restoring tidal marsh requires removing fill and invasive species, lowering the grade of the site to reintroduce tidal inundation, and replanting with native salt marsh grasses including *Spartina alterniflora*, *Spartina patens*, and *Distichlis spicata*. Restoring tidal hydrology will allow for routine tidal flushing that native vegetation requires and will reduce the ability of *Phragmites* to reestablish. The small remnant patch of *Spartina alterniflora* at the mouth of the creek at Richmond Terrace would be protected.

Storm water management

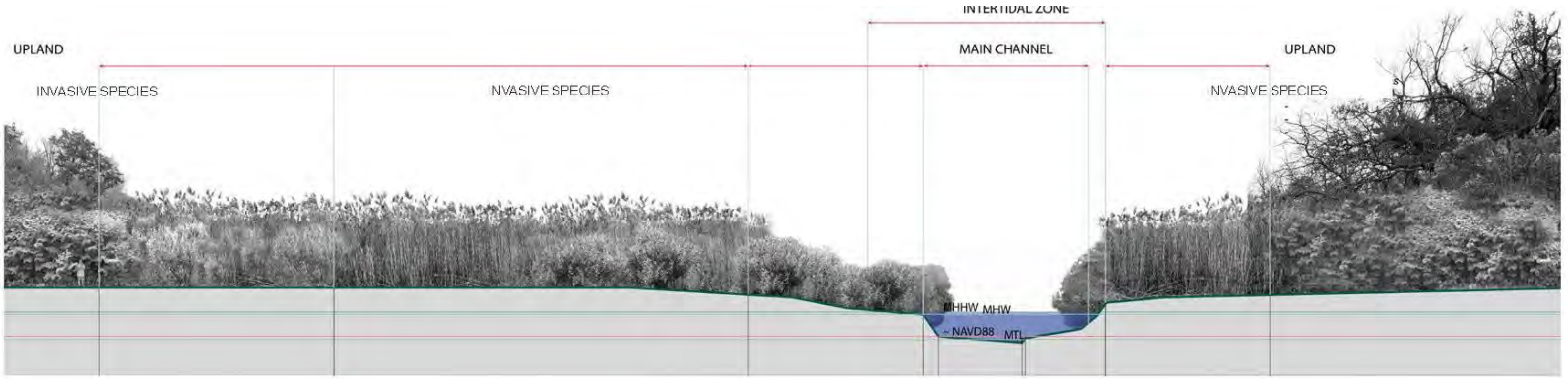
Retaining storm water on site, instead of allowing it to flow via catch basins directly into Harbor Brook, involves constructing vegetated bioswales or raingardens to capture stormwater from the surrounding street. These depressions would collect water flowing from Snug Harbor Road and retain it, allowing common street pollutants such as sediment, road salt, and petroleum to filter out before the water flows into Harbor Brook.

Access

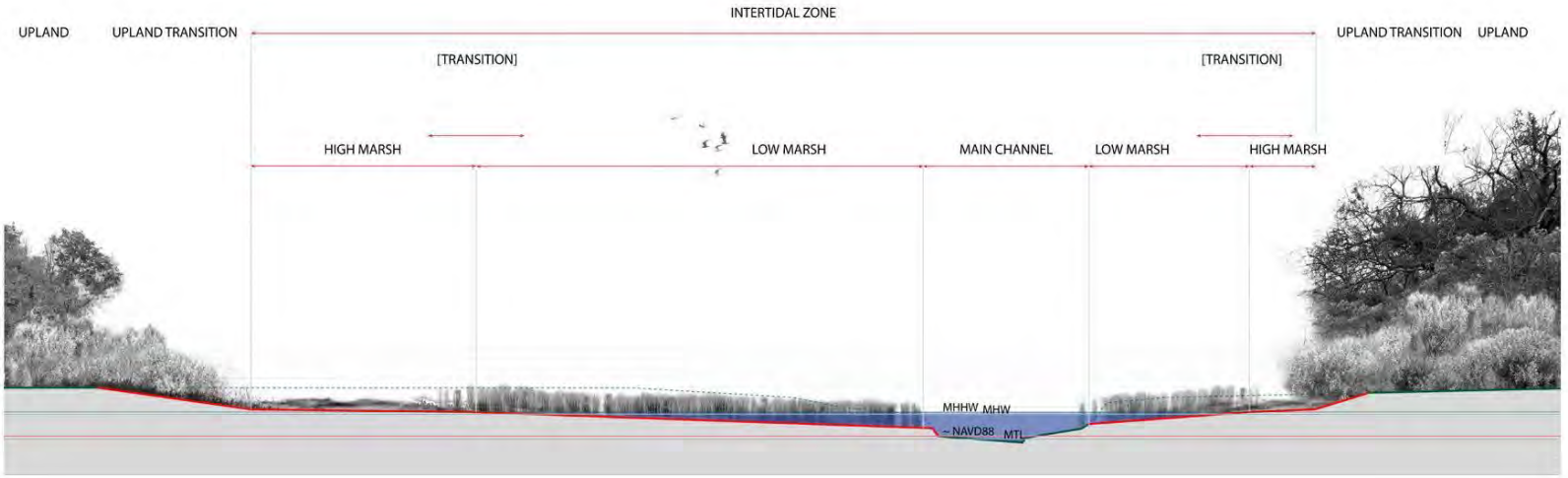
Timber rail is proposed at the edge of the property to prevent parking on the parkland and to discourage pedestrian traffic into the rain garden. Other site access enhancement such as crosswalks and trails will be explored further in a future formal design phase.



5.4 Restoration Concept



Existing Conditions



Target Conditions

5.4 Restoration Concept

Existing Conditions

Photograph of Harbor Brook taken facing south from Richmond Terrace in November 2017. The historic disturbance and the existing elevations have resulted in a habitat dominated by *Phragmites australis,* seen above on both sides of the channel. Native salt marsh species exist in small amounts.

5.4 Restoration Concept

Target Conditions

Rendering of what the proposed Harbor Brook habitat restoration may look like in the future. The grade has been lowered and native salt marsh grasses have been re-established. With the elevation lowered and the overall vegetation height reduced, the site will feel larger and more open and views from both the north and south ends of the site will be enhanced.