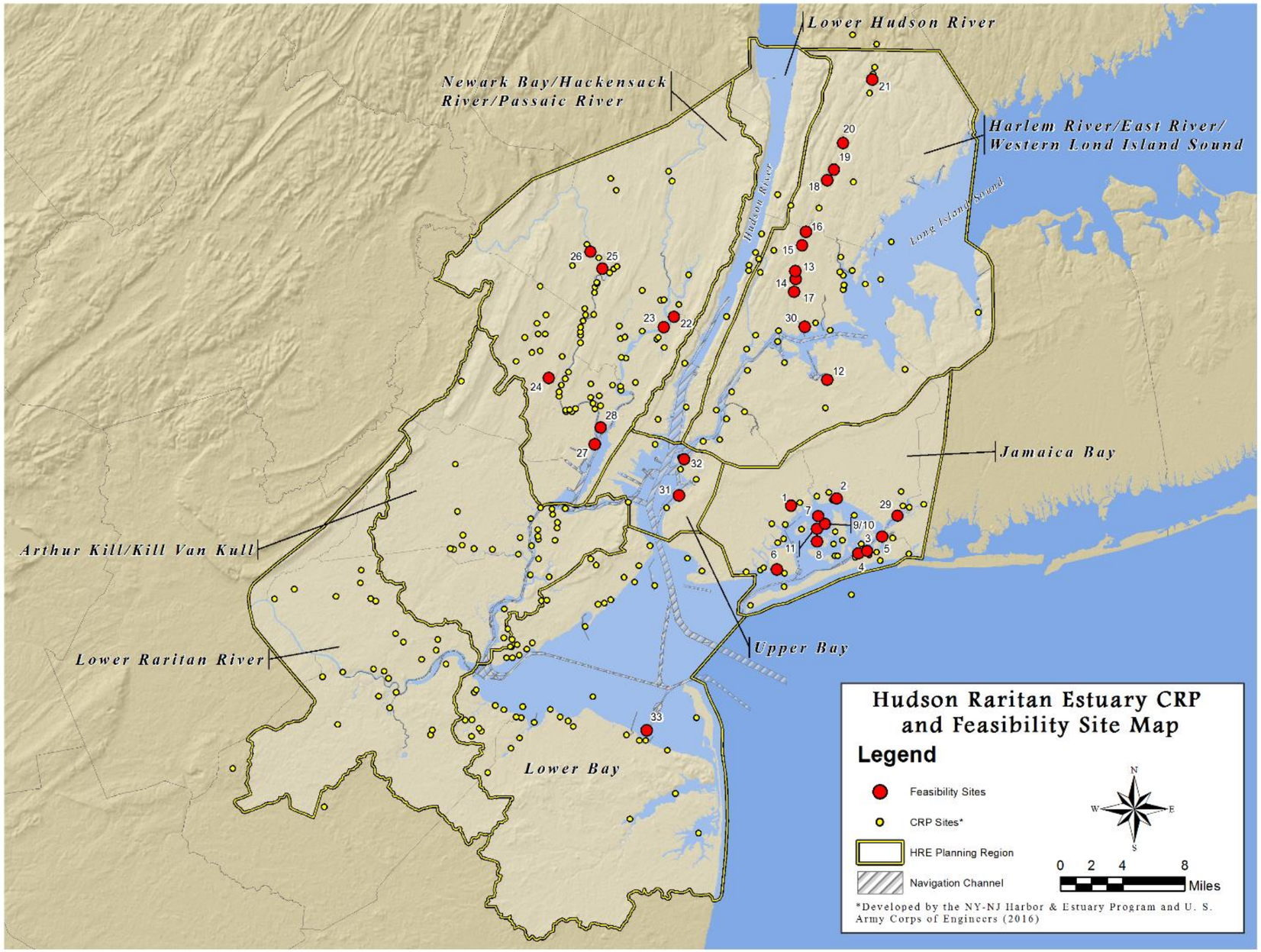
Hudson Raritan Estuary Ecosystem Restoration Feasibility Study
Appendix K
Restoration Site One-Pagers

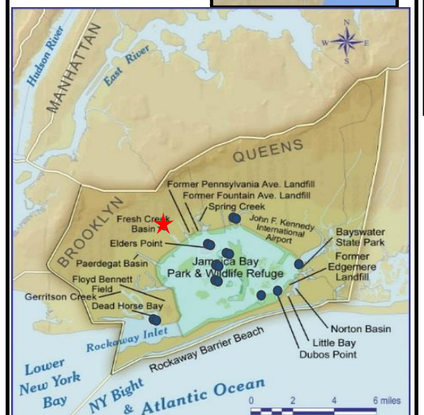


Restoration Sites
1. Fresh Creek (CRP ID 730)
2. Hawtree Point (CRP ID 161)
3. Dubos Point (CRP ID 149)
4. Brant Point (CRP ID 172)
5. Bayswater State Park (CRP ID 148)
6. Dead Horse Bay (CRP ID 732)
7. Elders Center Marsh Island (CRP ID 939)
8. Duck Point Marsh Island (CRP ID 935)
9. Pumpkin Patch- East Marsh Island (CRP ID 936)
10. Pumpkin Patch-West Marsh Island (CRP ID 936)
11. Stony Point Marsh Island (CRP ID 937)
12. Flushing Creek (CRP ID 188)
13. Stone Mill Dam (CRP ID 945)
14. Bronx Zoo and Dam (CRP ID 944)
15. Shoelace Park (CRP ID 113)
16. Muskrat Cove (CRP ID 862)
17. River Park/West Farm Rapids Park (CRP ID 860)
18. Bronxville Lake (CRP ID 857)
19. Crestwood Lake (CRP ID 852)
20. Garth Woods/Harney Road (CRP ID 942)
21. Westchester County Center (CRP ID 854)
22. Meadowlark Tract (CRP ID 719)
23. Metromedia Marsh (CRP ID 721)
24. Essex County Branch Brook Park (CRP ID 887)
25. Dundee Island Park (CRP ID 900)
26. Clifton Dundee Canal Green Acres (CRP ID 902)
27. Lower Passaic River "Deferred" Site- Oak Island Yards (CRP ID 866)
28. Lower Passaic River "Deferred Site"- Kearny Point (CRP ID 865)

<u>Oyster Restoration:</u>
29. Jamaica Bay - Head of Bay
30. Soundview Park
31. Bush Terminal
32. Governors Island
33. Naval Weapons Station Earle

HRE- Jamaica Bay- Fresh Creek

Jamaica Bay Planning Region



★ Fresh Creek

• Other Jamaica Bay Restoration Recommendations

Photo: NYC parks

Baseline Conditions and Water Resource Problems

- **Loss of marsh habitat** – Jamaica Bay has lost over 2000 acres in the last century, 75% reduction from historic levels.
- Site **dominated by non-native, invasive plant species**, which is a threat to existing desirable wetland habitats
- **Poor benthic habitat**
- **Poor tidal flushing and circulation**
- Continuing **shoreline erosion**
- **Fill and hardened shorelines**
- **Landfill leachate, CSO and waste water discharges**
- Presence of a combined sewer overflow at the head of the basin
- **Poor water quality** at the head of Fresh Creek
- **Straightened and deepened creek** with no finger tributaries

Restoration Opportunities/Measures

- Habitat improvements
- Wetland restoration/creation
- Invasive species removal/native species plantings
- Channel modification/realignment
- Bank stabilization
- Stream geomorphology restoration
- Secondary benefits of water quality improvements
- Sediment load reduction
- Basin bathymetry reconfiguration to promote optimal circulation
- Beneficial re-use of material onsite
- Public education/access

Jamaica Bay, Marine Park and Plumb Beach "Source" Feasibility Study History

- Study Resolution (1990), Reconnaissance Report (1994) and Feasibility Cost Share Agreement executed with NYCDEP (1996);

• 39 restoration opportunities identified in the "Jamaica Bay: Navigational Channels and Shoreline Environmental Surveys" Report in 1997;

• Eight (8) restoration sites recommended and approved at USACE Alternative Formulation Briefing Milestone meeting in 2010;

• Sandy 113-2 Interim Report 2 to Congress identified study to be evaluated for Coastal Storm Risk Management

• Restoration opportunities considered in the "perimeter plan" for East Rockaway to Rockaway -Jamaica Bay Reformulation Study. However, Storm Surge Barrier selected as Tentatively Selected Plan;

• Six (6) of 8 sites were evaluated further for recommendation in HRE Feasibility Restoration recommended in HRE Feasibility Study (per strategy approved by Director of Civil Works, Aug 2014)

✓ Updated MII Micro-Computer Aided Cost Estimating System (MCASES) costs

Alternative	1	2	3	4	5
Description	✓ Invasive dominated areas restored to saltmarsh or native coastal shrub, grass or forest habitat by grubbing, regrading, and planting. ✓ ~ 6.3 acres of low marsh, 1.7 acres of high marsh, and 9.7 acres of transitional coastal shrub zone restored. ✓ ~4.5 acres of buffer maritime forest restored for sustainability of marsh restoration.	✓ Similar to Alt. 1, with addition of recontouring at head of the basin through half of the underwater community. ✓ This is expected to improve flushing at the head of the basin and improve dissolved oxygen. ✓ ✓ Vegetation plantings and acreages are same as in Alt. 1.	✓ Basin filling only at the head of creek, raising the level of the bottom to intertidal levels, creating marsh and tidal creek habitat resulting in decreased residence time of water at the head of the creek with increase wetland habitat. ✓ 2.1-acre channel created, along with 13.0 acres of low marsh and 2.4 acres of high marsh. ✓ Similar to Alt. 1, an incidental 4.5 acres of forest will be restored, and 11 acres of coastal shrub created. The amount of coastal shrub is increased slightly from previous alt. to create a transition zone in the northwest corner of the site.	✓ Alt. 4 maximizes water quality improvements by improving tidal prism throughout the basin. ✓ Recontouring would occur with bottom filled from head to Jamaica Bay including filling of an existing 19'deep dredged channel in the southern portion of the basin. ✓ Vegetation plantings and acreages are same as in Alt. 1.	**Recommended at AFB 2010 and Approved:** ✓ Combines Alts. 3 and 4. Habitat improvements are exactly the same as Alt. 3. ✓ The head of the basin will be filled to create tidal marshes and creeks; however, the basin will be recontoured to the mouth of Fresh Creek substantially improving flushing throughout the basin, improve DO, increase wetland, and cap contaminated sediment. ✓ Restoration of 33 acre tidal marsh system with protective buffers will be created, which includes 13 acres of low marsh, 2.4 acres of high marsh, 2.1 acres of creek/pool, 4.5 acres of maritime forest and 11 acres of coastal shrub. In addition, 60.1 acres of shallow water will be restored. ✓ Create small detention pond at the head of Fresh Creek as a means of filtering CSO output.
Average Annual Functional Capacity Units (AAFCUs)	88	119	126	208	246
Project Cost	$5,057,000	$5,231,000	$8,388,000	$8,259,000	**$10,850,000**

NA: Not Applicable- First Level Costs were only prepared for June 2010 TSP Alternative

Tentatively Selected Plan Design

East Rockaway to Rockaway- Jamaica Bay Reformulation Study Optimization:

- ✓ Restoration of ~33 acres tidal marsh system with protective buffers will be created, which includes 13.6 acres of low marsh, 2.5 acres of high marsh, 1.5 acres of creek/pool, 11.3 acres of maritime forest.
- ✓ 42.4 acres of shallow water through channel regrading will be restored.
- ✓ The head of the basin will be filled to create tidal marshes and creeks; however, the basin will be recontoured to the mouth of Fresh Creek substantially improving flushing throughout the basin, improve DO, increase wetland, and cap contaminated sediment.
- ✓ Create small detention pond at the head of Fresh Creek as a means of filtering CSO output.
- ✓ Reformulation Study would recommend a tide gate at Fresh Creek if the perimeter plan was the TSP.

UPDATED PROJECT COST (2017): $45,473,000

Significance of Restoration in the Region and at the Site

- ✓ Restoration would improve wetland habitat – including increase diversity and abundance, connectivity, improve hydrologic connectivity, and reduce invasive monoculture of wetlands
- ✓ Improve roosting, nesting and foraging habitat for waterbirds
- ✓ Develop mosaic of habitat for fish communities
- ✓ Enhanced tributary connections through improved hydrologic connectivity, basin and tributary bathymetry improving flushing within basin and increased migratory fish habitat
- ✓ Long term positive impacts to wildlife from establishment of higher-quality habitats and refugia
- ✓ Restoration of one of two last major parcels of contiguous wildlife habitat in NY Bight
- ✓ Major stopover point in the Atlantic Flyway for over 300 species of migratory shorebirds
- ✓ Valuable nursery and feeding area for many finfish species
- ✓ Designated by NYC as a Special Natural Waterfront Area (1999)
- ✓ Recognized as Critical Environmental Area by NYSDEC
- ✓ Singled out by USFWS as highly productive habitat (1999)
- ✓ USEPA's CCMP identified Jamaica Bay as only one of two sites in the HRE area targeted for special efforts to protect and restore ecological integrity and values.
- ✓ Improvements in recreational opportunities for wildlife viewing, recreational fishing, kayaking, canoeing and educational opportunities through habitat improvements.
  - ✓ Improvements complement NYC Parks' small-scale restoration efforts and NYCDEP's saltmarsh mitigation along the creek.

Selected Alternative Map
Fresh Creek, Jamaica Bay, New York

Source: NYS GIS Clearinghouse 2014 Orthoimagery

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- EMERGENT WETLAND (LOW MARSH)
- EMERGENT WETLAND (HIGH MARSH)
- COASTAL AND MARITIME FOREST
- HABITAT FOR FISH, CRAB AND LOBSTER
- CHANNEL REGRADING
- RIP RAP

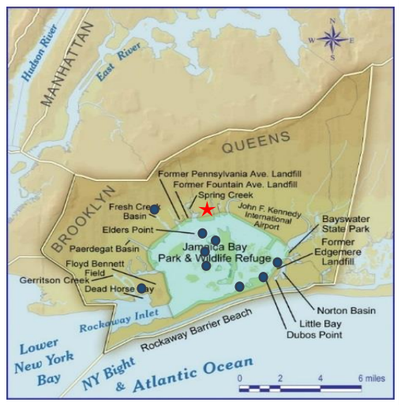
0 500 1,000 Feet

Environmental Protection

NYC Parks

HRE- Jamaica Bay- Hawtree Park

Jamaica Bay Planning Region



★ Hawtree Point

• Other Jamaica Bay Restoration Recommendations

Baseline Conditions and Water Resource Problems

- **Loss of marsh habitat** – Jamaica Bay has lost over 2000 acres in the last century, a 75% reduction from historic levels.
- Sites is dominated **by non-native, invasive plant species**, which is a threat to existing desirable wetland habitats
- Continuing **shoreline erosion**
- **Filled wetlands**
- Historic structures and canal systems of Hamilton beach **under the fill**
- **All Terrain Vehicle use along shoreline** of project area

Restoration Opportunities/Measures

- Habitat improvements
- Wetland protection and expansion through improvement of surrounding habitats
- Invasive species removal/native species plantings
- Erecting barrier to off-road vehicles

Jamaica Bay, Marine Park and Plumb Beach "Source" Feasibility Study History

- **Study Resolution (1990), Reconnaissance Report (1994) and Feasibility Cost Share Agreement executed with NYCDEP (1996);**
- **39 restoration opportunities identified in the "Jamaica Bay: Navigational Channels and Shoreline Environmental Surveys" Report in 1997;**
- **Eight (8) restoration sites recommended and approved at USACE Alternative Formulation Briefing Milestone meeting in 2010;**
- **Sandy 113-2 Interim Report 2 to Congress identified study to be evaluated for Coastal Storm Risk Management**
- **Restoration opportunities considered in the "perimeter plan" for East Rockaway to Rockaway -Jamaica Bay Reformulation Study. However, Storm Surge Barrier sel**ected as Tentatively Selected Plan;
- Six (6) of 8 sites were evaluated further for recommendation in HRE Feasibility Restoration recommended in HRE Feasibility Study (per strategy approved by Director of Civil Works, Aug 2014)
- Updated MII Micro-Computer Aided Cost Estimating System (MCASES) costs

Alternative	**1**
Description	**Recommended at AFB 2010 and Approved:** ✓ Within the limited confines of Hawtree Point, one solution was developed. ✓ Alternative 1 recovers 1.7 acres of coastal scrub shrub and grassland habitat from the existing invasive dominated areas. Some regrading and grubbing would remove the invasive species and native grasses and shrubs will be planted at the site. ✓ This alternative also includes the creation of a natural barrier to motorized vehicles. By placing boulders along the boundary of the restoration area, the newly created habitats as well as the preserved existing marshes will be protected. ✓ Through implementation of this project, an existing patch of salt marsh hay (0.07 acres) will be excavated and replaced. ✓ This area is currently being invaded by the surrounding invasives. Salt marsh hay will be planted in the location after the excavation and regrading of the surrounding land. The net amount of wetland habitat will be the same before and after project implementation.
Average Annual Functional Capacity Units (AAFCUs)	**6.5**
Project Cost	**$327,000**

Tentatively Selected Plan Design

East Rockaway to Rockaway- Jamaica Bay Reformulation Study Optimization:

✓ Based on recent field observations, no optimization is recommended.

UPDATED PROJECT COST (2017): $1,463,000

Significance of Restoration in the Region and at the Site

- ✓Restoration would improve wetland habitat – including increase diversity and abundance, connectivity, improve hydrologic connectivity, and reduce invasive monoculture of wetlands
- ✓Improve roosting, nesting and foraging habitat for waterbirds
- ✓ Develop mosaic of habitat for fish communities
- ✓Long term positive impacts to wildlife from establishment of higher-quality habitats and refugia
- ✓Restoration of one of two last major parcels of contiguous wildlife habitat in NY Bight
- ✓Major stopover point in the Atlantic Flyway for over 300 species of migratory shorebirds
- ✓Designated by NYC as a Special Natural Waterfront Area (1999)
- ✓Recognized as Critical Environmental Area by NYSDEC
- ✓Singled out by USFWS as highly productive habitat (1999)
- ✓USEPA's CCMP identified Jamaica Bay as only one of two sites in the HRE area targeted for special efforts to protect and restore ecological integrity and values.
- ✓Improvements in recreational opportunities for wildlife viewing, recreational fishing, kayaking, canoeing and educational opportunities through habitat improvements.
- ✓Restoration proposed would serve as a Natural/Nature Based Features complementing the Governor's Office of Storm Recovery New York Rising Community Reconstruction Program to protect and provide benefits to the Howard Beach Community

Selected Alternative Map
Hawtree Point, Jamaica Bay, New York

Source: NYS GIS Clearinghouse 2014 Orthoimagery

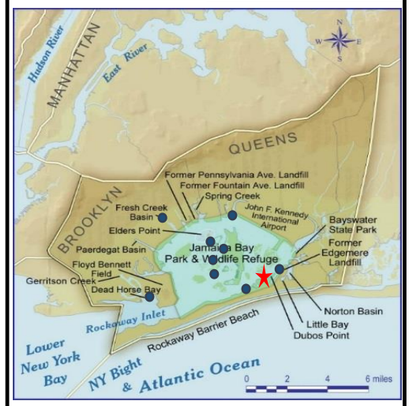
NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

NYC Environmental Protection

NYC Parks

HRE- Jamaica Bay- Dubos Point

Jamaica Bay Planning Region



★ Dubos Point

• Other Jamaica Bay Restoration Recommendations

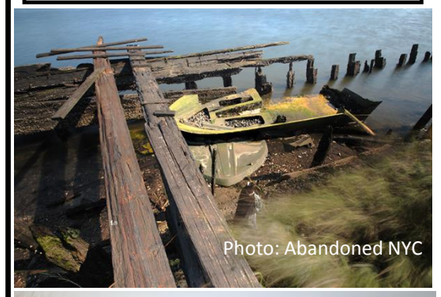


Photo: Abandoned NYC

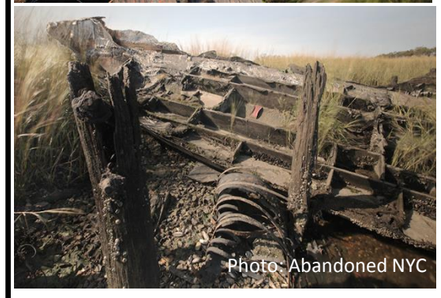


Photo: Abandoned NYC

Baseline Conditions and Water Resource Problems (EPW Report)

- **Loss of marsh habitat** – Jamaica Bay has lost over 2000 acres in the last century, a 75% reduction from historic levels.
- Site is **dominated by non-native, invasive plant species**, which is a threat to existing desirable wetland habitats.
- High energy littoral zone along western and northern shorelines.
- Continuing **shoreline erosion**.
- Dumped **trash and debris** throughout site.
- **Fill material** over historic marsh.

Restoration Opportunities/Measures

- Habitat improvements
- Wetland creation
- Invasive species removal/native species plantings
- Channel modification/realignment
- Shoreline stabilization
- Incorporate protective strategies against dumping.
- Beneficial use of material on site

Jamaica Bay, Marine Park and Plumb Beach "Source" Feasibility Study History

- **Study Resolution (1990), Reconnaissance Report (1994) and Feasibility Cost Share Agreement executed with NYCDEP (1996);**
- **39 restoration opportunities identified in the "Jamaica Bay: Navigational Channels and** Shoreline Environmental Surveys" Report in 1997;
- Eight (8) restoration sites recommended and approved at USACE Alternative Formulation Briefing Milestone meeting in 2010;
- Sandy 113-2 Interim Report 2 to Congress identified study to be evaluated for Coastal Storm Risk Management
- Restoration opportunities considered in the "perimeter plan" for East Rockaway to Rockaway -Jamaica Bay Reformulation Study. However, Storm Surge Barrier selected as Tentatively Selected Plan;
- Six (6) of 8 sites were evaluated further for recommendation in HRE Feasibility Restoration recommended in HRE Feasibility Study (per strategy approved by Director of Civil Works, Aug 2014)
- Updated MII Micro-Computer Aided Cost Estimating System (MCASES) costs

Alternative	1	2	3
Description	✓ Restoration of marsh by creating tidal channels of ~0.7 acres in an existing filled common reed stand and regrading the area to salt marsh elevations to create ~3.5 acres of low marsh and 0.6 acres of high marsh ✓ Tidal channels in the northern tip will also be reopened to allow salt water flushing and fish migration to alleviate the local overabundance of mosquitoes. ✓ By removing mugwort-dominated areas the project will incidentally restore 2.0 acres of maritime forest. Native canopy trees, understory trees, shrubs, forbs, and ferns will be planted here to prevent the spread of invasive species into the aquatic habitat. ✓ The existing pilings will remain and will continue to offer some protection to the salt marsh on the point.	✓ Similar to Alt.1, with the only difference being the amount of toe protection installed. This Alt. utilizes the existing piles, replacing only the ones that have failed. Restoration plans, vehicle barriers, and vegetation plantings are the same as in Alt. 1.	**Recommended at AFB 2010 and Approved:** ✓ Same as Alt. 1 and maximizes marsh habitat protection by implementing toe protection surrounding the entire western and northern shore. ✓ The north and west shorelines are exposed to high wave velocities from Jamaica Bay. Soldier piles were installed in the past, and still exist on the site but are beginning to fail. In the areas of failure, the erosion is quite obvious. Toe protection in this alternative includes the use of soldier piles or its equivalent, placed to the level of MLW, along the entire shoreline replacing all of the existing piles. ✓ A total of 6.8 acres will be restored at this site including, 3.5 of low marsh, 0.6 of high marsh, 0.7 of creek or pool, and 2 acres of maritime forest.
Average Annual Functional Capacity Units (AAFCUs)	24	27	**58**
Project Cost	$1,464,000	$2,192,000	**$2,919,000**

NA: Not Applicable- First Level Costs were only prepared for June 2010 TSP Alternative


Photo: NYC parks


Photo: Abandoned NYC

Tentatively Selected Plan Design

East Rockaway to Rockaway- Jamaica Bay Reformulation Study Optimization:

- ✓A total of 7.1 acres will be restored at this site including, 3.3 of low marsh, 0.9 of high marsh, 0.7 of creek or pool, and 2 acres of maritime forest.
- ✓The north and west shorelines are exposed to high wave velocities from Jamaica Bay. Soldier piles were installed in the past, and still exist on the site but are beginning to fail. In the areas of failure, the erosion is quite obvious. Toe protection in this alternative includes the use of soldier piles or its equivalent, placed to the level of MLW, along the entire shoreline replacing all of the existing piles.
- ✓Reformulation Study would recommend a composite sea wall if the perimeter plan was the TSP. If this measure is implemented the cost would be borne by the local sponsor.

UPDATED PROJECT COST (2017): $9,560,000

Significance of Restoration in the Region and at the Site

- ✓Restoration would improve wetland habitat – including increase diversity and abundance, connectivity, improve hydrologic connectivity, and reduce invasive monoculture of wetlands
- ✓Improve roosting, nesting and foraging habitat for waterbirds
- ✓ Develop mosaic of habitat for fish communities
- ✓Long term positive impacts to wildlife from establishment of higher-quality habitats and refugia
- ✓Restoration of one of two last major parcels of contiguous wildlife habitat in NY Bight
- ✓Major stopover point in the Atlantic Flyway for over 300 species of migratory shorebirds
- ✓Valuable nursery and feeding area for many finfish species
- ✓Designated by NYC as a Special Natural Waterfront Area (1999)
- ✓Recognized as Critical Environmental Area by NYSDEC
- ✓Singled out by USFWS as highly productive habitat (1999)
- ✓USEPA's CCMP identified Jamaica Bay as only one of two sites in the HRE area targeted for special efforts to protect and restore ecological integrity and values.
- ✓Improvements in recreational opportunities for wildlife viewing, recreational fishing, kayaking, canoeing and educational opportunities through habitat improvements.
- ✓Site serves as Natural/Nature Based Feature and complements recommended High Frequency Risk Reduction Measures for the East Rockaway to Rockaway – Jamaica Bay Reformulation Study

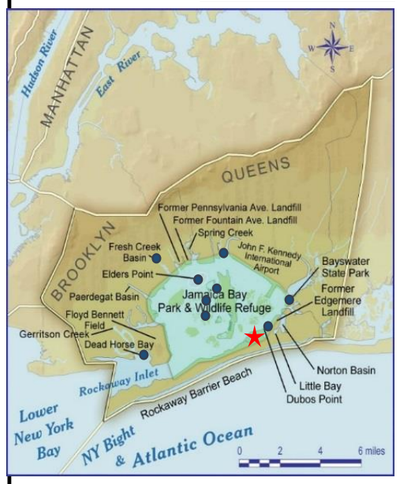
NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

NYC Environmental Protection

NYC Parks

HRE- Jamaica Bay- Brant Point

Jamaica Bay Planning Region



★ Brant Point

• Other Jamaica Bay Restoration Recommendations

Baseline Conditions and Water Resource Problems

- **Loss of marsh habitat** – Jamaica Bay has lost over 2000 acres in the last century, a 75% reduction from historic levels.
- Sites are **dominated by non-native, invasive plant species**, which is a threat to existing desirable wetland habitats
- A grounded barge offshore has acted as an erosion control device and created high quality benthic habitat behind the structure.
- **Fill material** over historic marsh.
- Continuing **shoreline erosion and wetland loss**.
- **Fill and hardening of shorelines**.
- Extensive **dumping of soil, trash, and debris** in wetland and upland.

Restoration Opportunities/Measures

- Habitat improvements
- Wetland creation/preservation
- Invasive species removal/native species plantings
- Address chronic erosion with off shore breakwaters
- Incorporate protective strategies against dumping.
- Beneficial use of material on site

Jamaica Bay, Marine Park and Plumb Beach Feasibility Study History

- Study Resolution (1990), Reconnaissance Report (1994) and Feasibility Cost Share Agreement executed with NYCDEP (1996);
- 39 restoration opportunities identified in the "Jamaica Bay: Navigational Channels and Shoreline Environmental Surveys" Report in 1997;
- Eight (8) restoration sites recommended and approved at USACE Alternative Formulation Briefing Milestone meeting in 2010;
- Sandy 113-2 Interim Report 2 to Congress identified study to be evaluated for Coastal Storm Risk Management
- Restoration opportunities considered in the "perimeter plan" for East Rockaway to Rockaway -Jamaica Bay Reformulation Study. However, Storm Surge Barrier selected as Tentatively Selected Plan;
- Six (6) of 8 sites were evaluated further for recommendation in HRE Feasibility Restoration recommended in HRE Feasibility Study (per strategy approved by Director of Civil Works, Aug 2014)
- Updated MII Micro-Computer Aided Cost Estimating System (MCASES) costs

Alternative	1	2
Description	✓ Protection of existing 1.2 acres of marsh and restores an additional 1.9 acres of low marsh, 0.7 acres of high marsh, 2.5 acres of meadow, and 2.4 acres of maritime forest to prevent the spread of invasive species into the aquatic habitat. ✓ Soil excavated to regrade for the marsh creation will be used for onsite landscaping.	**Recommended at AFB 2010 and Approved:** ✓ In addition to the tidal fringe marsh of Alternative 1, Alt. 2 maximizes marsh habitat protection and creates macroinvertebrate habitat by creating offshore rubble mounds. ✓ The grounded barge at this site shows that offshore structures are capable of protecting the marshes and creating beneficial habitat for macroinvertebrates. Three rock mounds are needed to protect the point from the ongoing erosion. The rocks will be placed randomly within a trapezoidal shape to create interstitial spaces of various sizes that can be used as refugia by various species.
Average Annual Functional Capacity Units (AAFCUs)	12	**27**
Project Cost	$2,091,000	**$3,641,000**

NA: Not Applicable- First Level Costs were only prepared for June 2010 TSP Alternative

Tentatively Selected Plan Design

East Rockaway to Rockaway- Jamaica Bay Reformulation Study Optimization:

- ✓ No change to acreage, cost updated below. In addition to the tidal fringe marsh of Alt. 1, Alt. 2 maximizes marsh habitat protection and creates macroinvertebrate habitat by creating offshore rubble mounds.
- ✓ The grounded barge at this site shows that offshore structures are capable of protecting the marshes and creating beneficial habitat for macroinvertebrates. Three rock mounds are needed to protect the point from the ongoing erosion. The rocks will be placed randomly within a trapezoidal shape to create interstitial spaces of various sizes that can be used as refugia by various species.
- ✓ This Alt. protects the existing 1.2 acres of marsh, but also restores an additional 1.9 acres of low marsh, 0.7 acres of high marsh, 2.5 acres of meadow, and 2.4 acres of maritime forest to prevent the spread of invasive species into the aquatic habitat.
- ✓ Soil excavated to regrade for the marsh creation will be used for onsite landscaping.
- ✓ Reformulation Study would recommend a composite sea wall if the perimeter plan was the TSP. If this measure was implemented, the cost would be borne by the local sponsor.

UPDATED PROJECT COST (2017): $7,480,000

Significance of Restoration in the Region and at the Site

- ✓ Restoration would improve wetland habitat – including increase diversity and abundance, connectivity, improve hydrologic connectivity, and reduce invasive monoculture of wetlands
- ✓ Improve roosting, nesting and foraging habitat for waterbirds
- ✓ Develop mosaic of habitat for fish communities
- ✓ Long term positive impacts to wildlife from establishment of higher-quality habitats and refugia
- ✓ Restoration of one of two last major parcels of contiguous wildlife habitat in NY Bight
- ✓ Major stopover point in the Atlantic Flyway for over 300 species of migratory shorebirds
- ✓ Designated by NYC as a Special Natural Waterfront Area (1999)
- ✓ Recognized as Critical Environmental Area by NYSDEC
- ✓ Singled out by USFWS as highly productive habitat (1999)
- ✓ USEPA's CCMP identified Jamaica Bay as only one of two sites in the HRE area targeted for special efforts to protect and restore ecological integrity and values.
- ✓ Improvements in recreational opportunities for wildlife viewing, recreational fishing, kayaking, canoeing and educational opportunities through habitat improvements.
- ✓ Restoration will complement the floating islands adjacent the site that were constructed by NYCDEP

Selected Alternative Map
Brant Point, Jamaica Bay, New York

Source: NYS GIS Clearinghouse 2014 Orthoimagery

NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

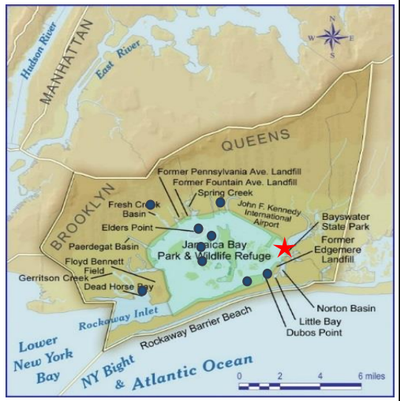
NYC Environmental Protection

NYC Parks

HRE- Jamaica Bay- Bayswater Point State Park

NEW YORK STATE OF OPPORTUNITY. Parks, Recreation and Historic Preservation

Jamaica Bay Planning Region



★ Bayswater Point State Park

• Other Jamaica Bay Restoration Recommendations

Baseline Conditions and Water Resource Problems

- **Loss of marsh habitat** – Jamaica Bay has lost over 2000 acres in the last century, a 75% reduction from historic levels.
- Site contains a mature native oak forest, rare for this area.
- Site is **dominated by non-native, invasive plant species**, which are a threat to existing desirable wetland habitats
- Potential loss of habitat due to **deteriorating seawall**
- Severe **shoreline erosion**
- **Fill and hardening of shorelines**

Restoration Opportunities/Measures

- Habitat Improvements
- Wetland creation/preservation
- Invasive species removal/native species plantings
- Bank/shoreline stabilization

Jamaica Bay, Marine Park and Plumb Beach "Source" Feasibility Study History

- Study Resolution (1990), Reconnaissance Report (1994) and Feasibility Cost Share Agreement executed with NYCDEP (1996);
- 39 restoration opportunities identified in the "Jamaica Bay: Navigational Channels and Shoreline Environmental Surveys" Report in 1997;
- Eight (8) restoration sites recommended and approved at USACE Alternative Formulation Briefing Milestone meeting in 2010;
- Sandy 113-2 Interim Report 2 to Congress identified study to be evaluated for Coastal Storm Risk Management
- Restoration opportunities considered in the "perimeter plan" for East Rockaway to Rockaway -Jamaica Bay Reformulation Study. However, Storm Surge Barrier selected as Tentatively Selected Plan;
- Six (6) of 8 sites were evaluated further for recommendation in HRE Feasibility Restoration recommended in HRE Feasibility Study (per strategy approved by Director of Civil Works, Aug 2014)
- ✓ Updated MII Micro-Computer Aided Cost Estimating System (MCASES) costs

Alternative	1	2	3
Description	✓ Removal of invasive dominated areas by regrading and creating a tidal channel of approximately 0.21 acres and associated salt marsh of 2.0 acres low marsh and 0.4 acres high marsh. All existing areas of marsh or native species will be preserved to the extent possible. ✓ Creation of ~ 0.7 acres of beach/dune ✓ Through selective removal of invasive/non-native vegetation, the mature woodland stands will be restored and replanted with native vegetation to prevent the spread of invasive species into the aquatic habitat and to provide a protective buffer for the marsh system. ✓ Training structures will be created on the banks at the mouth of the creek to stabilize the tidal creek and protect the existing beach and salt marsh habitat.	**Recommended at AFB 2010 and Approved:** ✓ Similar to Alt. 1, but with the addition of creating a tidal pool to the west of the creek/marsh complex. The tidal pool will cover approximately 0.6 acres to allow the creation of an additional 0.5 acres of low marsh. ✓ This area currently includes small patches of salt marsh and switchgrass, as well as some mowed areas that are mugwort-dominated. ✓ Hard structures will cover approximately 0.6 acres including armoring of the point and training structures at the mouth of the channel to protect the area from erosion.	✓ Integrates the tidal creek and marsh system of Alt. 1, but adds in the creation of a T-groin system and coastal dune restoration. ✓ The tidal creek area of restoration is exactly the same as in Alt. 1 and 2. The T-groin system would allow further inundation of tides creating 0.4 acres of shallow water and creating 0.5 acres of low marsh. ✓ Approximately 1.0 acre of dunes/ beach would also be constructed behind the groins. Low/high marsh will be planted in between rocks where tidal inundation and wave climate permit habitat survival.
Average Annual Functional Capacity Units (AAFCUs)	41	76	69
Project Cost	$1,007,000	**$2,507,000**	$3,751,000

NA: Not Applicable- First Level Costs were only prepared for June 2010 TSP Alternative

Tentatively Selected Plan Design

East Rockaway to Rockaway- Jamaica Bay Reformulation Study Optimization:

✓ Based on recent field observations, no optimization was recommended.

UPDATED PROJECT COST (2017): $5,815,000

Significance of Restoration in the Region and at the Site

- ✓Restoration would improve wetland habitat – including increase diversity and abundance, connectivity, improve hydrologic connectivity, and reduce invasive monoculture of wetlands
- ✓Improve roosting, nesting and foraging habitat for waterbirds
- ✓ Develop mosaic of habitat for fish communities
- ✓ Enhanced tributary connections through improved hydrologic connectivity, basin and tributary bathymetry improving flushing within basin and increased migratory fish habitat
- ✓Long term positive impacts to wildlife from establishment of higher-quality habitats and refugia
- ✓Restoration of one of two last major parcels of contiguous wildlife habitat in NY Bight
- ✓Major stopover point in the Atlantic Flyway for over 300 species of migratory shorebirds
- ✓Valuable nursery and feeding area for many finfish species
- ✓Designated by NYC as a Special Natural Waterfront Area (1999)
- ✓Recognized as Critical Environmental Area by NYSDEC
- ✓Singled out by USFWS as highly productive habitat (1999)
- ✓USEPA's CCMP identified Jamaica Bay as only one of two sites in the HRE area targeted for special efforts to protect and restore ecological integrity and values.
- ✓Improvements in recreational opportunities for wildlife viewing, recreational fishing, kayaking, canoeing and educational opportunities through habitat improvements.
- ✓Coordinated and leveraged with planned public access improvements of NY State Parks and Recreation and Historic Preservation and NYC Parks plans for ~1.5 acres of coastal wetland and forest restoration

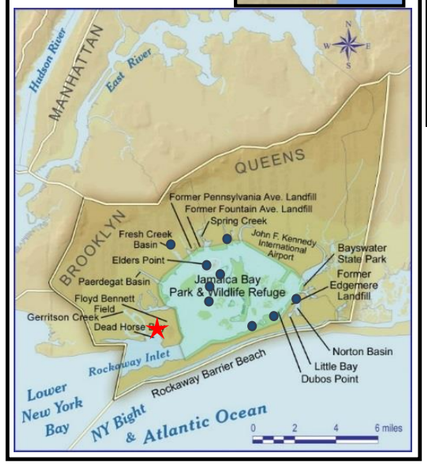
Selected Alternative Map
Bayswater State Park, Jamaica Bay, New York

Source: NYS GIS Clearinghouse 2014 Orthoimagery

NEW YORK STATE OF OPPORTUNITY. Parks, Recreation and Historic Preservation

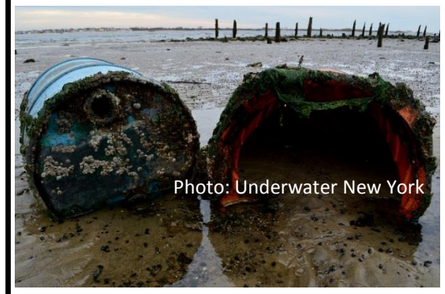
HRE- Jamaica Bay- Dead Horse Bay

Jamaica Bay Planning Region



★ Dead Horse Bay

• Other Jamaica Bay Restoration Recommendations



Baseline Conditions and Water Resource Problems

- **Loss of marsh habitat –** Jamaica Bay has lost over 2000 acres in the last century, a 75% reduction from historic levels.
- Site is **dominated by non-native, invasive plant species**, which is a threat to existing desirable wetland habitats
- **Poor benthic habitat**
- **Poor tidal flushing and circulation**
- **Fill and hardening of shorelines**
- **Landfill leachate, CSO and waste water discharges**
- **Erosion and exposure of the solid waste landfill**
- **Steep bathymetry** of the southwest and southern shorelines

Restoration Opportunities/Measures

- Habitat improvements
- Wetland creation
- Dune creation in high energy southern parcel
- Invasive species removal/native species plantings
- Channel modification/realignment
- Bank and landfill stabilization
- Shoreline protection stragegies
- Stream geomorphology restoration
- Secondary benefits of water quality improvements
- Sediment load reduction
- Public education/access
- Beneficially reuse the excavated fill onsite

Jamaica Bay, Marine Park and Plumb Beach "Source" Feasibility Study History

- Study Resolution (1990), Reconnaissance Report (1994) and Feasibility Cost Share Agreement executed with NYCDEP (1996);
- 39 restoration opportunities identified in the "Jamaica Bay: Navigational Channels and Shoreline Environmental Surveys" Report in 1997;
- Eight (8) restoration sites recommended and approved at USACE Alternative Formulation Briefing Milestone meeting in 2010;
- Sandy 113-2 Interim Report 2 to Congress identified study to be evaluated for Coastal Storm Risk Management
- Restoration opportunities considered in the "perimeter plan" for East Rockaway to Rockaway -Jamaica Bay Reformulation Study. However, Storm Surge Barrier selected as Tentatively Selected Plan;
- Six (6) of 8 sites were evaluated further for recommendation in HRE Feasibility Restoration recommended in HRE Feasibility Study (per strategy approved by Director of Civil Works, Aug 2014)
- Updated MII Micro-Computer Aided Cost Estimating System (MCASES) costs

Alternative	1	**2**	**3**	**4**
Description	✓ Replace existing *Phragmites* stands in the northern portion of the site with fringe marsh system and native maritime forest species. ✓ The eroding shoreline and landfill in the southern portion of the site will be covered with clean fill and sand from the northern portion of the site. The sand will be used to create dunes along the edge of the water. ✓ Creation of dunes on ~ 31 acres, restore 10 acres of low marsh, and 3 acres of high marsh. Additionally, 87 acres of maritime forest will be restored to act as a protective buffer and provide habitat for the species that utilize the area.	✓ Alt. 2 includes all the elements of Alternative 1. ✓ Removal of 31 acres of the landfill closest to the water which covers the old existing marsh. ✓ Geotubes will be used to stabilize the remaining landfill and to prevent future erosion along the southern bank.	✓ Alt. 3 maximizes marsh habitat by creating a tidal channel in the northern portion of the site and regrading this existing upland *Phragmites* stand to salt marsh elevations. ✓ A tidal channel of ~ 4 acres will be built in the northern parcel and ~31 acres of low marsh and 7 acres of high marsh will be restored. ✓ Clean fill and sand will be beneficially reused to create dunes, and to restore the maritime forest. ✓ Creation of ~ 28 acres of dunes on the site and consequently restores over 60 acres of maritime forest. ~9 acres of existing beach will be preserved in the north. ✓ Stabilize the tidal creek and protect the existing beach habitat, training structures will be created on the banks at the mouth of the creek.	**Recommended at AFB 2010 and Approved:** ✓ Alt. 4 includes all the elements of Alt. 3, and also includes removal of 31 acres of landfill in the southern portion. ✓ The area will also be stabilized with geotubes beneath the dunes to avoid erosion of the site back into the remaining landfill. ✓ Materials will be beneficially reused on site to create dunes along the edge of the water and to restore a buffer to the maritime forest. ✓ This alt. will remove landfill and create dunes on ~27.7 acres of the site and will restore 61 acres of maritime forest on the southern parcel of the project area. Roughly 9 acres of existing beach will be preserved in the north. ✓ To stabilize the tidal creek and protect the existing beach habitat, training structures will be created on the banks at the mouth of the creek.
Average Annual Functional Capacity Units (AAFCUs)	116	166	334	**413**
Project Cost	$23,615,000	$26,197,000	$31,864,000	**$34,885,000**

NA: Not Applicable- First Level Costs were only prepared for June 2010 TSP Alternative

Tentatively Selected Plan Design

East Rockaway to Rockaway- Jamaica Bay Reformulation Study

✓ Based on recent field observations, no optimization is recommended.

UPDATED PROJECT COST (2017): $82,769,000

Significance of Restoration in the Region and at the Site

✓Restoration would improve wetland habitat – including increase diversity and abundance, connectivity, improve hydrologic connectivity, and reduce invasive monoculture of wetlands

✓Improve roosting, nesting and foraging habitat for waterbirds

✓ Develop mosaic of habitat for fish communities

✓ Enhanced tributary connections through improved hydrologic connectivity, basin and tributary bathymetry improving flushing within basin and increased migratory fish habitat

✓Long term positive impacts to wildlife from establishment of higher-quality habitats and refugia

✓Restoration of one of two last major parcels of contiguous wildlife habitat in NY Bight

✓Major stopover point in the Atlantic Flyway for over 300 species of migratory shorebirds

✓Valuable nursery and feeding area for many finfish species

✓Designated by NYC as a Special Natural Waterfront Area (1999)

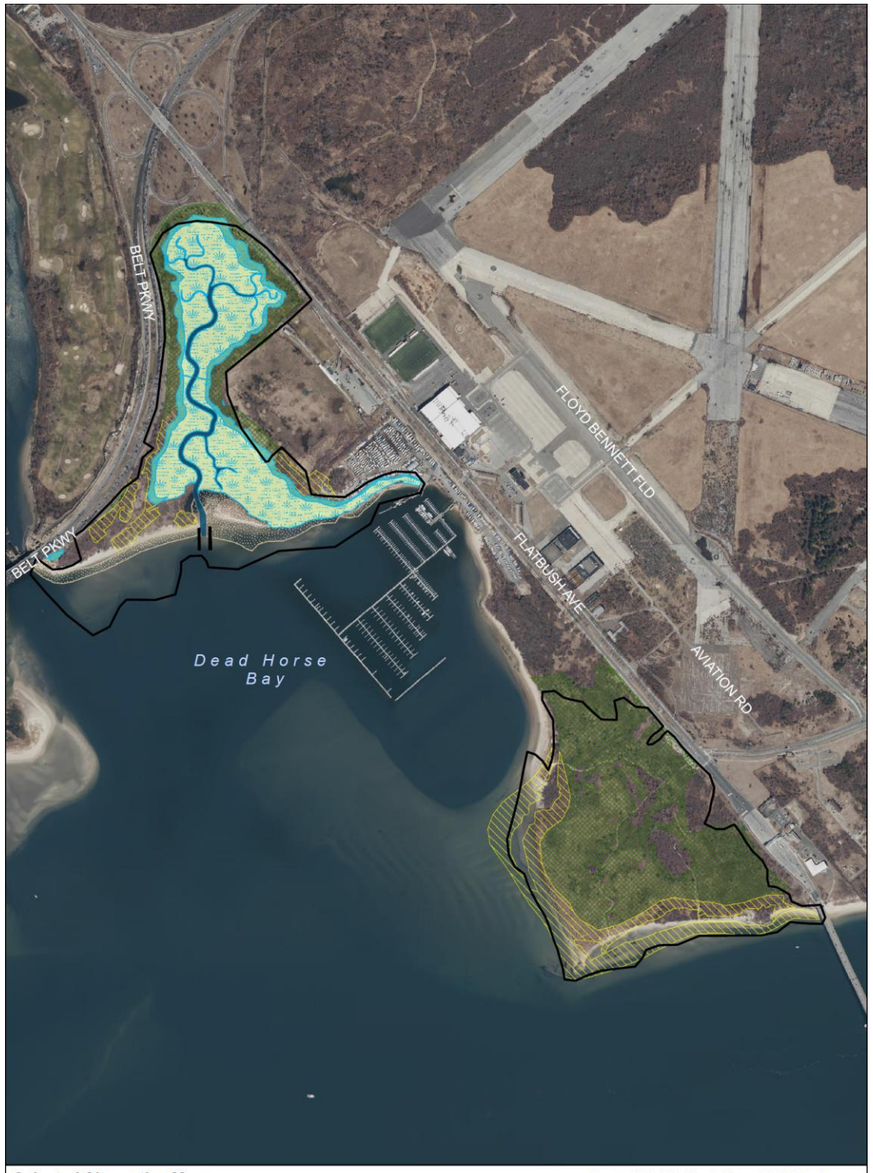
✓Recognized as Critical Environmental Area by NYSDEC

✓Singled out by USFWS as highly productive habitat (1999)

✓USEPA's CCMP identified Jamaica Bay as only one of two sites in the HRE area targeted for special efforts to protect and restore ecological integrity and values.

✓Improvements in recreational opportunities for wildlife viewing, recreational fishing, kayaking, canoeing and educational opportunities through habitat improvements.

✓**Partner Collaboration: Project now an important part of collaboration with USEPA Trash Free Waters Program, NPS Gateway Recreation Area General Management Plan and other partner initiatives (NYSDEC, NYCDEP, NYC Parks, NYSDOS, NYC Dept of Sanitation) which formed an Advisory Committee for the "Dead Horse Bay Restoration Project" formed in July 2016.**



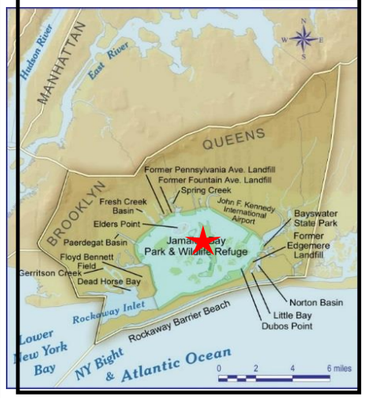
NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

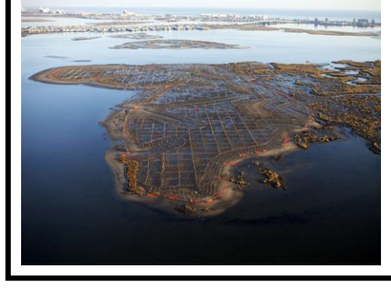
NYC Environmental Protection

NYC Parks

HRE – JAMAICA BAY MARSH ISLANDS

Jamaica Bay Planning Region





Baseline Conditions and Water Resource Problems

- Marsh Islands located in the USDOI National Park Service Gateway National Recreation Area
- More than 1,400 acres of tidal salt marsh have been lost from the marsh islands since 1924. Marsh island loss has been estimated at 47 acres/year.

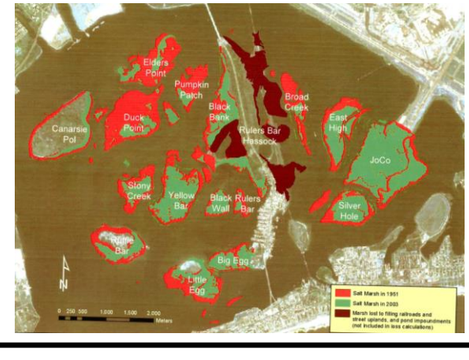
Leveraging Lessons Learned and Plan Formulation

- Builds upon the success of construction of Elders East (2007- 43 acres, CYD), Elders West (2010- 40 acres, CYD), Yellow Bar (2012- 47 acres, 375,000 CYD), Black Wall (2012- 20 acres, 155,000 CYD) and Rulers Bar (2012- 10 acres, 95,000 CYD)
- Jamaica Bay Integrated Ecosystem Restoration Report and EA (2006), Engineering Documentation Report for Yellow Bar (2011), Structures of Coastal Resilience (2015)
- Ecological output for a given acre of marsh island is constant while the cost is dependent upon existing condition depth and the cost of the sand material and material transport.
- Size of the marsh island is influenced by the amount of contiguous and sustainable acreage within the 1974 regulatory footprint within a given range of elevations. The range of acreage at each marsh island has a minimum area driven by cost constraints of mobilization and demobilization, and maximum area described by the existing depth (contour) at which sand placement becomes more expensive and less cost-effective.
- ~50% Subsidence of sand following placement
- Islands selected based on constructability, bathymetry, hydrodynamics
- Past construction/monitoring indicated success of hummock replanting, tri-plugs, optimal spacing (18-in on center), seeding
- Islands selected based on minimum sand volumes for maximum wetland acreage and sustainability
- Marsh islands provide secondary coastal storm risk management benefits

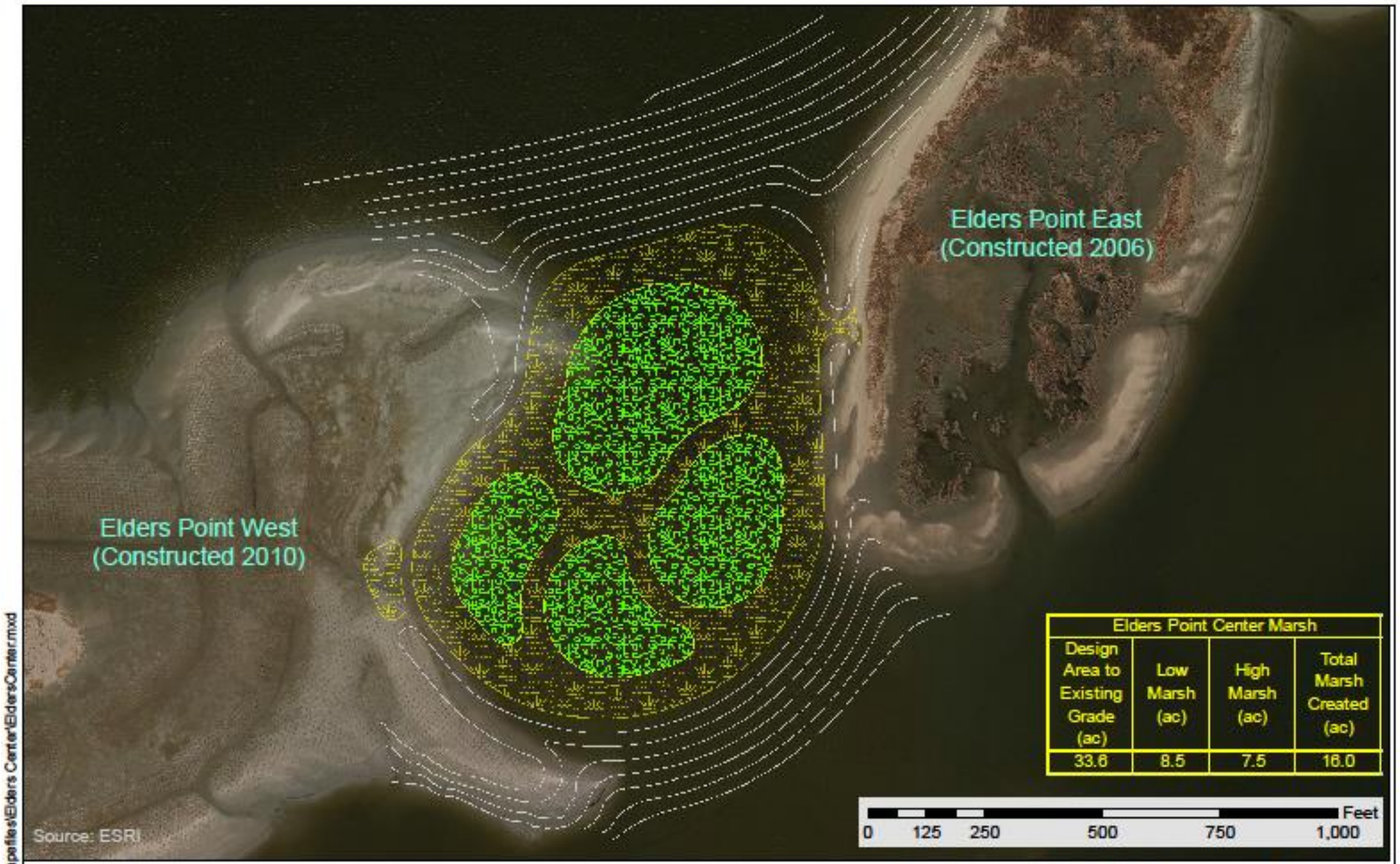
Site	Elders Center	Pumpkin Patch East	Pumpkin Patch West	Duck Point with Atoll Terrace	Stony Creek
CYD Sand	236,410	432,790	206,810	259,800	151,360
Total Marsh Created (ac)	16	35.3	16.3	27.9 (+9 acre atoll)	51
Description	✓ Restoration of 8.5 aces low marsh and 7.5 acres of high marsh. ✓ Restores an area largely within the 1974 footprint of Elders West and connects two prior restorations ✓ Improves the sustainability of the Elders Marsh complex ✓ Serves as a potential area for natural sediment deposition and accretion.	✓ Restoration of 18.5 acres of low marsh and 16.8 acres of high marsh, returning this portion of Pumpkin Patch Marsh to the approximate dimensions of the 1974 footprint. ✓ Increases land above MTL (-0.27 ft NAVD88) from existing condition area of less than 5 acres to 35.3 acres.	✓ Restoration of 10.8 acres of low marsh and 5.5 acres of high marsh, returning this portion of Pumpkin Patch Marsh to the approximate dimensions of the 1974 footprint. ✓ As with the other recommended restorations, continued restoration within this northeast portion of Jamaica Bay will reestablish a system of marsh islands, resulting in reinforced sustainability for all individual islands. ✓ Increases land above MTL (-0.27 ft NAVD88) from existing condition area of less 4.5 acres to 20.2 acres	✓ Restoration of 15.4 (+3.5 atoll) acres of low marsh and 12.5 (5.5 atoll) acres of high marsh ✓ 9 acre vegetated atoll ✓ Restores the "core' of this marsh to approximate 1974 dimensions ✓ Highly efficient restoration (cubic yards: marsh acres ratio) owing to the high existing condition elevations found within the 1974 footprint ✓ Atoll terrace design, based on Structures of Costal Resilience research, seeks to harness natural processes of sediment transport to promote sediment accretion and sustainability.	✓ Restoration of 26 acres of low marsh and 25.3 acres of high marsh ✓ Highly efficient restoration (cubic yards: marsh acres ratio) owing to the high existing condition elevations found within the 1974 footprint. ✓ The 1974 footprint of Stony Creek Marsh reveals a land area of approx. 85.0 acres. This restoration effort may be appreciably enlarged without a significant decrease in cubic yards: marsh acres efficiency. ✓ Pending further investigation of existing conditions, certain areas may not be restored or disturbed, thereby resulting in greater efficiency
Average Annual Functional Capacity Units	**17.9**	**63.3**	**29.9**	**65.2**	**122.2**
Project Cost (Beneficial Use)	**$20.730,000**	**$37,950,000**	**$20,040,000**	**$27,780,000**	**$30,520,000**

Significance of Restoration in the Region and at the Site

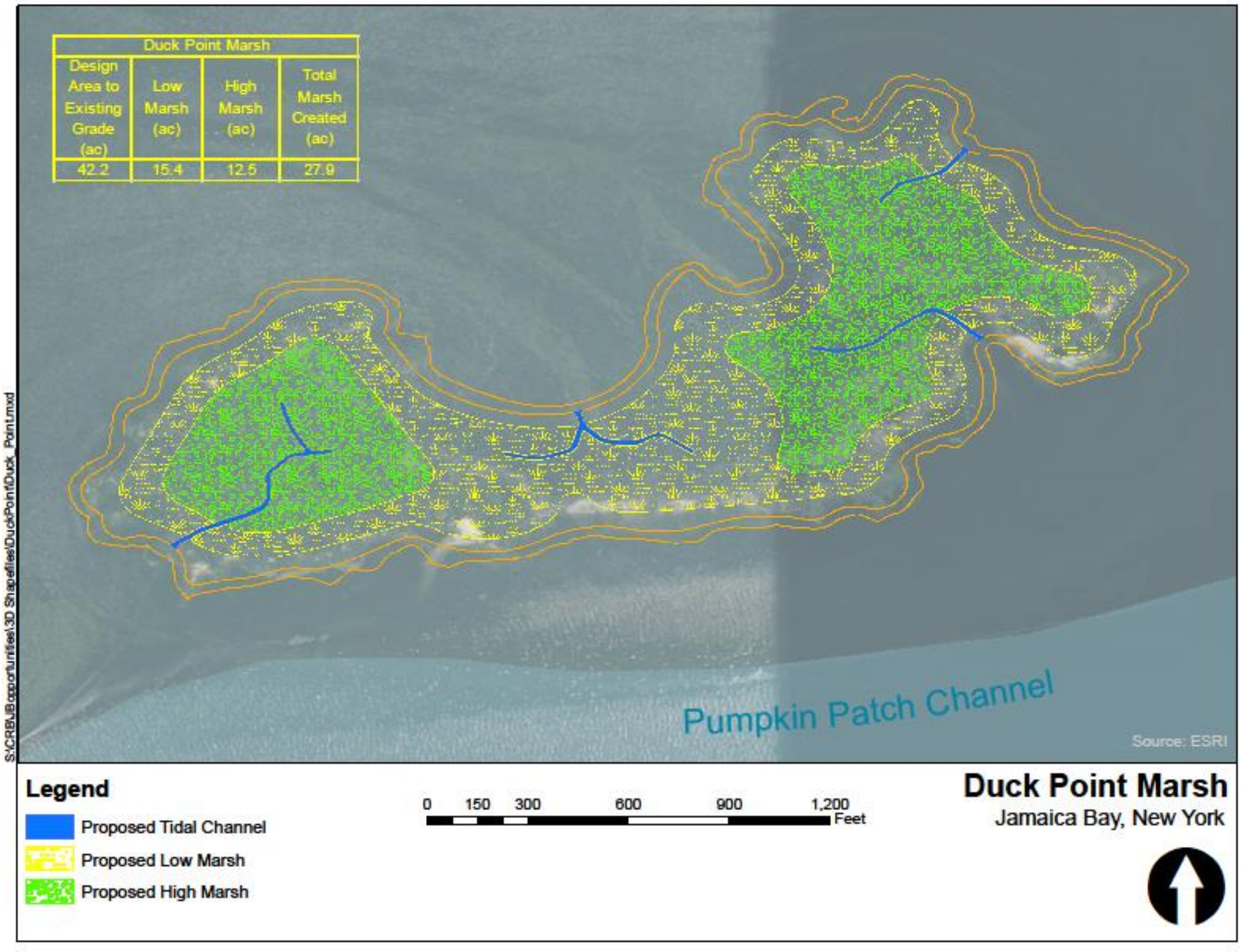
- ✓ Surrounded by heavily urbanized and densely populated areas of Brooklyn and Queens, including JFK International Airport, there is little remaining habitat suitable for avian and marine wildlife in the region.
- ✓ The rapidly eroding marsh islands of Jamaica Bay are visited by more than 300 bird species annually, providing important nesting habitat as part of the Atlantic Flyway. Wetlands within these islands are home to shellfish, invertebrates and more than 100 species of fish and provide critical habitat to breeding horseshoe crabs.
- ✓ Improve wetland habitat, increase diversity/abundance and increase connectivity.
- ✓ Continued erosion of the marsh islands further reduces the quality of the existing available habitat.
- ✓ Jamaica Bay has been designated by the US Fish & Wildlife Service as a Significant Habitat Complex of the New York Bight Watershed.
- ✓ The enhancement of the marsh islands could help to reduce the fetch distance across Jamaica Bay, thereby potentially reducing such damage to the surrounding neighborhoods as occurred during catastrophic hurricane Sandy.



Tentatively Selected Plan Design



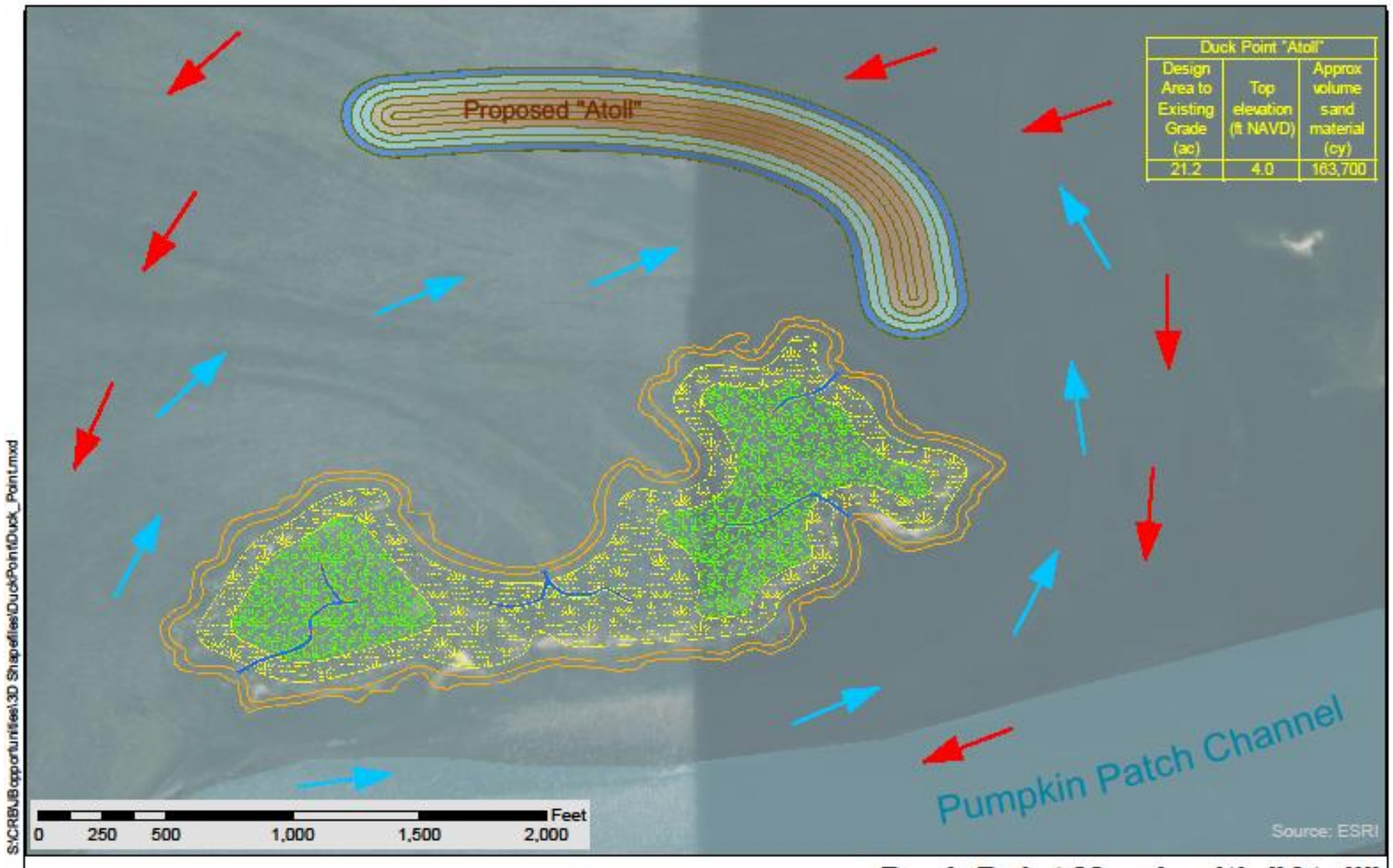
Tentatively Selected Plan Design



NYC Environmental Protection

NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

Tentatively Selected Plan Design



NYC Environmental Protection

NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

Tentatively Selected Plan Designs

NYC Environmental Protection

NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

Tentatively Selected Plan Design

Stony Creek Marsh			
Design Area to Existing Grade (ac)	Low Marsh (ac)	High Marsh (ac)	Total Marsh Created (ac)
69.6	26.0	25.3	51.3

S:\CRB\UBopportunities\3D Shapefiles\Stony Creek\Stony_Creek.mxd

Legend

- Proposed Tidal Channel
- Proposed Low Marsh
- Proposed High Marsh
- Proposed Scrub-shrub

0 150 300 600 900 1,200 Feet

Stony Point Marsh

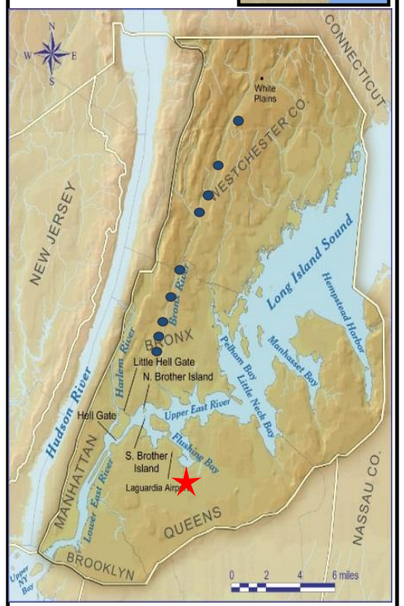
Jamaica Bay, New York

NYC Environmental Protection

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

HRE – Flushing Creek

Harlem River, East River, Long Island Sound Planning Region



★ Flushing Creek Restoration Sites Recommended in Planning Region

Baseline Conditions and Water Resource Problems

- Study area included Flushing Bay and Creek and the 20,577 ac watershed including ~16,700 ac of highly-urbanized densely-developed land.
- Prior to 1939 World's Fair, Flushing Creek was a sinuous tidal creek that supported an extensive tidal wetland system.
- Development of World's Fair site included **significant straightening of the stream, filling in wetlands**, and reconfiguring headwaters of Flushing Creek.
- Remaining **wetlands are significantly degraded** and are limited to fringe areas.
- Banks of Flushing Creek are organically rich muck **severely eroding** into the creek at low tide.
- **Shorelines and upland habitat are dominated by disturbed invasive species**.
- **Benthic communities are dominated by common pollution-tolerant marine annelids.**
- **Fisheries resources are limited in species diversity and abundance.**
- **Poor hydrologic connection, water circulation and tidal flushing** between Flushing Bay, Flushing Creek and Meadow Lake. **Poor water quality, hypoxic/anoxic conditions and odor problems** from exposed mudflats will be addressed by complementary NYCDEP Long Term Control Plan (CSO abatement) measures and environmental dredging activities.

Restoration Opportunities/Measures

- Habitat improvement
- Wetland creation
- Invasive species removal and native plantings
- Channel modification/realignment to improve flushing and erosion
- Bank stabilization
- Stream geomorphology restoration
- Improve suitability of bottom substrate for benthic community
- Secondary benefits of water quality improvements
- Sediment load reduction

Alternative	A	B	
Description	✓ Low Salt Marsh (2.42 ac): Re-grade existing common reed-dominated areas to create low salt marsh consisting of saltmarsh cordgrass. ✓ Preserving ephemeral pond (0.28 ac) ✓ Existing Upland (6.56 ac): Preserve existing upland forest with no re-grading or replanting proposed.	✓ Mudflat (1.16 ac): Re-grade tidal creek edges to establish mudflats with a target elevation between Mean Low Water and Mean Tide Line ✓ Low Marsh (3.67 ac): Re-grade existing common reed-dominated areas to create low salt marsh consisting of saltmarsh cordgrass. ✓ High Marsh (0.44 ac): Establish transitional high marsh/shrub swamp area between low marsh and upland maritime forest. ✓ Maritime Forest (6.77 ac): Restore existing upland forest area to a Maritime forest Community. ✓ Ephemeral pond (0.28 acres): Preserving the ephemeral pond.	✓ Mudflat (1.25 ac): Eliminate or minimize mudflats by raising the elevation of low salt marsh surface and use a coir log or other tidal bank revetment to protect the edge from erosion. ✓ Low Marsh (4.01 ac): Re-grade existing common reed-dominated areas to create low salt marsh through planting saltmarsh cordgrass. ✓ High Marsh (0.41 ac): Establish transitional salt shrub/high marsh area between low marsh and upland maritime forest. ✓ Maritime Forest (6.85 ac): Restore existing upland forest area to a Maritime forest Community. ✓ Stormwater infiltration features would be placed to collect runoff from adjacent roads and areas to improve stormwater quality and sustainability of the wetland. ✓ Ephemeral pond (0.28 acres) – Preserve ephemeral pond.
Average Annual Functional Capacity Units (AAFCUs)	12.48	16.93	17.74
Project Cost	$ 5,900,000	$ 17,500,000	$ 20,000,000
Annual Cost	$ 233,000	$ 691,000	$ 789,000
Average Cost/AAFCU	$ 18,640	$ 40,890	$ 44,570

Alternatives A is the "Best Buy Plan"

Flushing Bay and Creek Ecosystem Restoration Feasibility Study History

- ✓ Reconnaissance Report (1996) demonstrated Federal interest in ecosystem restoration and related water quality improvements.
- ✓ The Preliminary Draft Feasibility Report prepared November 2007 evaluated 1) tidal and freshwater wetland restoration; 2) dredging in Flushing Bay and Creek; 3) partial or total removal of breakwater at La Guardia Airport; 4) reorientation of Federal Navigation Channel; and 5) Bank Stabilization, Site Cleanup and Debris Removal.
- ✓ A total of 17 Alternatives were evaluated. Cost Effectiveness/ Incremental Cost Analysis "Best Buy Plan" included the recommendation of 4.4 ac of riparian habitat, 5 ac of wetland habitat (both banks).
- ✓ NYCDEP requested coordination between restoration and NYCDEP's Long Term Control Plan (CSO Abatement) and possible dredging efforts in creek. Draft recommendation was optimized as a result of additional sampling and 3 additional alternatives were prepared.

Tentatively Selected Plan Design

Significance of Restoration in the Region and at the Site

- ✓Proposed restoration of higher quality habitat for fish, birds and wildlife communities from improved water quality and provision of forage, spawning, nursery, and refuge habitat.
- ✓Restoration provides sediment stabilization, will reduce sediment scouring and improve water quality for fish propagation.
- ✓Long-term improvements in regulation of water flow, storm surge and flood buffering, wave attenuation, shoreline protection, and stormwater runoff control.
- ✓Advancement of Target Ecosystem Characteristics (TECs), Regional Goals and Planning Objectives for:
  - Wetlands by increasing diversity and abundance, increased wetland connectivity, reduction in invasives monoculture and replacing with native species;
  - Habitat for Waterbirds to improve roosting, nesting and foraging habitat and increase nests and improve feeding habitat.
- ✓ Long-term improvement in recreational opportunities for wildlife viewing, hiking, recreational fishing, kayaking, and canoeing through habitat improvement.

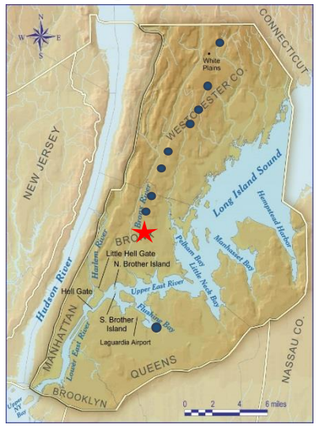
Leveraging with Partner Programs

- ✓Restoration complements and is projected to be sustainable resulting from NYCDEP water quality improvements conducted to date including construction of the Flushing Creek Combined Sewer Overflow (CSO) Retention Facility (2007) and Tallman Island Conveyance Enhancements.
- ✓Restoration coordinated and sequenced following the completion of NYCDEP water quality improvements resulting from their Long Term Control Plan and dredging/capping of Flushing Bay and Creek.
- ✓Restoration complements NYCDEP green infrastructure plans to mitigate stormwater and the remediation of the adjacent C.E. Flushing Site included in the Brownfield Remediation Program.
- ✓Restoration will complement the NYC Mayor's Flushing West Neighborhc part of the *Housing New York* program and the Flushing West Brownfield Opportunity Area.

NYC Environmental Protection

HRE- River Park/West Farm Rapids Park

Harlem River, East River, Long Island Sound Planning Region



★ Bronx River Park
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- River Park/West Farm Rapids Park is approximately 900 feet in length, bisected by 180th Street, located within a **densely populated, urban area**.
- Strong anthropogenic pressures: proximity of commercial and residential developments, roads, and urban parks with **limited and/or disturbed natural areas**.
- **Wetland resources are extremely limited**: few very small pockets and **sparsely vegetated wetlands**.
- Uplands consist of developed areas and an urban park, interspersed with a few small woodlots. The woodlots are **fragmented and offer limited, if any, habitat resources** to organisms not adapted for an urban environment. The site's uplands are **further impaired by garbage and stormwater runoff**.
- The river's benthic substrate largely consists of large pieces of concrete, bricks, other construction debris, and some boulders. Several large shaded pools occur. **Algae and anthropogenic debris** are present throughout the site. **Engineered Channel** with most of the **shoreline is armored**, consisting of vertical concrete debris/stone armoring or engineered walls constructed of tires and other man-made materials.
- Stream Visual Assessment Protocol (SVAP) revealed score of 4.3 for overall **POOR water quality** (< 6 considered Poor)

Restoration Opportunities/Measures

- Invasive species removal with native planting
- Debris removal
- Channel modifications with instream structures
- Select native plantings
- Emergent wetland creation
- Shoreline softening
- River bed restoration

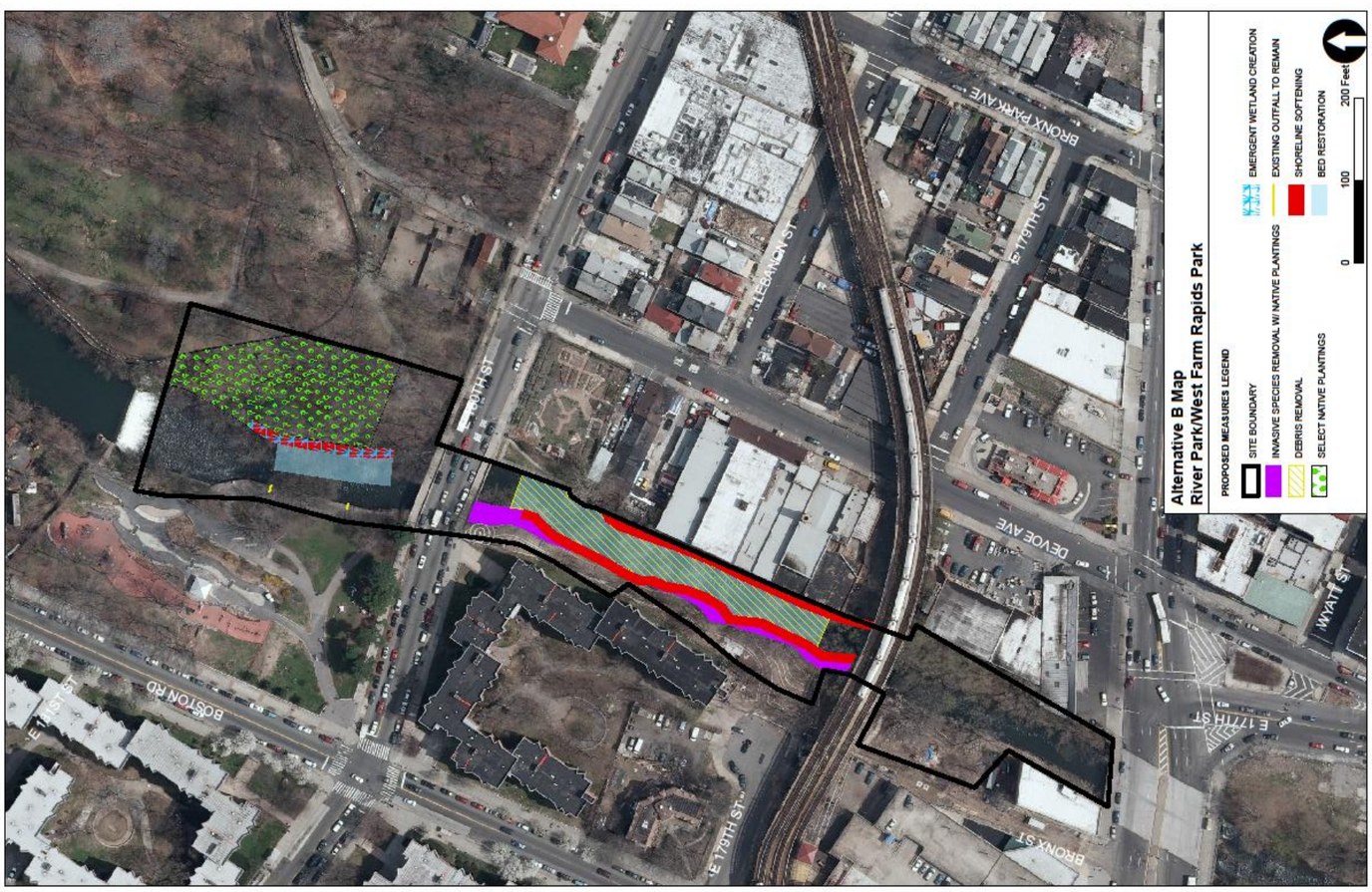
Alternative	A	B	C
Description	✓ Creation woodland area along the east side of the site with native upland trees and shrubs (~0.59 ac). ✓ Shoreline softening on the east and west channel banks (~0.31 ac) using boulders and facultative plants between the dam and 180th Street, stacked rock walls with brush layers along the east bank, and drilling with native plant materials along the west bank down stream of 180th Street. ✓ Creation of emergent wetlands (~0.04 ac). ✓ Channel modification between the dam and 180th Street (0.03 mi) with 3 instream cross vanes and 4 J-hooks. ✓ Removal of of invasive vegetation and replacement with native upland shrubs and herbaceous vegetation upslope from both banks of the river down stream of 180th Street (~0.20 ac). ✓ Removal of debris from river bottom downstream of 180th Street (0.52 ac along 0.07 mi stretch). ✓ Restoration of river bed by substrate excavation and replacement with with bedding stone (~0.36 ac). ✓ improvement of public access to the river.	✓ Creation woodland area along the east side of the site with native upland trees and shrubs (~0.59 ac). ✓ Shoreline softening on the east and west channel banks (~0.31 ac) using boulders and facultative plants between the dam and 180th Street, stacked rock walls with brush layers along the east bank, and drilling with native plant materials along the west bank down stream of 180th Street. ✓ Creation of emergent wetlands (~0.04 ac). ✓ Bed restoration between the dam and 180th Street (0.47 ac). ✓ Removal of of invasive vegetation and replacement with native upland shrubs and herbaceous vegetation upslope from both banks of the river down stream of 180th Street (~0.20 ac). ✓ Removal of debris from river bottom downstream of 180th Street (0.36 ac). ✓ Restoration of river bed by substrate excavation and replacement with with bedding stone (~0.36 ac). ✓ improvement of public access to the river.	✓ Creation woodland area along the east side of the site with native upland trees and shrubs (~0.59 ac). ✓ Shoreline softening on the east bank (~0.07 ac) using stacked rock walls with brush layers. ✓ Removal of of invasive vegetation and replacement with native upland shrubs and herbaceous vegetation upslope from both banks of the river down stream of 180th Street (~0.20 ac). ✓ Removal of debris from river bottom downstream of 180th Street (0.36 ac). ✓ Restoration of river bed by substrate excavation and replacement with with bedding stone (~0.36 ac). ✓ Improvement of public access to the river.
Average Annual Functional Capacity Units (AAFCUs)	**0.380**	**0.379**	**0.069**
Project Cost	**$3,930,000**	**$3,880,000**	**$2,430,000**
Annual Cost	**$157,600**	**$155,590**	**$97,450**
Average Cost/AAFCU	**$414,726**	**$410,530**	**$1,412,250**

Alternatives A and B are the "Best Buy Plans" and Alternative B is slightly more cost effective.

Significance of Restoration in the Region and at the Site

- ✓ Fulfills HRE mission by promoting Target Ecosystem Characteristics by increasing /improving wetlands, public access, shoreline and shallows, and habitat for fish, crabs and lobster.
- ✓ Created wetlands provide important habitats for migratory birds in a dense urban setting.
- ✓ Increased native biodiversity through wetlands creation and targeted reduction of invasive plant species
- ✓ Improved aquatic habitat, hydrologic flow regime and water quality
- ✓ Dense urban settings with limited natural environments; ecological enhancements increase the user experience of the park.
- ✓ Increased flood control value through wetlands creation
- ✓ Alternatives Improve water quality from score of 4.3 to 6.1 (Alternative A), 6.0 (Alternative B) and 5.9 (Alternative C)
- ✓ Improved public access

Tentatively Selected Plan Design

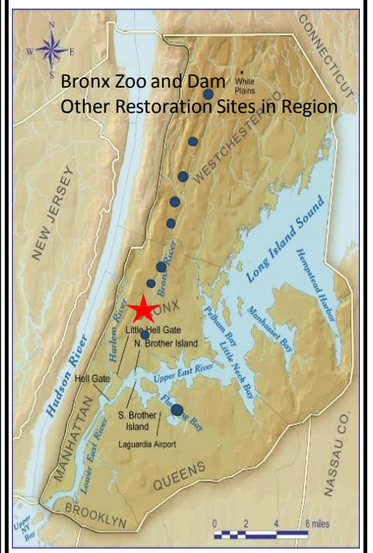


Environmental Protection

NYC Parks

HRE- Bronx Zoo and Dam

Harlem River, East River, Long Island Sound Planning Region



Baseline Conditions and Water Resource Problems

- The Bronx Zoo and Dam site is generally flat and occupied with roadways, parking lots, and the installations of the Bronx Zoo.
- River flow is affected by a dam system consisting of two dams abreast of each other separated by a mid-stream island.
- A distinct **sewage odor** was encountered upon entering the water (downstream of East Fordham Road.)
- Upstream of the dams, the majority of the observed wetlands are narrow strips of emergent vegetation along the banks of the river. However, in the northwest corner, an emergent wetland-mudflat complex has formed. In the southeastern portion of the site, a small stream drains into a flat, low area, resulting in a small forested/scrub/shrub wetland.
- Downstream of the dam, **wetlands are very limited** and consist of only small, **discontinuous pockets of emergent vegetation** adjacent to the shoreline.
- Upstream of the dams, the uplands consist of lawns and a thin wooded strip along the shoreline. Downstream of the dam, the upland areas are comprised of deciduous woodlands. On the west bank, the zoo's amenities limit the width of these woods to fewer than 20 feet. In contrast, the woodlands extend for approximately 150 feet on the east side.
- In the northernmost portion of the site, the river is broader (~100-feet wide) and water flows more slowly than other typical channel sections, with depth over five (5) feet at some locations. Just upstream of the dam, an upland island vegetated mostly by **invasive species** splits the river into two channels that rejoin between the two dams. The west bank of the upstream portion of the river is mostly armored and directly adjacent to a zoo enclosure; **the east bank is fairly steep with lightly vegetated and bare areas**. Downstream of the dams, the narrower channel has a moderate flow with a rocky bottom and bank.
- Stream Visual Assessment Protocol (SVAP) revealed score of 3.9 for overall **poor water quality** (< 6 considered Poor)

Restoration Opportunities/Measures

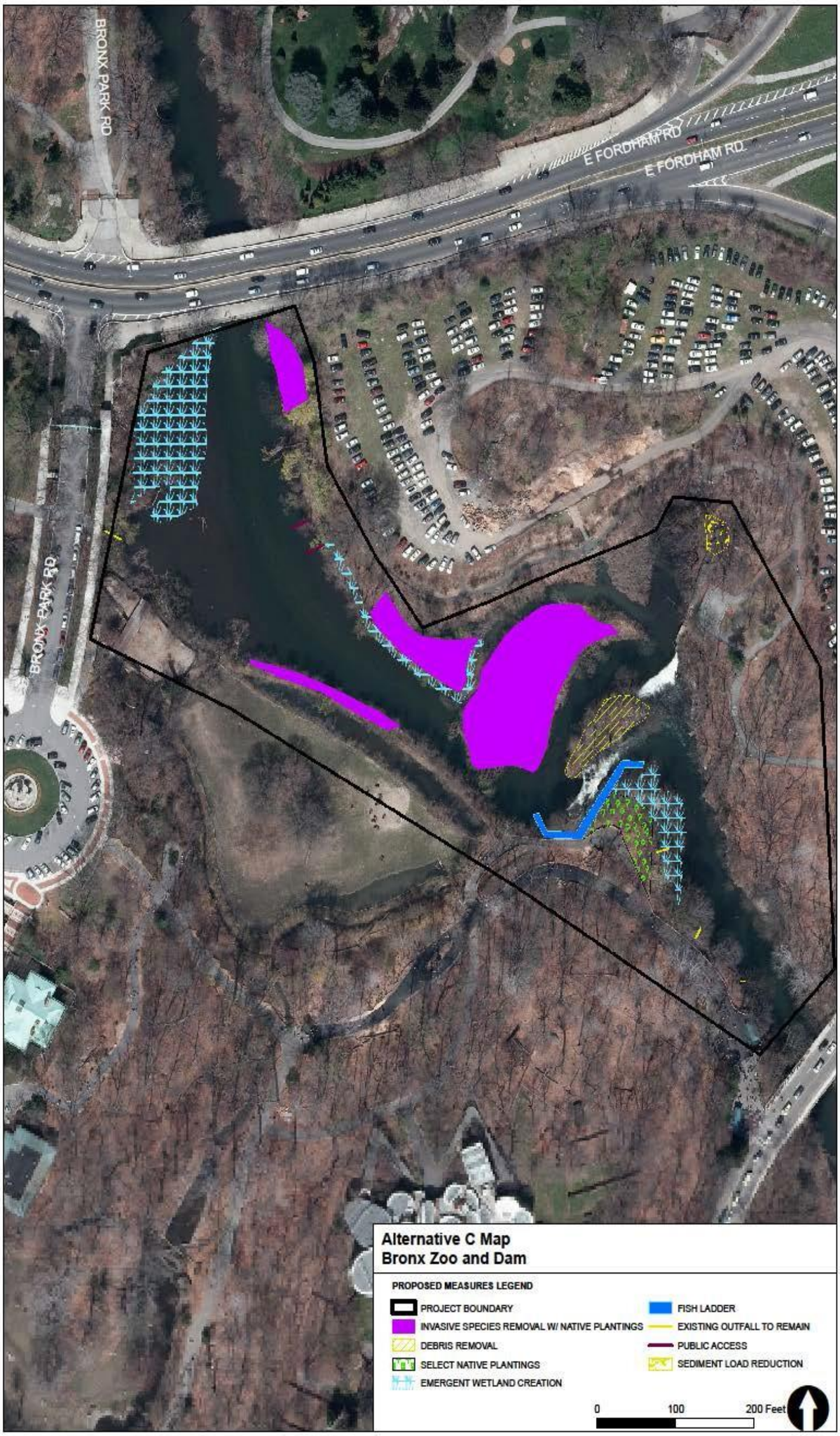
- Invasive species removal with native species plantings
- Channel modification with in stream structures
- Debris removal
- Forested scrub/shrub wetland creation
- Emergent wetland creation
- Select native plantings
- Shoreline softening
- Sediment load reduction
- Fish ladder installation
- Public access

Alternative	A	B	C
Description	✓ Removal of invasive vegetation and native planting (0.27 ac) along both banks, on the upland island upstream of the dams, and additional location downstream of the dams. ✓ Channel modification (~0.35 ac): river bottom excavation and bed material replacement between the island and the west bank . ✓ Bank softening of the west side (415 lf) by select removal of the existing armor and native planting. ✓ Installation of a fish ladder (0.04 ac) to link the excavated channel area upstream of the dams to the river channel below the dams . ✓ Creation of emergent wetlands (0.99 ac) along both banks upstream of the dams, and along the west bank downstream of the dams. ✓ Creation of forested wetlands (0.29 ac) in two locations upstream of the dams, along the east bank and on the island . ✓ Debris removal between the dams (0.09 ac). ✓ Installation of a sediment trap to reduce sediment loads reaching the river. ✓ Improved public access.	✓ Removal of invasive vegetation and native planting (0.56 ac) along both banks, on the upland island upstream of the dams, and additional location downstream of the dams. ✓ Channel modification (~0.35 ac): river bottom excavation and bed material replacement between the island and the west bank . ✓ Bank softening of the west side (415 lf) by select removal of the existing armor and native planting. ✓ Installation of a fish ladder (0.04 ac) to link the excavated channel area upstream of the dams to the river channel below the dams . ✓ Creation of emergent wetlands (0.70 ac) along both banks upstream of the dams, and along the west bank downstream of the dams. ✓ Debris removal between the dams (0.09 ac). ✓ Installation of a sediment trap to reduce sediment loads reaching the river. ✓ Improved public access.	✓ Removal of invasive vegetation and native planting (0.56 ac) along both banks, on the upland island upstream of the dams, and additional location downstream of the dams. ✓ Installation of a fish ladder (0.04 ac) to link the excavated channel area upstream of the dams to the river channel below the dams . ✓ Creation of emergent wetlands (0.54 ac) along both banks upstream of the dams, and along the west bank downstream of the dams. ✓ Debris removal between the dams (0.09 ac). ✓ Installation of a sediment trap to reduce sediment loads reaching the river. ✓ Improved public access.
Average Annual Functional Capacity Units (AAFCUs)	**2.038**	**1.692**	**1.369**
Project Cost	**$5,590,000**	**$4,360,000**	**$3,360,000**
Average Cost	**$224,450**	**$175,060**	**$134,740**
Average Cost/AAFCU	**$110,134**	**$103,466**	**$98,422**

Significance of Restoration in the Region and at the Site

- ✓ Improved water quality through increased connectivity.
- ✓ Increased nesting, roosting and foraging habitat.
- ✓ Improved riparian habitat connectivity and increased migratory fish habitat.
- ✓ Provides vegetated buffer and transitional zone.
- ✓ Increased diversity and abundance of species.
- ✓ Stabilized shorelines and retention of soils as well as reduced sediment loads downstream.
- ✓ Replaces invasive plant species with native species in wetland and upland areas.
- ✓ Restored buffer riparian zones.
- ✓ Creation of scrub/shrub and forested wetlands provides habitat for migratory birds.
- ✓ Improved public access.

Tentatively Selected Plan Design

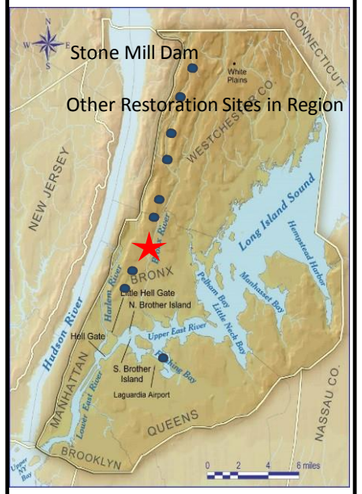


NYC Parks

NYC Environmental Protection

HRE- Stone Mill Dam

Harlem River, East River, Long Island Sound Planning Region



★

●

Baseline Conditions and Water Resource Problems

- The Stone Mill Dam Site (also called Snuff Mill Dam) is situated in a steep valley within the New York Botanical Garden (NYBG). The valley side slopes are over 40-percent grade with numerous rock outcrops. The presence of a dam divides the site into two hydrologic regimes: a slow-flowing waterbody upstream of the dam and a swift-flowing waterbody downstream of the dam.
- A distinct **sewage odor** was encountered downwind of the dam. NYBG staff noted that samples from the River often contained **high levels of coliform bacteria**.
- Wetlands at the site consist only of a few, very small (less than five (<5) square feet), discontinuous pockets of emergent vegetation adjacent to the shoreline.
- Uplands consist of wooded slopes with large rock outcrops.
- Above the dam, the river is ponded and forms a large pool that is over four (4)-feet deep; NYBG personnel indicated that the pool contains a **thick sediment deposit**.
- Below the dam, swifter flows occur and the river bottom consists of cobbles and boulders. Pools in excess of four (4) feet occur below the dam. Most of the shoreline and banks consist of bedrock and boulders.
- At the southeast limits of the project, a stone and masonry retaining wall that separates a paved walkway from the shoreline has partially collapsed.

Restoration Opportunities/Measures

- Invasive species removal and replacement with native plantings
- Installation of fish ladder and concomitant attractors/habitat improvements
- Installation of native plantings area
- Bed Restoration

Alternative	A	B	C
Description	✓ Installation of a fish ladder to link the slow-flowing pool upstream of the dam and the faster-flowing channel downstream of the dam. ✓ Placement of clay-pipe fish attractors at both the upstream and downstream ends of the fish ladder to function as refuge habitats for fish. ✓ Planting of native vegetation along the east bank of the river, abutting the fish ladder (0.03 ac). ✓ Removal of invasive vegetation from a small area along the west bank, immediately downstream of the dam, and replacement with native vegetation.	✓ Installation of a fish ladder to link the slow-flowing pool upstream of the dam and the faster-flowing channel downstream of the dam. ✓ Planting of native vegetation along the east bank of the river, abutting the fish ladder (0.03 ac).	✓ River bed excavation and material replacement upstream of the dam (0.09 ac).
Project Cost	**$650,000**	$590,000	$440,000

Significance of Restoration in the Region and at the Site

✓ In combination with Shoelace Park, Bronxville Lake, Westchester County Center and other riverine habitat restoration projects will increase and improve tributary connections, shoreline and shallows, and habitats for fish, crab and lobsters.

✓ Improved fish connectivity- providing access for anadromous species.

✓ Restore natural stream geomorphology.

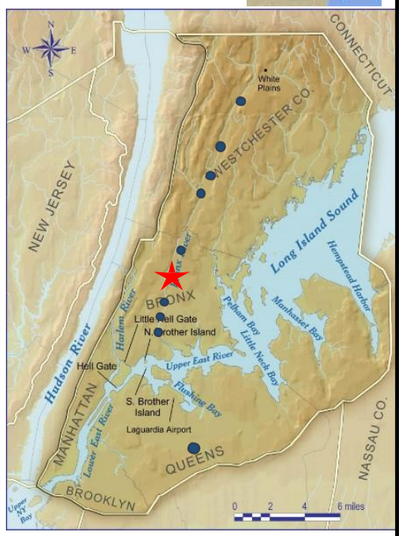
✓ Restore natural riverine habitat by replacing invasive plant species with native vegetation.

Tentatively Selected Plan Design

NYC Parks

HRE- Shoelace Park North and South

Harlem River, East River, Long Island Sound Planning Region



★ Shoelace Park
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- Shoelace Park is surrounded by dense, urban development. The west side of the site consists largely of the Bronx River Parkway's roadway embankment.
- Site characterized by **over-widened channel** with **steep vertical banks and eroded shoreline**.
- The eastern side of the site is parkland, predominantly consisting of maintained lawns that rise on a slope of notable steepness (~25- to 30-% grade) to 60 feet in elevation from the River channel.
- Banks are sparsely vegetated and wetlands are limited to very narrow, dispersed strips of emergent vegetation. The wetlands and large portions of the upland riverine corridor provide **low quality upland buffer** and are **dominated by invasive species**.
- Much of the uplands consist of Park lawns with pockets of deciduous woodlots in the extreme north and south sections.
- The channel bottom is sandy and generally one to three feet deep with limited riffles and pools, **poor water quality** and i**ncreased sediment load.**

Restoration Opportunities/Measures

- Habitat Improvement
- Wetland Creation
- Invasive species removal/native species plantings
- Channel modification/realignment
- Bank Stabilization
- Stream geomorphology restoration
- Secondary benefits of water quality improvements
- Sediment load reduction
- Public education/access

Alternative	A	B	C
Description	✓ Restoration of Bronx River reach to pre-industrialization conditions: realigns channel with natural meanders and restores large tracts of forested wetlands along the banks. ✓ Entire channel modification with instream structures (6,680 Lft mi): restoration of natural pools, thalweg, riffle complexes, etc. - resulting in a substantial increase of aquatic habitat value. ✓ Bank stabilization with environmental engineering techniques that provide vegetation coverage along the banks (11,620 Lft, on both sides). ✓ Select native plantings (6.5 ac) would provide a wooded riparian corridor along the banks of the entire reach. The riparian woodlands and restored forested wetlands would provide habitat resources that are currently very limited in the Bronx urban environment and reduce nutrient inputs to the water. ✓ Sediment load reduction with bank stabilization and installation of rain gardens, bioretention basins, etc. ✓ Invasive removal and select native plantings. ✓ Public access to the river would be maintained.	✓ Entire channel modified with instream structures (1.3 mi): restoration of natural pools, thalweg, riffle complexes, etc. - resulting in a substantial increase of aquatic habitat value. ✓ Bank stabilization with environmental engineering techniques that provide vegetation coverage along the banks (>1 mi on both sides). ✓ Select native plantings would provide a wooded riparian corridor along the banks of the entire reach. ✓ Sediment load reduction with bank stabilization and installation of rain gardens, bioretention basins, etc. ✓ Invasive removal and select native plantings (~3.5 ac). ✓ Public access to the river would be maintained.	✓ Entire channel modified with instream structures (~1.2 mi): restoration of natural pools, thalweg, riffle complexes, etc. - resulting in a substantial increase of aquatic habitat value. ✓ Bank stabilization with environmental engineering techniques that provide vegetation coverage along the banks (>1.1 mi). ✓ Sediment load reduction with bank stabilization and installation of rain gardens, bioretention basins, etc. ✓ Invasive removal and select native plantings (3.5 ac). ✓ Public access to the river would be maintained.
Average Annual Functional Capacity Units (AAFCUs)	**3.30**	**0.46**	**0.36**
Project Cost	**$25,010,000**	**$18,610,000**	**$8,850,000**
Annual Cost (1000)	**$959,250**	**$713,780**	**$338,230**
Average Cost (1000)/AAFCU	**$290,330**	**$1,544,970**	**$929,210**

Significance of Restoration in the Region and at the Site

- ✓ Improve hydrologic and riparian habitat connectivity and increase migratory fish habitat.
- ✓ Restore natural stream geomorphology while stabilizing the shoreline and retaining soils.
- ✓ Reduce sediment loads
- ✓ Improve wetland habitat.
- ✓ Reduce nutrient inputs to the water.
- ✓ Restore mosaic of diverse habitats by increasing diversity and abundance.
- ✓ Replace invasive species with native vegetation.
- ✓ Ensure sustainability of adjacent habitats.
- ✓ Restore buffer riparian zones.
- ✓ Provide vegetated buffer and transitional zone.

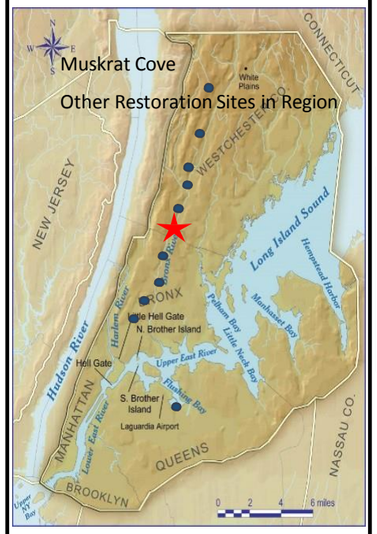
Tentatively Selected Plan Design

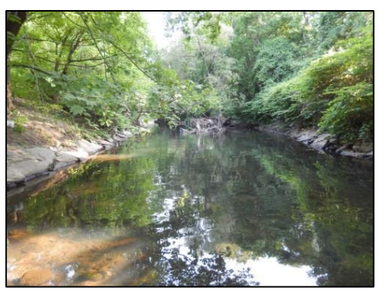
North

South (downstream)

HRE- Muskrat Cove

Harlem River, East River, Long Island Sound Planning Region





Baseline Conditions and Water Resource Problems

- The Muskrat Cove site is located just north of the Shoelace Park Site, flowing through a small valley located between a Metro North commuter rail line and the Bronx River Parkway, and intersected by Webster Avenue.
- The majority of the terrestrial area of the site consists of wooded slopes dominated by deciduous species.
- The **wetlands are limited** to very small isolated pockets with **sparse vegetation**.
- The uplands consist of maintained lawns associated with the park and Parkway right-of-way. Portions of the upland slopes were occupied by **dense stands of Japanese knotweed**. Paved walkways, retaining walls and other infrastructure fragment the woodlands.
- The river is shallow and widened with limited pools and riffles. The river bottom is sandy with large boulders.
- **Banks are armored** throughout much of the site, including almost the entire western shoreline; in some areas vegetation has grown up through cracks in the armor. In the northeastern half of the site, unarmored **banks are generally steep and some are undercut.**

Restoration Opportunities/Measures

- Invasive species removal and replacement with native plantings
- Channel modification with instream structures
- Debris and snag removal
- Shoreline softening and bank stabilization
- Sediment basin installation

Alternative	A	B	C
Description	✓ Invasive species removal with native plantings on the upland slopes and along both banks throughout the length of the site (~0.49 ac). ✓ River bank stabilization between Nereid Avenue and the rail line bridge over the river, construction of vegetated cribwalls, softening using drilling with native plant materials (1,350 lf). ✓ Removal of debris and log jams from the river (1.24 ac). ✓ Channel modification along two segments (1.24 ac), excavation and replacement of bed material, and construction of instream cross vanes and J-hooks. ✓ Installation of a sediment basin at an existing outfall to reduce sediment loads reaching the river.	✓ Invasive species removal with native plantings on the upland slopes and along both banks throughout the length of the site (~0.49 ac). ✓ River bank stabilization between Nereid Avenue and the rail line bridge over the river, construction of vegetated cribwalls, softening using drilling with native plant materials (1,350 lf). ✓ Removal of debris and log jams from the river (1.24 ac). ✓ Channel modification along one segment, excavation and replacement of bed material, and instream structures (0.11 ac). ✓ Bed restoration along another segment (0.26 ac) with creation of a riffle-pool complex. Excavation and replacement of bed material (0.10 ac), and placement of cut and round boulders. ✓ Installation of a sediment basin at an existing outfall to reduce sediment loads reaching the river.	✓ Invasive species removal with native plantings on the upland slopes and along both banks throughout the length of the site (~0.49 ac). ✓ River bank stabilization between Nereid Avenue and the rail line bridge over the river (640 lf). ✓ Removal of debris and log jams from the river (1.24 ac). ✓ Bed restoration along another segment (0.26 ac) with creation of a riffle-pool complex. Excavation and replacement of bed material (0.10 ac), and placement of cut and round boulders. ✓ Installation of a sediment basin at an existing outfall to reduce sediment loads reaching the river.
Average Annual Functional Capacity Units (AAFCUs)	**0.76**	**.77**	**.1**
Project Cost	**$7,840,000**	**$8,050,000**	**$4,090,000**
Annual Cost	**$300,700**	**$308,750**	**$156,500**
Average Cost/AAFCU	**$397,220**	**$403,070**	**$1,647,350**

Significance of Restoration in the Region and at the Site

- ✓ Restore natural stream geomorphology and reduce shoreline erosion.
- ✓ Enhance basin and tributary bathymetric configuration.
- ✓ Develop mosaic of diverse habitats.
- ✓ Increase migratory fish habitat.
- ✓ Reduce invasive monocultures and replace with native plant species.
- ✓ Improvements designed to act in concert with future Parks Department activities and contribute to improvement of recreational use.
- ✓ Improve water quality through improved hydrologic connectivity.

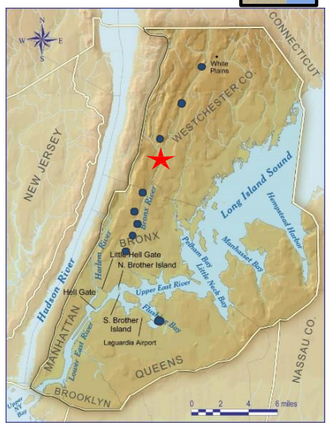
Tentatively Selected Plan Design

NYC Parks

NYC Environmental Protection

HRE- Bronxville Lake

Harlem River, East River, Long Island Sound Planning Region



★ Bronxville Lake
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- River flows through a broad valley (~400-feet wide) with sides twenty to forty (20-40) feet high. The weir across the River at the southern end of the site creates a broad and shallow lake in the southern two-thirds (2/3) of the site.
- A park, part of the Bronx River Parkway Reservation maintained by the Westchester County Department of Parks, Recreation, and Conservation, surrounds the lake. The park consists largely of maintained lawns with trees, with several pockets of emergent wetlands that are landscaped and mowed.
- **Canada geese and their fecal matter** throughout the site and an **odor of sewage** present downwind of the weir.
- Edge of lake has **narrow and sparsely vegetated wetlands**. Wetlands extend to ~ five (5) feet in width for short distances on western side of lake. Several **sediment bars** have formed with limited amounts of emergent vegetation within the lake.
- Several small pockets of **interspersed mowed wetlands in shallow depressions in the uplands**.
- The majority of the uplands at this site are maintained lawns with isolated trees located within the park and Parkway right-of-way. Dominated by deciduous species, **small woodlots are present but fragmented and provide limited habitat value**.
- The broad, shallow lake in the southern portion of the site is subject to **nutrient-enriched runoff** from the park. Several **drainage pipes** that empty into the lake from the Parkway and other upland areas were observed at the site. The shoreline in the northern portions of the site and the area in the south adjacent to the bridge are armored with large boulders. Around the lake, the short **banks are generally vertical**, with the upper bank predominantly lined with a single row of trees (e.g., alders, maples, etc.) that are impacted with **heavy vine growth**. To the north, the channel is narrower with steeper and higher banks.
- Stream Visual Assessment Protocol (SVAP) revealed score of 2.9 for overall **POOR water quality** (< 6 considered Poor)

Restoration Opportunities/Measures

- Invasive species removal and native plantings
- Channel realignment with in stream structures
- Forested subshrub wetland creation
- Emergent wetland creation
- Select native plantings
- Sediment load reduction
- Weir modification (fish passage)
- Forebay installation

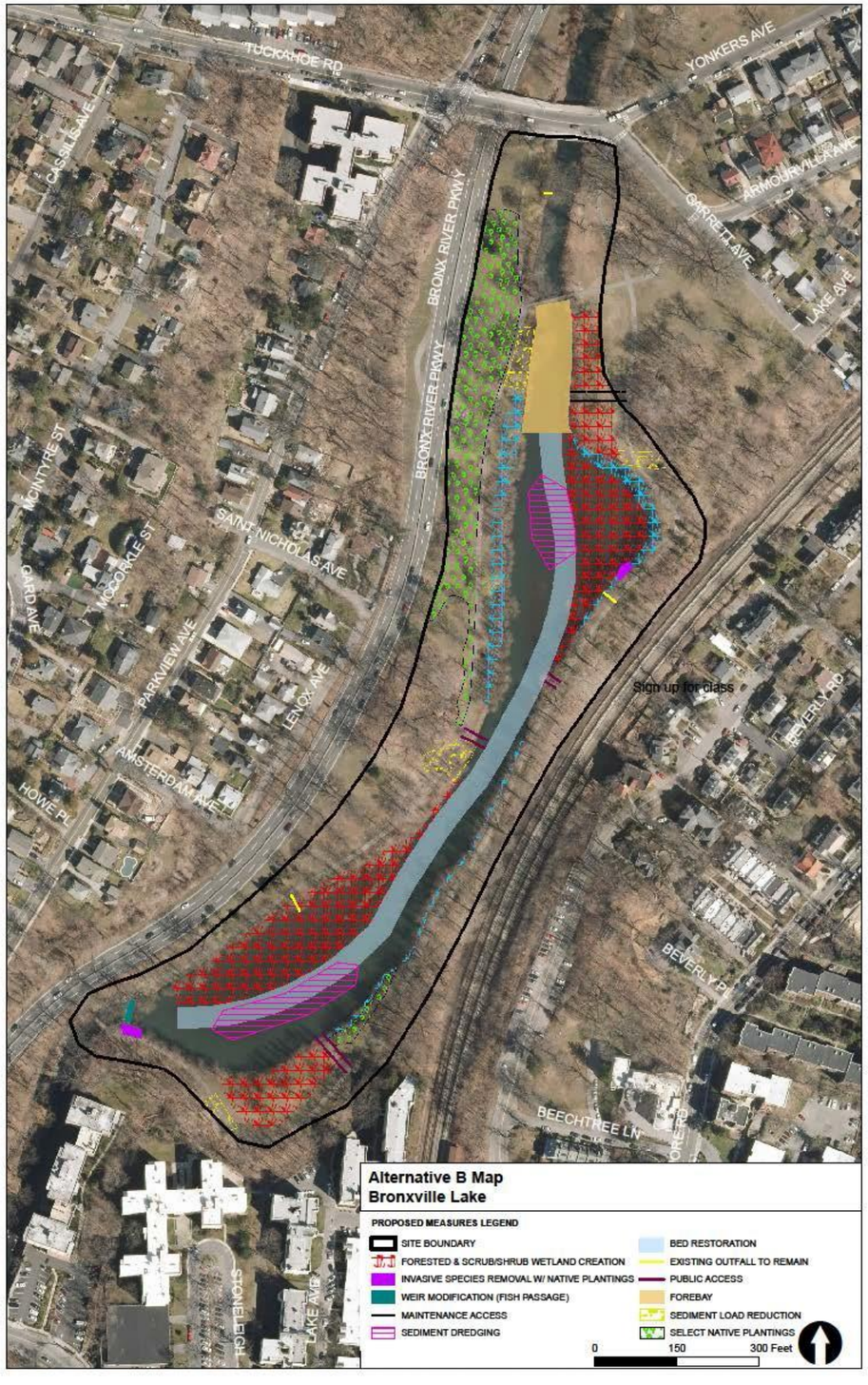
Alternative	A	B	C
Description	✓ Native planting: upland trees and shrubs in the northwest portion of the site along the Bronx River Parkway (~1.3 ac) and along the southeast portion of the lake (~0.09 ac). ✓ Construction of a rip rap forebay upstream of the lake (0.43 ac). ✓ Channel realignment (1.28 ac) with replacement of bed material and construction of 11 instream cross vanes. ✓ Creation of emergent wetlands between the channel and the lake banks (3.67 ac) and forested and scrub/shrub wetlands around the lake perimeter (1.02 ac). ✓ Modification of the existing rock weir at the southern end of the lake to facilitate fish passage. ✓ Removal invasive vegetation (0.03 ac) and replacement/addition of native species (1.40 ac). ✓ Sediment load reduction with installation of vegetated swales, bioretention basins, and rain gardens at three locations (0.24 ac). ✓ Improved public access to the river.	✓ Channel bed restoration with excavation and bedding stone installation (~1.28 ac). ✓ Creation of emergent wetlands in narrow strips along the banks of the lake (0.59 ac) ✓ Creation of forested and scrub/shrub wetlands around sections of lake perimeter and in filled areas (2.90 ac). ✓ Modification of the existing rock weir at the southern end of the lake to facilitate fish passage. ✓ Removal invasive vegetation and replacement/addition of native species (1.40 ac). ✓ Sediment dredging in two small sections of the channel. ✓ Sediment load reduction with installation of vegetated swales, bioretention basins, and rain gardens at three locations (0.24 ac).	✓ Native planting: upland trees and shrubs in the northwest portion of the site along the Bronx River Parkway (~1.3 ac) , and along the southeast portion of the lake (~0.09 ac). ✓ Construction of a rip rap forebay upstream of the lake (0.43 ac). ✓ Channel bed restoration along the intervening river channel (0.37 ac). ✓ Creation of emergent wetlands in smaller and narrower strips along the lake shore (~0.2 ac) ✓ Creation of forested and scrub/shrub wetlands east bank of the river, upstream of the lake (0.57 ac). ✓ Installation of fish passage to link the lake and the river downstream of the existing weir. ✓ Removal invasive vegetation (0.03 ac) and replacement/addition of native species (1.40 ac). ✓ Sediment dredging both broad, shallow lobes of lake. ✓ Sediment load reduction with installation of vegetated swales, bioretention basins, and rain gardens at three locations (0.24 ac). ✓ Improved public access to the river.
Avg Annual Funct. Capacity Units (AAFCUs)	**7.47**	**5.34**	**1.61**
Project Cost	**$21,210,000**	**$14,530,000**	**$13,150,000**
Annual Cost	**$813,500**	**$555,970**	**$503,170**
Average Cost/AAFCU	**$108,920**	**$104,080**	**$311,940**

Significance of Restoration in the Region and at the Site

- ✓ Improved aquatic habitat and water quality
- ✓ Improved flow regime and improved fish connectivity- providing access for anadromous species
- ✓ Created wetlands provide important habitats for migratory bird.
- ✓ Increased native biodiversity through wetlands creation and targeted removal of invasive plant species
- ✓ Created forested wetlands may provide a potential habitat/roosting resource for endangered bat species, if present.
- ✓ Increased flood control value through wetlands creation
- ✓ Alternatives Improve water quality from score of 2.9 to 5.8 (Alternative A), 4.9 (Alternative B) and 4.6 (Alternative C)
- ✓ Improved public access

** Alternatives A and B are "Best Buy Plans and Alternative B is the most cost effective.

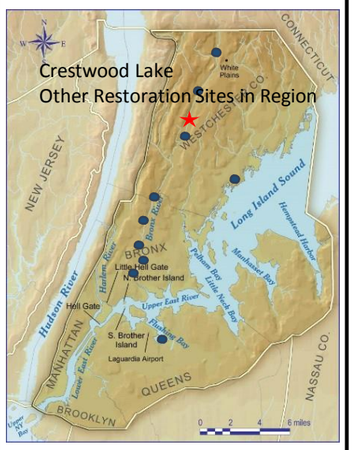
Tentatively Selected Plan Design



Westchestergov.com

HRE- Crestwood Lake

Harlem River, East River, Long Island Sound Planning Region



Baseline Conditions and Water Resource Problems (EPW Report)

- Crestwood Lake site flows through a broad valley (~400- to 600-feet wide), the sides of which are approximately 20 feet in elevation. At the southern end, the River is dammed, forming a broad, shallow lake approximately three (3) times the width of the river upstream. On the Westside of the lake, there is a confluence with a small tributary of moderate flow named Troublesome Creek. A walking trail and lawns with trees border the eastern side of the lake; woodlots and lawns bordering the northwest side of the lake are part of the Bronx River Parkway Reservation. A portion of the southeast side of the project overlaps the Parkway Oval Recreation area.
- **Canada geese and their fecal matter** present throughout the site.
- Around the lake, the wetlands generally consist of a vegetated strip that varies in width from two to ten (2-10) feet.
- The majority of the uplands are maintained lawns with single trees and woodlands. In the northern portion of the site, wetlands are bounded by a **thin riparian strip** with several dense pockets of **invasive vegetation**.
- The majority of the site is a broad and shallow lake habitat subject to **nutrient enriched runoff** from the lawns and potential upstream sources.
- In the northern portion of the site, a small reach of shady river channel exists with a rock and sand bottom.
- **Armored shoreline** on northern and southern ends adjacent to the roadway and pedestrian bridges, respectively.
- A vegetated sediment bar is present at the Troublesome Creek tributary confluence and several additional **sediment bars**, both vegetated and mudflat, are present within the lake.

Restoration Opportunities/Measures

- Invasive species removal and replacement with native plantings
- Select native plantings
- Channel modification with in-stream structures
- Emergent wetland creation
- Weir modification (fish passage)
- Forebay installation
- Path installation
- Public access

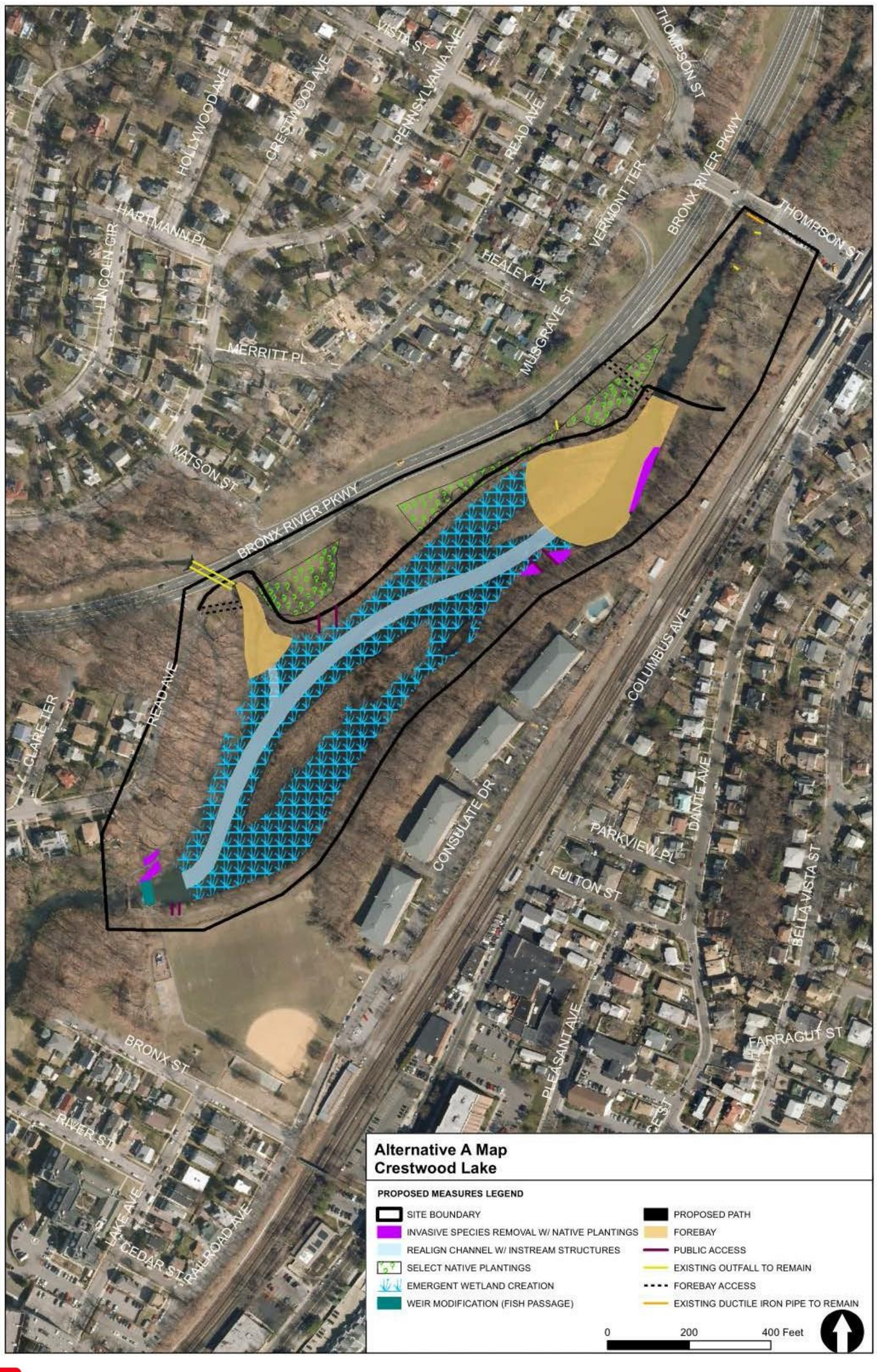
Alternative	A	B	C
Description	✓ Native planting of upland trees and shrubs at three in the western portion of the site along the Bronx River Parkway areas. Invasive species removal and native planting along the lake shore and at two other locations near the weir (1.3 ac). ✓ Channel realignment, replacement of bed material and construction of 11 instream cross vanes (1.2 ac). ✓ Creation of emergent wetlands (4.8 acres) between the channel and the lake banks.	✓ Native planting of upland trees and shrubs at three in the western portion of the site along the Bronx River Parkway areas (1.12 ac). ✓ Invasive species removal and native planting along the lake shore and at two other locations near the weir (0.14 ac). ✓ Construction of two rip rap forebays with access roads at the upstream end of the lake, and at the Troublesome Creek tributary confluence. ✓ Channel bed restoration: excavation and installation of bedding stones (1.24 ac). ✓ Creation of emergent wetlands at a single location at the river inlet along the west bank of the lake (0.94 ac). ✓ Modification of existing rock weir at the southern end of the lake to include slopes and pools in order to promote fish passage. ✓ Improved public access to the river.	✓ Native planting of upland trees and shrubs at three in the western portion of the site along the Bronx River Parkway areas (1.12 ac). ✓ Invasive species removal and native planting along the lake shore and at two other locations near the weir (0.14 ac). ✓ Construction of two rip rap forebays with access roads at the upstream end of the lake, and at the Troublesome Creek tributary confluence. ✓ Creation of emergent wetlands at a single location at the river inlet along the west bank of the lake (0.32 ac). ✓ Installation of fish passage to link the lake and the river downstream of the weir. ✓ Sediment dredging in the channel and the lake to create deeper pools (1.21 ac). ✓ Improved public access to the river.
Average Annual Functional Capacity Units (AAFCUs)	13.27	6.15	5.19
Project Cost	$27,610,000	$14,000,000	$12,610,000
Avg Annual Cost	$1,058,970	$536,330	$482,510
Avg Cost/ AAFCU	$79,820	$87,150	$93,060

Significance of Restoration in the Region and at the Site

- ✓ Improved flow regime
- ✓ Improved fish connectivity- providing access for anadromous species
- ✓ Created wetlands providing important habitats for migratory birds
- ✓ Increased native biodiversity through wetlands creation, plantings and targeted reduction of invasive vegetation
- ✓ Created forested uplands providing a habitat for endangered bat species
- ✓ Improved water quality and aquatic habitat
- ✓ Increased flood control value through wetlands creation
- ✓ Improved public access

** Alternative A is the “Best Buy Plan”

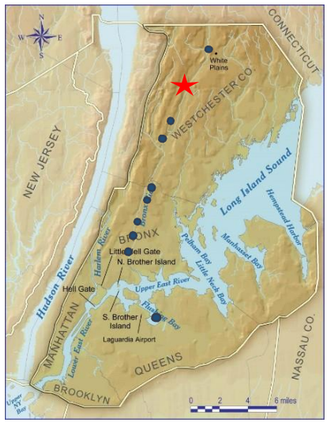
Tentatively Selected Plan Design



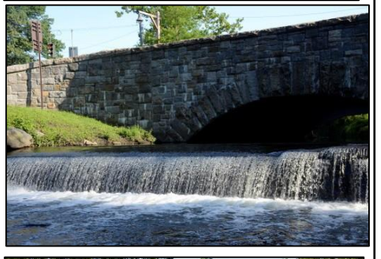
Westchestergov.com

HRE- Harney Road & Garth Woods

Harlem River, East River, Long Island Sound Planning Region



★ Harney Road/Garth Woods
• Other Restoration Sites in Region



Baseline Conditions and Water Resource Problems

- The majority of the **Harney Road** site is located north of Harney Road between the northbound and southbound lanes of the Bronx River Parkway. The eastern portion of the site is bounded by Parkway's northbound lanes. The southbound lanes cut through the western portion of the site.
- The **channel is over-widened and shallow**, with a ponded area upstream of the weir located immediately south of Harney Road bridge.
- A paved path and park on the east side of the River are part of the Bronx River Parkway Reservation maintained by the Westchester County Department of Parks, Recreation, and Conservation.
- Along the water's edge, the **wetlands are often very narrow**. Within the mowed lawn area west of the Parkway, several emergent wetlands occur in depressional areas. **These wetlands are also mowed**. Banks south of Harney Road are armored.
- This site's upland landscape essentially consists of road embankment slopes. On the western side, the slopes are steep narrow between the channel and Parkway, with a strip of lawn and some pockets of trees and shrubs. The eastern side is wider, with shallower slopes of maintained lawns and a strip of woodland adjacent to the Parkway. On the eastern side of the site, just north of Harney Road, a **buried storm drain is causing sediment deposition and minor erosion**. West of the southbound lanes of the Parkway, there is a large mowed lawn area with few single trees; as stated above, pockets of emergent wetlands are present within the lawn.
- North of Harney Road, the River is an **over-widened, broad (~60 feet wide), slow moving channel**, with depths often less than two (2) feet. A single deep pool exists at the northern end, just below the Garth Woods site. The banks are generally vertical and show signs of moderate erosion. **Dense growths of Japanese knotweed** were also observed along the banks. Immediately south of Harney Road, the River flows over a four (4)-foot high weir, creating swifter flows and a semi-vegetated alluvial bar.
- The **Garth Wood site is immediately north of the Harney Road Site,** consists of a large forested area, traversed by the Bronx River Parkway Reservation path on the east, and bordered by the Bronx River on the west. **Wetlands are absent along the western shoreline** and consist of **very thin strips of sparse emergent vegetation along the eastern shoreline** occurring in wet depressions within the adjacent forests, mostly within the remnant channel east/north of the river. Evidence of likely vernal pools was also observed within the forested areas. The majority of the uplands consist of **invasive dominated** deciduous forest characteristic in structure to that of a floodplain forest.
- Stream Visual Assessment Protocol (SVAP) score of 4.0 characterized as **poor water quality** (<6 considered poor water quality)

Restoration Opportunities/Measures

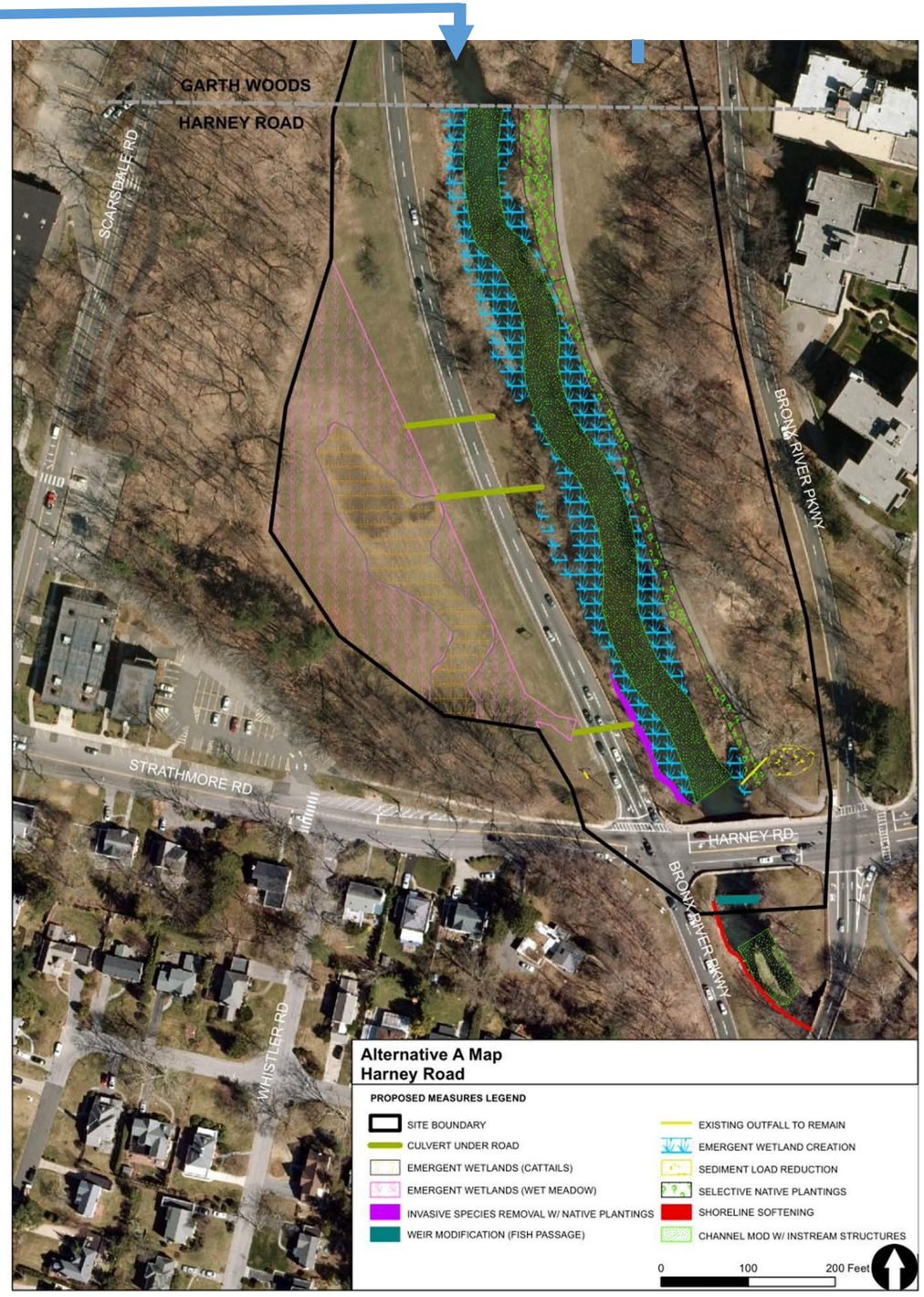
- Invasive species removal and replacement with native plantings
- Channel modification with in stream structures
- Shoreline softening
- Forested and Scrub/Shrub wetland creation
- Emergent wetland creation
- Weir modification (fish passage)
- Installation of select native plantings
- Sediment load reduction
- Installation of select native plantings

Alternative	A-2	B	C
Description	✓ Modification of the existing weir at the southern end of the site to promote fish passage. ✓ Modification of 0.85 acres of the river channel upstream of Harney Road and a short off-site section of river channel downstream of the weir by replacing the bed material and construction of approximately 15 instream cross vanes. ✓ Creation of 0.79 acres of emergent wetlands along both shores of the river. ✓ Installation of native upland trees and shrubs between the created emergent wetlands on the east shore and the paved path. ✓ Construction of three culverts under the southbound lanes of Bronx River Parkway to transfer river water to emergent cattail-dominated wetlands created throughout most of the maintained lawn area on the west side. ✓ Removal of 0.03 acres of invasive Japanese knotweed from the west bank of the river, just north of Harney Road, and replacement with native, upland or wetland shrubs and herbaceous vegetation ✓ Installation of a raingarden/bioretention area at the upstream end of the buried storm drain. ✓ Softening a segment (190 linear feet) of the west bank of the river, down of the weir, by constructing a stacked rock wall with brush layers.	✓ The restoration measures included in Alternative A also are included in Alternative B, with the exception of channel modification with instream structures, upstream of Harney Road and shoreline softening. ✓ Alternative B will restore the channel bed by excavating and replacing 1.34 acres of bed material. ✓ Alternative B will not construct culverts under the southbound lanes of the Parkway. ✓ The extent of emergent wetland creation is restricted to 0.21 acres of cattail-dominated core described in Alternative A ✓ Native upland trees and shrubs will be planted within the Alternative A wet meadow. ✓ Weir modification will not incorporate slopes and pools to promote fish passage; the west bank of the river.	✓ Relative to Alternative B, Alternative C will not restore the river bed, nor will the channel be modified. ✓ Forested and scrub/shrub wetland creation will replace approximately 0.52 acres of emergent wetland creation within the maintained lawn to the west of the southbound lanes of the Parkway. Emergent wetland creation will reduce to approximately 0.21 acres. ✓ The existing weir at the southern end of the site will not be modified; rather, a fish passage will be installed to link the upstream and downstream segments of the river.
	Note: For each alternative, the same actions are proposed for the Garth Woods site. The actions are the following: ✓ Creation of forested and scrub/shrub wetlands along the west bank of the river at the upstream end of the site (0.03 ac). ✓ Select native plantings in the adjacent lawn, on both sides of the paved path (0.14 ac). ✓ Removal of invasive species near the northern border of the site and replacement with native upland or wetland shrubs and herbaceous vegetation (0.02 ac).		
AAFCUs	3.23	2.44	2.26
Project Cost	$7,200,000	$6,490,000	$3,750,000
Annual Cost	$275,830	$248,630	$143,490
Average Cost/AAFCU	$85,470	$101,810	$63,410

Significance of Restoration in the Region and at the Site

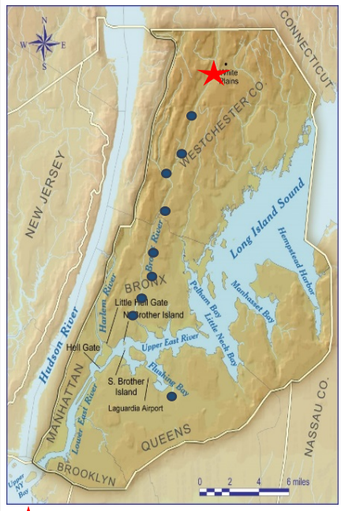
- ✓ Designed to compliment future habitat enhancements at Garth Woods to be performed by Westchester County.
- ✓ Restoration actions were designed to act in concert with viewscapes of the Bronx River Parkway.
- ✓ Improved wetland habitat.
- ✓ Improved roosting, nesting, and foraging habitat for migratory birds.
- ✓ Increased plant diversity and abundance.
- ✓ Soften hardened shorelines and reduce sediment loads.
- ✓ Provide vegetated buffer riparian zones.
- ✓ Water quality improved through increased connectivity and restoration of natural stream geomorphology.
- ✓ Increase migratory fish habitat.
- ✓ Replace invasive species with native species.

Tentatively Selected Plan Design



HRE- Westchester County Center

Harlem River, East River, Long Island Sound Planning Region



★ Westchester County Center
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- The Westchester County Center site is bounded by the southbound lanes of the Bronx River Parkway to the west, the Metro North right-of-way to the east, and the Westchester County Center East Parking lot to the south, with large tracts of maintained lawn with trees. The topography is generally flat with the Bronx River flowing through the middle of the site. The only notable change in elevation is along the eastern boundary of the site where the embankment for the rail line rises about twenty to thirty (20-30) feet.
- Two tributaries: the Manhattan Brook and the Fulton Brook flow into the Bronx River at this site .
- Existing wetlands include thin, sparsely vegetated strips of emergent vegetation along the banks, and a few pockets of emergent species along a gas line next to the eastern boundary adjacent to the rail line. In the lower half of the site, along the western bank, larger pockets of emergent wetlands occur on a shelf that is of lower elevation.
- The majority of the uplands on site consist of flat, maintained park and right-of-way lawns with single or clustered trees. Adjacent to the banks, **thick stands of Japanese knotweed and numerous vines dominate**. Along the easternmost portion of the site, a thin strip of woodlands occurs. Within these woodlands, there appear to be pockets of wetlands and potential vernal pool habitat.
- The river has a moderate flow with a mostly sandy bottom. It is generally shallow with some intermittent deep pools. Several mudflats and sparsely vegetated **sediment deposits** were observed; a large deposit, collecting some **garbage and debris** is located just north of the Fulton Brook.
- Sediment staining on vegetation, wrack lines, and other hydrologic indicators implies that this portion of the River is subject to **strong and high flows during storm events**.
- The river's **vertical banks** show sign of **active erosion and are sparsely vegetated**. Only the extreme southernmost portion and northern portion of the site have armored banks.

Restoration Opportunities/Measures

- Invasive species removal and replacement with native plantings
- Select native plantings
- Emergent wetland creation
- Channel realignment with in-stream structures
- Installation of sediment basin
- Installation of channel plug with native plantings
- Path creation
- Shoreline softening
- Bed restoration
- Improves migratory bird habitat
- Hydrologic connectivity
- Improve flow regime

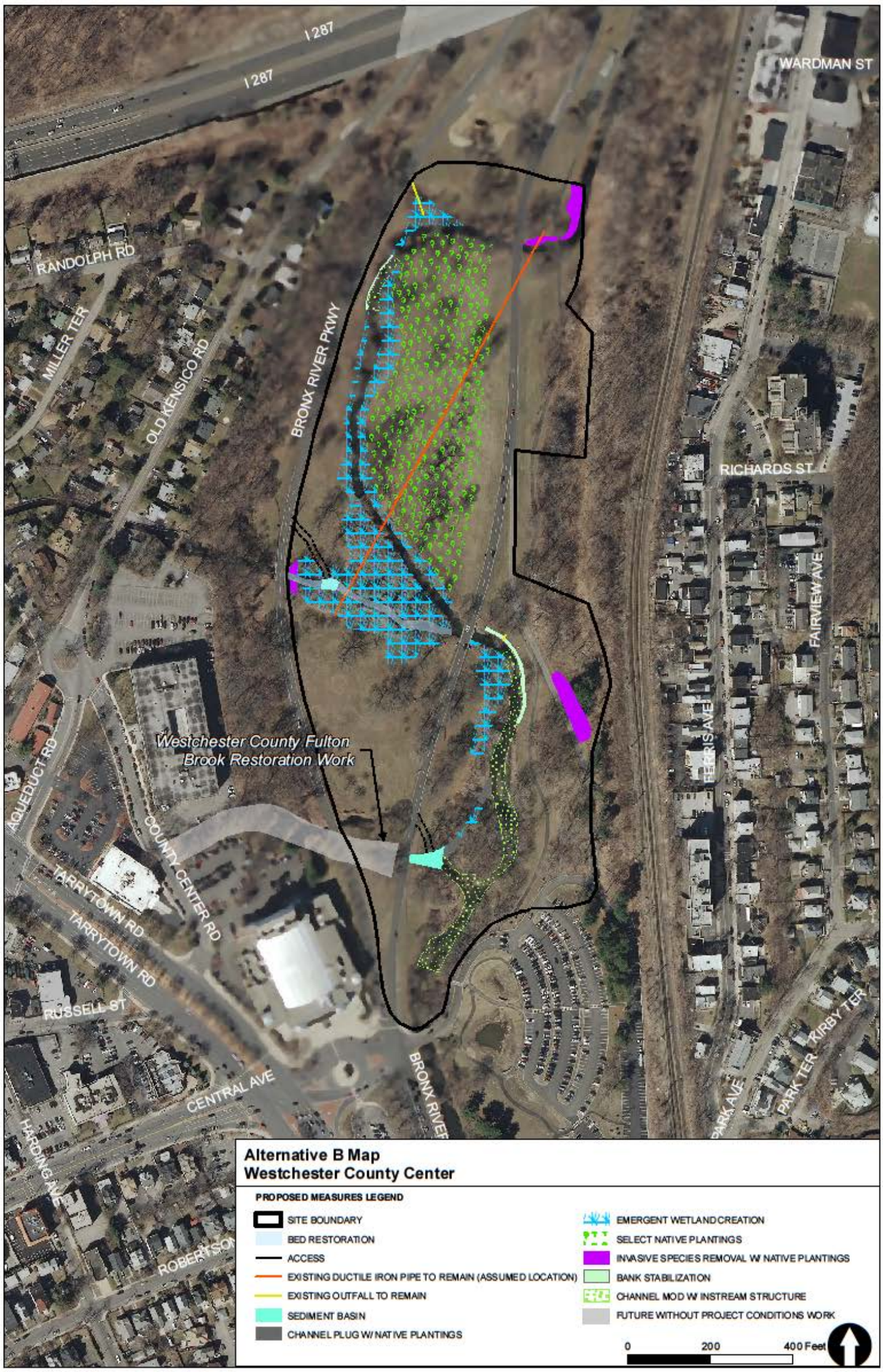
Alternative	A	B	C
Description	✓ Realignment of river channel (4.79 ac) and section of Manhattan Brook, with excavation and replacement of bed material, construction of instream cross vanes ✓ Creation of emergent wetlands along both shores of the Bronx River and the Manhattan Brook. ✓ Construction of in-stream sediment basins in the Manhattan Brook and at the Fulton Brook confluence with the Bronx River. ✓ Construction of channel plugs at the upstream and downstream ends of the channel on the east side of the island. Planting of upland vegetation on the plugs. ✓ Native planting of upland trees and shrubs along the west side of the Parkway northbound lanes (~3.45 ac). ✓ Removal of invasive vegetation at two locations along the eastern boundary of the site, and replacement with select native vegetation (0.26 ac). ✓ Creation emergent wetlands along the east and west banks of the channel (4.79 ac). ✓ Construction of a 500-foot-long paved path to divert pedestrian traffic away from emergent wetlands creation.	✓ Channel modification (0.83 ac), excavation and replacement of bed material, and installation of 10 in-stream cross vanes and 6 J-hooks ✓ Creation of emergent wetlands along both shores of the Bronx River and the Manhattan Brook. ✓ Construction of in-stream sediment basins in the Manhattan Brook and at the Fulton Brook confluence with the Bronx River. ✓ Construction of channel plugs at the upstream and downstream ends of the channel on the west side of the island will shift the Fulton Brook confluence to the east. ✓ Native planting of upland trees and shrubs along the west side of the Parkway northbound lanes (~3.7 ac). ✓ Removal of invasive vegetation at two locations along the eastern boundary of the site and Manhattan Brook. Native planting along channel (0.28 ac). ✓ Creation emergent wetlands along the east and west banks of the channel. ✓ Construction of a 500-foot-long paved path to divert pedestrian traffic away from emergent wetlands creation. ✓ Bank stabilization on the west bank with a tiered rock slope, and on the east bank with a stacked rock wall (285 lf).	✓ Creation of emergent wetlands along both shores of the Bronx River and the Manhattan Brook. ✓ Construction of in-stream sediment basins in the Manhattan Brook and at the Fulton Brook confluence with the Bronx River. ✓ Native planting of upland trees and shrubs along the west side of the Parkway northbound lanes (~3.45 ac). ✓ Removal of invasive vegetation at two locations along the eastern boundary of the site and Manhattan Brook. Native planting along channel (0.28 ac). ✓ Creation emergent wetlands along the east and west banks of the channel (2.64 ac). ✓ Construction of a 500-foot-long paved path to divert pedestrian traffic away from emergent wetlands creation. ✓ Bank stabilization on the west bank with a tiered rock slope, and on the east bank with a stacked rock wall (285 lf). ✓ Removal of debris from the upstream portion of the island (0.07 ac).
Average Annual Functional Capacity Units (AAFCUs)	9.64	7.26	6.11
Project Cost	$24,560,000	$14,520,000	$13,490,000
Annual Cost	$940,870	$555,590	$515,570
Average Cost/AAFCU	$97,580	$76,540	$84,350

Significance of Restoration in the Region and at the Site

- ✓ Fulfills HRE mission by promoting Target Ecosystem Characteristics by increasing /improving wetlands, tributary connections, public access, shoreline and shallows, and habitats for fish, crabs and lobsters.
- ✓ Proposed restoration designed to compliment future Westchester County restoration actions at adjacent Fulton Brook.
- ✓ Restoration action designed to act in concert with viewscapes of the Bronx River Parkway.
- ✓ Improved habitat quality and water quality
- ✓ Improved flow regime
- ✓ Increased native biodiversity through wetlands creation
- ✓ Secondary benefit of increased flood control value through wetlands creation
- ✓ Created forested wetlands may provide a potential habitat/roosting resource for endangered bat species, if present.
- ✓ Reduction of invasive plant species
- ✓ Improved public access

** Alternatives A and B are the "Best Buy Plans"; however, Alternative B is the most cost effective

Tentatively Selected Plan Design



Westchestergov.com

HRE- Metromedia Tract

Hackensack River, Hackensack Planning Region

★ Metromedia Tract
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- The Hackensack Meadowlands is an ecologically significant wetlands complex in the **heavily industrialized** and densely populated NY Bight region that drains approximately 200 square miles of the Hackensack River basin.
- Significant pressure to continue to fill the remaining 8,500 acres of open waters and wetlands for industrial, commercial and residential use has greatly **fragmented** this wetlands complex. The Metromedia tract is an approximately 67-acre site within the Meadowlands, generally of **poor habitat value** that is largely **overrun by *phragmites australis***.
- The Meadowlands support more than 7 dozen species of special interest or listed fish and bird species; they serve as important open space for migratory birds and provide flood storage. Further **losses of wetlands** and open space would lead to the continued decline of fish and wildlife populations in a heavily urbanized area where little such habitat remains.

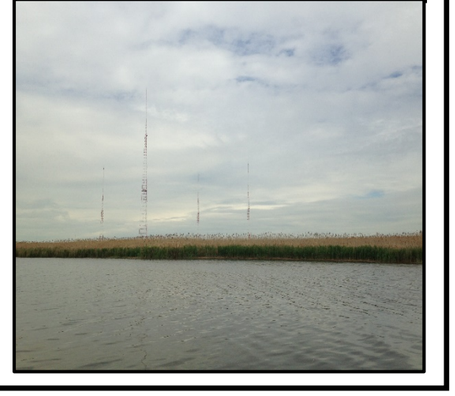
Restoration Opportunities/Measures

- Emergent wetland creation (Low Marsh, High Marsh)
- Forested scrub shrub wetland creation
- Invasive species removal and native plantings
- Bank stabilization
- Coastal Maritime Forest
- Habitat for fish, crabs and lobster
- Secondary benefits of water quality improvements
- Public education/access

Alternative	A	B	C
Description	✓ Reconnect fragmented areas within the parcel, introduce new tidal channels and make improvements to the existing channels. ✓ Create approximately 50.6 acres of low marsh, 4.1 acres of high marsh, 3.5 acres of scrub-shrub and 1.1 acres of maritime upland ✓ Removal of approximately 38,000 cy of excavated material to an upland disposal facility in order to remove the top 0.6 inches of invasive root mass. ✓ A 1-ft cap of clean soil growing medium is required at high marsh elevations in order to prevent invasive recolonization.	✓ Reconnect fragmented areas within the parcel, introduce new tidal channels and make improvements upon the existing channels. ✓ Create approximately 43.1 acres of low marsh, 4.5 acres of high marsh and 11.8 acres of scrub-shrub ✓ Removal of approximately 63,000 cy of excavated material to an upland disposal facility in order to remove the top 0.6 inches of invasive root mass. ✓ A 1-ft cap of clean soil growing medium is required at high marsh elevations and above in order to prevent invasive recolonization.	✓ Reconnect fragmented areas within the parcel, introduce new tidal channels and make improvements upon the existing channels. ✓ Create approximately 50.6 acres of low marsh, 4.1 acres of high marsh, 3.5 acres of scrub-shrub and 1.1 acres of maritime upland ✓ Removal of approximately 74,000 cy of excavated material to an upland disposal facility to remove the top 0.6 inches of invasive root mass. ✓ A 1-ft cap of clean soil growing medium is required at high marsh elevations and above in order to prevent invasive recolonization.
Average Annual Functional Capacity Units (AAFCUs)	187.11	202.72	198.37
Total Project Cost	$32,510,000	$49,800,000	$36,600,000
Average Annual Cost	$1,285,268	$1,968,821	$1,446,965
Average Cost/AAFCU	$6,870	$9,710	$7,300

Significance of Restoration in the Region and at the Site

- ✓ The restoration of the Metromedia Tract will contribute greatly to the joint effort among a coalition of public interest groups, local, state and Federal agencies and academia to restore and/or enhance the remaining 8,500 acres of open water and wetlands.
- ✓ Once the Metromedia Tract is restored, it will combine with an adjacent previously restored tract to create a contiguous connected expanse of approximately 200 acres.
- ✓ The Meadowlands are located within the Atlantic Flyway, a significant coastal pathway for migratory birds; the wetlands provide food and resting ground for hundreds of migratory bird species as well as breeding habitat for more than 60 resident bird species. Numerous juvenile fish species depend on the Meadowlands for nursery habitat
- ✓ The only other large estuarine wetlands complex in the NY Metropolitan area is the Jamaica Bay Wildlife Refuge, another significant restoration concern within the HRE study area.



Tentatively Selected Plan Design

HRE- Meadowlark Marsh

Hackensack River, Hackensack Planning Region

★ Meadowlark Marsh
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- The Hackensack Meadowlands is an ecologically significant wetlands complex in the heavily industrialized and densely populated NY Bight region that drains approximately 200 square miles of the Hackensack River basin.
- Significant pressure to continue to fill the remaining 8,500 acres of open waters and wetlands for industrial, commercial and residential use has greatly **fragmented this wetlands complex**. Meadowlark Marsh is an approximately 85-acre site within the Meadowlands, generally of **poor habitat value** that is largely **overrun by *phragmites australis***.
- **Tidal flow into the interior of the site is impeded by crushed and/or blocked culverts**.
- The Meadowlands support more than 7 dozen species of special interest or listed fish and bird species; they serve as important open space for migratory birds and provide flood storage. Further losses of wetlands and open space would lead to the continued decline of fish and wildlife populations in a heavily urbanized area where little such habitat remains.

Restoration Opportunities/Measures

- Emergent wetland creation (Low Marsh, High Marsh)
- Forested scrub shrub wetland creation
- Invasive species removal and native plantings
- Bank stabilization
- Coastal Maritime Forest
- Habitat for fish, crabs and lobster
- Secondary benefits of water quality improvements
- Public education/access

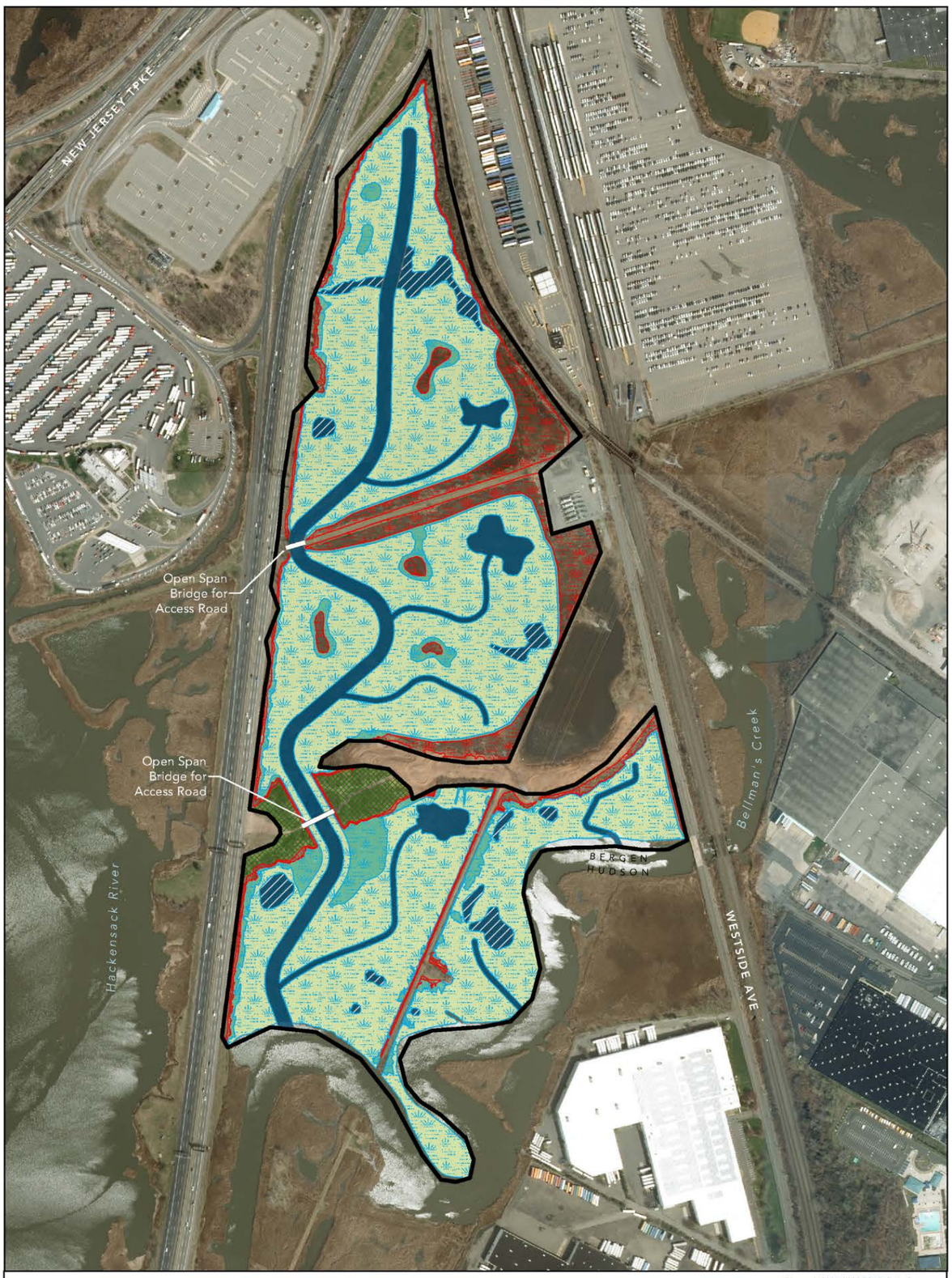
Alternative	A	B	C
Description	✓ Improvements and restoration to existing wetlands to include removal of debris, historic fill and invasive vegetation and re-introducing proper tidal inundation with the development of new, deepened and wider, secondary and tertiary channels (8,319 lf). Construction of 2 open span bridges to maintain access roads over proposed tidal channels. Restoration of low marsh (57.78 ac) by excavation and removal of 0.5 feet of sediment and *Phragmites* root mat and replanting with native species. Creation of high marsh by importing clean planting substrate (sand) and replanting with native species (6.89 ac). ✓ Debris, fill and invasive vegetation removal and planting of native trees and shrubs (2.33 ac). ✓ Restoration/creation of riparian shrub and wooded area (~2.31 ac). ✓ Removal of invasive plant species and creation of habitat connectivity along new mudflats/tidal channels (~12.33 ac) and existing habitat (2.58 ac). ✓ Excavation of top 0.5 ft of sediment plant (~ 46,609 cy), off-site disposal to remove any surface soil/roots of the invasive *Phragmites*. Excavation of additional sediments (120,584 cy) and off-site disposal. Importation of clean planting substrate (sand) to create high marsh areas (3,080 cy).	✓ Re-establishment of degraded portion of wetlands by re-introduction of proper tidal inundation with the development of new, deepened and wider, secondary and tertiary channels (7,086 lf). Invasive species removal and native species planting of low marsh (60.96 ac) and high marsh (5.01 ac). Installation of 1 culvert to maintain gas pipeline access road over proposed tidal channel. ✓ Forested and Scrub Shrub Wetlands – Debris, fill and invasive vegetation removal and planting with native trees and shrubs (2.33 ac). ✓ Restoration/creation of riparian shrub and wooded area (2.44 ac). ✓ Removal of invasive plant species and creation of habitat connectivity along new mudflats/tidal channels (~10.33 ac) and existing habitat (3.28 ac). ✓ Excavation of additional sediments (102,639 cy) and off-site disposal.	✓ Re-establishment of degraded portion of wetlands. Invasive species removal and native species planting of low marsh (60.21 ac) and high marsh (4.64 ac) by excavation and removal of 0.5 feet of sediment and *Phragmites* root mat and replanting with native species. Installation of 1 culvert to maintain gas pipeline access road over proposed tidal channel. ✓ Debris, fill and invasive vegetation removal and planting of native trees and shrubs to restore and create habitat (1.89 ac). ✓ Restoration/creation of maritime forest habitat through debris removal and native plantings (3.21 ac). ✓ Removal of invasive species to restore existing mudflats/tidal channels and associated habitats within the interior marsh (~12.72 ac). ✓ No sediment removal.
Average Annual Functional Capacity Units (AAFCUs)	306.20	307.25	294.22
Total Project Cost	$63,700,000	$56,400,000	$41,660,000
Annual Cost	$2,457,320	$2,191,650	$1,618,870
Average Cost/AAFCU	$8,080	$7,130	$5,500

Alternatives B and C were “Best Buy Plans” and Alternative C is the most cost-effective plan

Significance of Restoration in the Region and at the Site

- ✓ The restoration of Meadowlark Marsh will contribute greatly to the joint effort among many public interest groups, local, state and Federal agencies and academia to restore and/or enhance the remaining 8,500 acres of open water and wetlands.
- ✓ Once Meadowlark Marsh is restored, it will combine with the adjacent and previously restored Bellman’s Creek Marsh to create a contiguous expanse of approximately 100 acres.
- ✓ The Meadowlands are located within the Atlantic Flyway, a significant coastal pathway for migratory birds; the wetlands provide food and resting ground for hundreds of migratory bird species as well as breeding habitat for more than 60 resident bird species. Numerous juvenile fish species depend on the Meadowlands for nursery habitat
- ✓ The only other large estuarine wetlands complex in the NY Metropolitan area is the Jamaica Bay Wildlife Refuge, another significant restoration concern within the HRE study area.

Tentatively Selected Plan Design



Source: NJGIN NJ 2015 Orthoimagery

Alternative A Map
Meadowlark Marsh, New Jersey Meadowlands

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- FORESTED AND SCRUB/SHRUB WETLAND
- EMERGENT WETLAND (HIGH MARSH)
- EMERGENT WETLAND (LOW MARSH)
- COASTAL AND MARITIME FOREST
- EXISTING HABITAT FOR FISH, CRAB AND LOBSTER
- HABITAT FOR FISH, CRAB AND LOBSTER

0 250 500 Feet

KEY MAP

HRE- Oak Island Yards (Deferred Lower Passaic River Site)

Passaic River, Lower Passaic Planning Region

★ Oak Island Yards
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- Oak Island Yards contains Newark's largest extent of tidal marsh, tidal creeks, and palustrine emergent wetland.
- The **dominant vegetative species are invasive** *Phragmites*, mugwart and sumac. The substrate type is predominantly fine (sand/silt/clay) with some coarse cobble/gravel. Hydrologic environments include tidal, subtidal, and intertidal.
- The water regime is permanently and intermittently flooded with a drainage pathway on the east-west southern property.
- This site is located along approximately 900 feet of Newark Bay and is bordered by a shipping container yard, railroad tracks, and a HESS petroleum tank farm. A semi-tidal ditch with a tide gate is located adjacent to the site, below the railroad track embankment on the southeast border of the site. Since the date of the project mapping aerial photo, the shipping container storage yard has been extended southeast to within approximately 100 feet of the pond and runs the full width of the northwestern boundary of the site. Also, a considerable amount of **rock and gravel fill** has been placed onsite since the aerial photo was taken. Rock fill extends from the shipping containers all the way to the river along the southeast portion of the site and has also been placed in the river. The remainder of the site is vegetated.

Restoration Opportunities/Measures

- USEPA Remedial Action followed by restoration
- Emergent wetland creation (Low Marsh, High Marsh)
- Forested scrub shrub wetland creation
- Invasive species removal and native plantings
- Bank Stabilization
- Coastal Maritime Forest
- Habitat for fish, crabs and lobster
- Secondary benefits of water quality improvements
- Public education/access
- Coordinated comprehensive remediation and restoration with Urban Waters Federal Partnership

Alternative	A	B	C
Description	✓ Restoration and creation of low marsh (7.13 ac). ✓ Creation of new tidal channels (1,821 lf). ✓ Debris, fill and invasive vegetation removal and planting of native trees and shrubs (4.0 ac).	✓ Restoration and creation of low marsh (5.97 ac).0 ✓ Creation of new tidal channels (1,987 lf). ✓ Planting of emergent high marsh vegetation (1.48 ac). ✓ Debris, fill and invasive vegetation removal and planting of native trees and shrubs (0.84 ac). ✓ Stabilization of riparian forest by removing invasive species and planting with native vegetation (1.86 ac). ✓ Debris removal and preservation of natural bank vegetation (0.33 ac). ✓ Invasive plant removal and creation of habitat connectivity along new mudflats/tidal channels (1.31 ac) and existing habitat (1.40 ac). ✓ Improved public access to water (3,711 lf), and construction of overlook pier and dock for kayak and canoe launch (0.04 ac). ✓ Deepening and/or capping of contaminated sediment will be required conducted as part of the EPA Superfund Program.	✓ Restoration and creation of low marsh (2.43 ac). ✓ Creation of new tidal channels (1,369 lf). ✓ Planting of emergent high marsh vegetation (5.66 ac). ✓ Debris, fill and invasive vegetation removal and planting of native trees and shrubs (0.84 ac). ✓ Stabilization of riparian forest by removing invasive species and planting with native vegetation (1.86 ac). ✓ Debris removal and preservation of natural bank vegetation (0.33 ac). ✓ Invasive plant removal and creation of habitat connectivity along new mudflats/tidal channels (0.54 ac) and existing habitat (1.55 ac). ✓ Improved public access to water (3,711 lf), and construction of overlook pier and dock for kayak and canoe launch (0.04 ac). ✓ Deepening and/or capping of contaminated sediment will be required as part of the EPA Superfund Program.
Avg Annual Functional Capacity Units (AAFCUs)	**30.77**	29.03	29.54
Project Cost	**$29,640,000**	$29,960,000	$28,160,000
Avg Annual Cost	**$1,134,140**	$1,146,380	$1,180,080
Average Cost/AAFCU	**$36,860**	$39,490	$36,480

Alternatives A and C were "Best Buy Plans" and Alternative A can be justified as TSP

Significance of Restoration in the Region and at the Site

- ✓ Creates/restores habitat (wetlands) lost, improves hydrology and functionality of site.
- ✓ Restoration would improve tidal flow and improve water quality through nutrient update and exchange.
- ✓ Habitats will provide secondary benefits of flood control to a flood prone area.
- ✓ T&E species habitat will be expanded; stabilizes ecologically significant urban wetlands/riparian areas.
- ✓ Advancement of TECs and Regional Goals: Alternative A restores ~5acres more low marsh
- ✓ Environmental Justice: restoration in underserved communities of Newark NJ that have been significantly impacted
- ✓ Improves recreational opportunities.

Tentatively Selected Plan Design

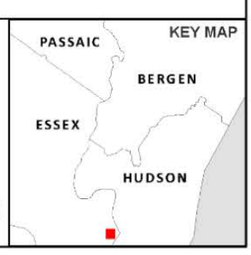
Alternative A Map
Oak Island Yards, Newark, New Jersey (Deferred Site)

Source: NJGIN NJ 2015 Orthoimagery

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- SHORELINE STABILIZATION
- PUBLIC ACCESS
- EMERGENT WETLAND (HIGH MARSH)
- EMERGENT WETLAND (LOW MARSH)
- FORESTED AND SCRUB/SHRUB WETLAND
- COASTAL AND MARITIME FOREST
- EXISTING HABITAT FOR FISH, CRAB AND LOBSTER
- HABITAT FOR FISH, CRAB AND LOBSTER

KEY MAP



Note: This site is a "Deferred Site" and would be restored following remediation as outlined in US EPA's Record of Decision (11 March 2016) of dredging and capping of the lower Passaic River.

0 100 200 Feet

HRE- Kearny Point (Deferred Lower Passaic River Site)

Passaic River, Lower Passaic Planning Region

★ Kearny Point
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- The Kearny Point restoration site is a **decommissioned industrial facility** built entirely of **historic fill dominated by invasive species**. It contains a forested area on the eastern half of the site which is the location of an active bald eagle nest.
- This site consists of a 300 to 1,000 foot wide area located along approximately 3,000 feet of the northern shore of Newark Bay in Kearny, NJ.
- The surrounding environment consists entirely of **commercial develo**pments and roadways.
- Adjacent commercial developments include Hudson County Correctional Center and River Terminal, which is a massive distribution warehouse that includes the former site of a Western Electric's Kearny Works manufacturing plant and the Kearny Yard of Federal Shipbuilding and Drydock Company.
- Within the site boundary, half of the site is an active construction soil sorting site and half of the site is an undeveloped forested area.

Restoration Opportunities/Measures

- USEPA Remedial Action followed by Restoration
- Emergent wetland creation (Low Marsh, High Marsh)
- Forested scrub shrub wetland creation
- Invasive species removal and native plantings
- Bank stabilization
- Coastal Maritime Forest
- Habitat for fish, crabs and lobster
- Secondary benefits of water quality improvements
- Public education/access

Alternative	A	B	C
Description	✓ Re-establishment of existing low marsh along the eastern portion of the point and creation of new marsh along the western portion of the point. Creation of native emergent low marsh (25.98 ac). ✓ Debris and invasive vegetation removal and planting native emergent high marsh vegetation (0.41 ac). ✓ Debris, fill and invasive vegetation removal and planting with native trees and shrubs (0.99 ac). ✓ Stabilization of riparian forest and protection of area for continued use by bald eagles. Invasive plant species removal and planting with native vegetation to create a forest accessible to avian migrants and residents (6.55 ac). ✓ Debris removal and preservation of natural bank vegetation of existing bank stabilization (1,724 lf). ✓ Creation of new tidal channels (1.82 ac). ✓ Creation of an elevated path system that spans several habitats and that leads to a public overlook (1,614 lf). ✓ Deepening and/or capping of contaminated sediment will be required conducted as part of the EPA Superfund Program.	✓ Re-establishment of existing low marsh along the eastern portion of the point and creation of new marsh along the western portion of the point. Creation of native emergent low marsh (18.62 ac). ✓ Debris and invasive vegetation removal and planting native emergent high marsh vegetation (2.18 ac). ✓ Debris, fill and invasive vegetation removal and planting with native trees and shrubs (2.33 ac). ✓ Stabilization of riparian forest and protection of area for continued use by bald eagles. Invasive plant species removal and planting with native vegetation to create a forest accessible to avian migrants and residents (11.28 ac). ✓ Debris removal and preservation of natural bank vegetation of existing bank stabilization (1,771 lf). ✓ Creation of new tidal channels (1.81 ac). ✓ Creation of an elevated path system that spans several habitats and that leads to a public overlook (~ 3,097 lf). ✓ Deepening and/or capping of contaminated sediment will be required conducted as part of the EPA Superfund Program.	✓ Re-establishment of existing low marsh along the eastern portion of the point and creation of new marsh along the western portion of the point. Creation of native emergent low marsh (8.8 ac). ✓ Debris and invasive vegetation removal and planting native emergent high marsh vegetation (2.5 ac). ✓ Stabilization of riparian forest and protection of area for continued use by bald eagles. ✓ Creation of new tidal channels (0.49 ac). ✓ Creation of an elevated path system that spans several habitats and that leads to a public overlook (4,455 lf). ✓ Deepening and/or capping of contaminated sediment will be required conducted as part of the EPA Superfund Program.
Average Annual Functional Capacity Units (AAFCUs)	145.00	135.01	125.27
Project Cost	$81,650,000	$75,520,000	$57,790,000
Annual Cost	$3,172,840	$2,934,640	$2,245,670
Avg Cost/AAFCU	$21,880	$21,740	$17,930

Alternatives A and C were “Best Buy Plans”, Alternative C most cost-effective

Significance of Restoration in the Region and at the Site

- ✓ Leverages prior and ongoing regional wetland restoration and enhancements within watershed.
- ✓ Restoration would improve tidal flow and improve water quality through nutrient update and exchange, improve connectivity of habitats.
- ✓ Habitats will provide secondary benefits of flood control to a flood prone area.
- ✓ T&E species habitat will be expanded; stabilizes ecologically significant urban wetlands/riparian areas.
- ✓ Kearny Point restores significant acreage of wetland habitat to achieve TEC goals
- ✓ Environmental Justice: Lower Passaic River damages from impacts and loss of habitat to underserved community
- ✓ Improves recreational opportunities.

Tentatively Selected Plan Design

Alternative C Map
Keamy Point, Kearny, New Jersey (Deferred Site)

Source: NJGIN NJ 2015 Orthoimagery

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- PUBLIC ACCESS
- BANK STABILIZATION
- FORESTED WETLAND & SCRUB SHRUB WETLAND
- COASTAL AND MARITIME FOREST
- EMERGENT WETLAND (HIGH MARSH)
- EMERGENT WETLAND (LOW MARSH)
- EXISTING HABITAT FOR FISH, CRAB AND LOBSTER
- HABITAT FOR FISH, CRAB AND LOBSTER

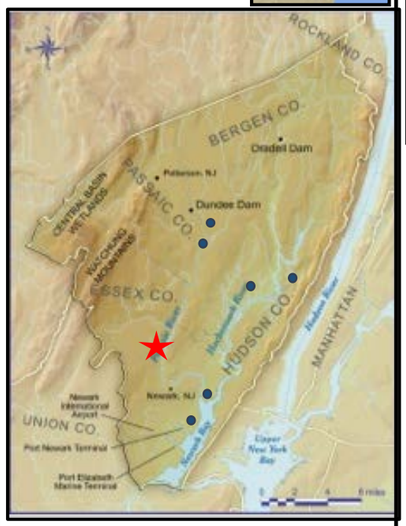
Note: This site is a "Deferred Site" and would be restored following remediation as outlined in US EPA's Record of Decision (11 March 2016) of dredging and capping of the lower Passaic River.

0 200 400 Feet

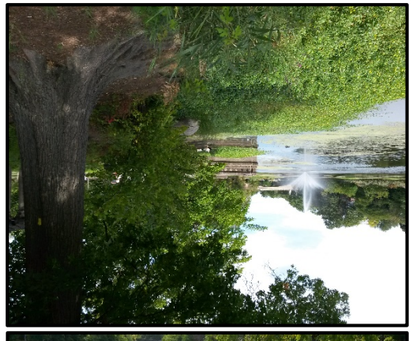
KEY MAP

HRE- Essex County Branch Brook Park

Passaic River, Lower Passaic Planning Region



★ Essex County Branch Brook Park
● Other Restoration Sites in Region



Baseline Conditions and Water Resource Problems (EPW Report)

- This site contains of approximately 4,200 linear feet of Branch Brook and adjacent parkland in Newark, NJ.
- The surrounding environment consists primarily of commercial and residential developments and roadways.
- The site includes a day-lighted section of Branch Brook as well as 3 larger pond features (Branch Brook Lake, Clarks Pond, and an unnamed pond) that were created using weirs.
- Branch Brook Park was established by Essex County as the first county park in the nation.
- The park is notable as having the largest collection of cherry blossom trees in the United States.
- The park is four miles long and a quarter mile wide and includes open grassland with patches of forest stands that line Branch Brook.
- The stream and adjacent forest areas experience considerable amounts of **anthropogenic trash**.
- The ponds suffer from **algal blooms and eutrophication** indicative of excess nutrient inputs.
- The stream is characterized by the presence of **invasive vegetation.**

Restoration Opportunities/Measures

- Emergent wetland creation (Low Marsh, High Marsh)
- Forested scrub shrub wetland creation
- Invasive species removal and native plantings
- Bank stabilization
- Sediment basins
- Shoreline softening
- Secondary benefits of water quality improvements
- Public education/access

Alternative	A	B	C
Description	✓ Debris, fill, pipes, and invasive vegetation removal and planting of native trees and shrubs (26.3 ac). ✓ Invasive plant removal with native plantings to create a riparian forest accessible to avian migrants and residents. ✓ Tributary Connections – Stream Naturalization and Clearing – Decrease channelization in 2.04 acres to restore freshwater stream to provide a range of quality habitats to aquatic organisms. ✓ Channel dredging to restore freshwater stream (23.52 ac). ✓ Floodplain erosion control through management of steep slopes, planting of understory vegetation, and control of surface runoff and foot traffic (8.25 ac). ✓ Planting of native vegetation to reduce damage to habitat and water quality by Canada geese (29.98 ac). ✓ Installation of sediment basins and clean silt from existing storm drains and plant wetland (3.8 ac). ✓ Support to ongoing public access improvements by installing 17 interpretative signs, improving access to the water and creating linkages to other recreational areas, as well as providing increased opportunities for boating, hiking, education, and passive recreation	✓ Remove debris and invasive vegetation and increase the density of 22.9 acres of wetland and riparian native vegetation ✓ Remove invasive plant species and plant with native vegetation to create a riparian forest accessible to avian migrants and residents. ✓ Channel dredging to restore freshwater stream and floodplain (17.07 ac). ✓ Floodplain erosion control through management of steep slopes, planting of understory vegetation, and control of surface runoff and foot traffic (8.25 ac). ✓ Planting of native vegetation to reduce damage to habitat and water quality by Canada geese (29.98 ac). ✓ Installation of sediment basins and clean silt from existing storm drains and plant wetland (5.32 ac). ✓ Install retention basins and plant wetland vegetation ✓ Support to ongoing public access improvements by installing 17 interpretive signs.	✓ Invasive plant removal and planting of native vegetation (13.7 ac).. ✓ Channel dredging to restore freshwater stream and floodplain (23.52 ac). ✓ Debris removal and erosion control on the banks and shorelines with stormwater control and planting native understory vegetation along (10,320 lf). ✓ Support to ongoing public access improvements through development of 12 new public interpretive signs.
Average Annual Functional Capacity Units (AAFCUs)	**142.81**	103.30	99.70
Total Project Cost	**$74,690,000**	$74,390,000	$21,890,000
Average Annual Cost	**$2,898,930**	$2,887,290	849,610
Average Cost/AAFCU	**$20,300**	$27,950	$8,520

Alternatives C and A are the “Best Buy Plans” and Alternative C is the most cost-effective.

Significance of Restoration in the Region and at the Site

- ✓ Shoreline stabilization will reduce erosion and turbidity in waters and improve aquatic habitat.
- ✓ Restoration and enhance actions would reduce nutrient inputs to the waters and increase opportunity for nutrient transformation.
- ✓ First County Park Provides opportunities for public education/engagement.
- ✓ Shoreline stabilization and habitat improvements will provide secondary benefits of flood control to a flood prone area.
- ✓ Stabilizes ecologically significant urban wetlands/riparian areas.
- ✓ Advancement of TECs and Regional Goals
- ✓ Environmental Justice

Tentatively Selected Plan Design

Source: NJGIN NJ 2015 Orthoimagery

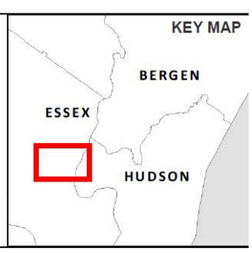
Alternative C Map
Essex County Branch Brook Park, Newark, New Jersey

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- INTERPRETIVE SIGNS
- SHORELINE SOFTENING
- CHANNEL DEEPENING
- INVASIVE SPECIES REMOVAL WITH NATIVE PLANTINGS
- GOOSE MANAGEMENT

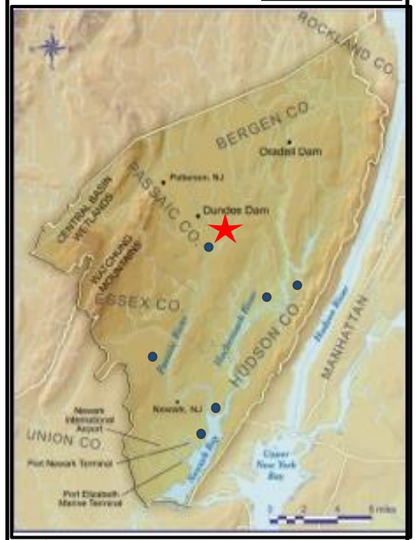
0 500 1,000 Feet

KEY MAP



HRE- Dundee Island Park/Pulaski Park

Passaic River, Lower Passaic Planning Region



★ Dundee Island Park
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- This site consists of approximately 2,370 linear feet of the western shoreline of the Lower Passaic River approximately 1.3 miles downstream of the Dundee Dam in Passaic, NJ.
- An inactive set of railroad tracks and right-of-way border the site to the west and north; a church and commercial properties border the site to the south.
- The City of Passaic has established Dundee Island Park within the site which includes a soccer field, benches, a playground, a boat launch and fish consumption advisory signage.
- Flood-driven **woody debris and floatable trash** have been deposited along the shore of the site.
- Large ash trees have been removed from the shoreline and bank is now dominated by i**nvasive Japanese knotweed**.
- Within the boundary of the site the bank of the Passaic River is **very steep and stabilized with rip-rap and concrete**.

Restoration Opportunities/Measures

- Invasive species removal/native species plantings
- Bank stabilization
- Secondary benefits of water quality improvements
- Public education/access

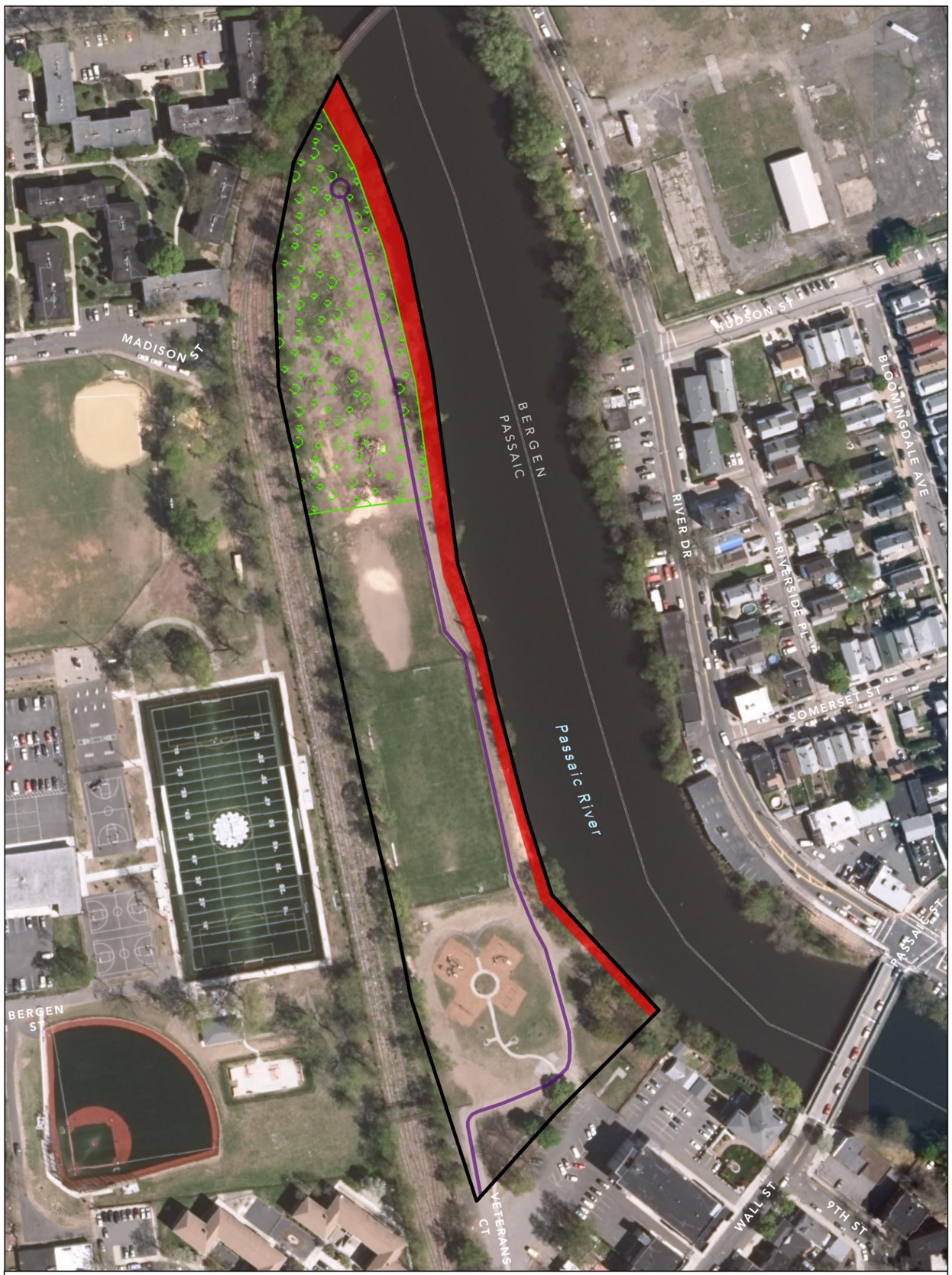
Alternative	A	B	C
Description	✓ Debris removal, natural bank vegetation preservation, bank stabilization and shoreline softening by planting willow stakes in the existing riprap stream bank (~0.71 ac). ✓ Restoration of riparian vegetation through removal of debris and invasive plant species and planting of native trees and shrubs (~1.23 ac). ✓ Support City of Passaic plans for public access improvements through development of site trail and enhancement of existing trail (~1,580 lf)	N/A	N/A
Average Annual Functional Capacity Units (AAFCUs)	**1.29**	N/A	N/A
Project Cost	**$2,720,000**	N/A	N/A
Average Cost/AAFCU	**$8,039**	N/A	N/A

* This project could be advanced with the Continuing Authorities Program (CAP) in conjunction with NJDEP, Trust for Public Land (TPL), County of Passaic and City of Passaic. The restoration would be a key component of the local plans for a community park following receipt of a NJDEP grant to TPL and additional local funding sources.

Significance of Restoration in the Region and at the Site

- ✓ Shoreline stabilization will reduce erosion and turbidity in waters.
- ✓ Shoreline stabilization and habitat improvements will provide secondary benefits of flood control to a flood prone area.
- ✓ T&E species habitat will be enhanced; stabilizes ecologically significant urban wetlands/riparian areas.
- ✓ Enhancement actions would reduce nutrient inputs to the waters and increase opportunity for nutrient transformation.
- ✓ Provides for additional public access and education opportunities.
- ✓ Advancement of TECs and Regional Goals
- ✓ Address Environmental Justice issues within Passaic River basin.

Tentatively Selected Plan Design



Source: NJGIN NJ 2015 Orthoimagery

Alternative A Map
Dundee Island Park/Pulaski Park, Passaic, New Jersey

PROPOSED MEASURES LEGEND

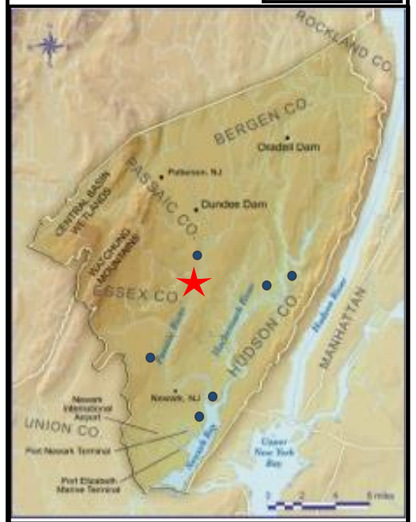
- SITE BOUNDARY
- BANK STABILIZATION / SHORELINE SOFTENING
- SELECT NATIVE PLANTINGS
- PUBLIC ACCESS

0 100 200 Feet

KEY MAP

HRE- Clifton Dundee Canal Green Acres Purchase

Passaic River, Lower Passaic Planning Region



★ Clifton Dundee Canal Green Acres
● Other Restoration Sites in Region

Baseline Conditions and Water Resource Problems

- This site consists of approximately 1,800 linear feet of the western shoreline of the Lower Passaic River downstream of the Dundee Dam in Clifton, NJ. Rt 21 and a commercial property border the landward side of the site.
- The City of Clifton has established Dundee Island Park within the site which includes a trail network, benches, interpretive signage and fish consumption advisory signage.
- This site includes the Safas property, which is subject to an **NJDEP environmental investigation/cleanup** (NJDEP case # E20050092). Large volumes of flood-driven **woody debris and floatable trash** has been deposited along the shore of the central portion of the site, immediately below a low, flat peninsula projecting out into the river.
- An ancient stone fish weir is present in the middle of the river between this site and the Semel Ave & River Road Parcel site. An **active vagrant campsite strewn with trash** was observed within the southern portion of the site near Ackerman Ave during the site visit.

Restoration Opportunities/Measures

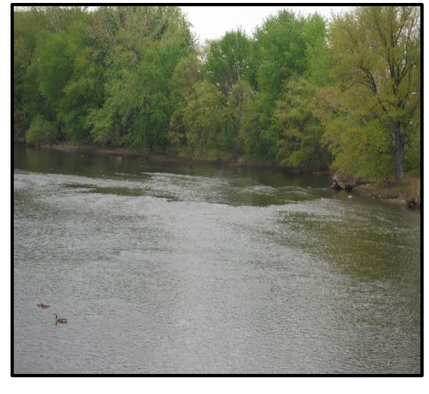
- Invasive species removal and native plantings
- Bank stabilization
- Secondary benefits of water quality improvements
- Public education/access

Alternative	A	B	C
Description	✓ Debris and invasive vegetation removal, re-grading, and planting of native emergent wetland (0.1 ac). ✓ Debris, fill and invasive vegetation removal and planting with native trees and shrubs to restore and create habitat for waterbirds (2.84 ac). ✓ Restoration and stabilization of riparian forest. Invasive species removal and planting with native vegetation to create a forest accessible to avian migrants and residents. Grading to improve hydrology and soil stability within the riparian zone (5.50 ac). ✓ Remove debris along stable shoreline (0.82 acres). ✓ Support Dundee Island Preserve plans for improvements to riparian floodplain by reconnecting riparian buffers and floodplains to the estuary to provide a range of quality habitats to aquatic organisms. ✓ Debris removal, improvement of shallow water habitat with incorporation and/or preservation of natural cobble and riffle structures (0.27 ac). ✓ Installation of sediment basin to treat stormwater runoff (0.11 ac). ✓ Support Dundee Island Preserve plans for improvements to public access. Creation of public trails through native vegetation habitat (1,081 lf), public overlook (0.01 ac), and public boat launch with access road.	✓ Debris and invasive vegetation removal, re-grading, and planting of native emergent wetland vegetation (0.1 ac). ✓ Remove invasive plant species and plant with native vegetation to create a forest accessible to avian migrants and residents. Conduct grading to provide proper hydrology and soil stability within the riparian zone (totaling 7.86 acres). ✓ Debris removal along stable shoreline (0.82 ac). ✓ Support Dundee Island Preserve plans for improvements to riparian floodplain by reconnecting riparian buffers and floodplains to the estuary to provide a range of quality habitats to aquatic organisms. ✓ Debris removal, improvement of shallow water habitat with incorporation and/or preservation of natural cobble and riffle structures (0.27 ac). ✓ Installation of sediment basin to treat stormwater runoff (0.11 ac). ✓ Support Dundee Island Preserve plans for improvements to public access. Creation of public trails through native vegetation habitat (1,081 lf) and public overlook (0.01 ac).	✓ Restoration and stabilization of riparian forest. Invasive species removal and planting with native vegetation to create a forest accessible to avian migrants and residents. Grading to improve hydrology and soil stability within the riparian zone (7.93 ac). ✓ Debris removal along stable shoreline (0.82 ac). ✓ Support Dundee Island Preserve plans for improvements to riparian floodplain by reconnecting riparian buffers and floodplains to the estuary to provide a range of quality habitats to aquatic organisms. ✓ Support Dundee Island Preserve plans for improvements to public access. Creation of public trails through native vegetation habitat (1,081 lf) and public overlook (0.01 ac).
Average Annual Functional Capacity Units (AAFCUs)	**14.43**	8.36	6.74
Project Cost	**$11,950,000**	$10,750,000	$9,530,000
Avg Annual Cost	**$457,250**	$411,330	$364,650
Average Cost/AAFCU	**$31,690**	$49,140	$54,180

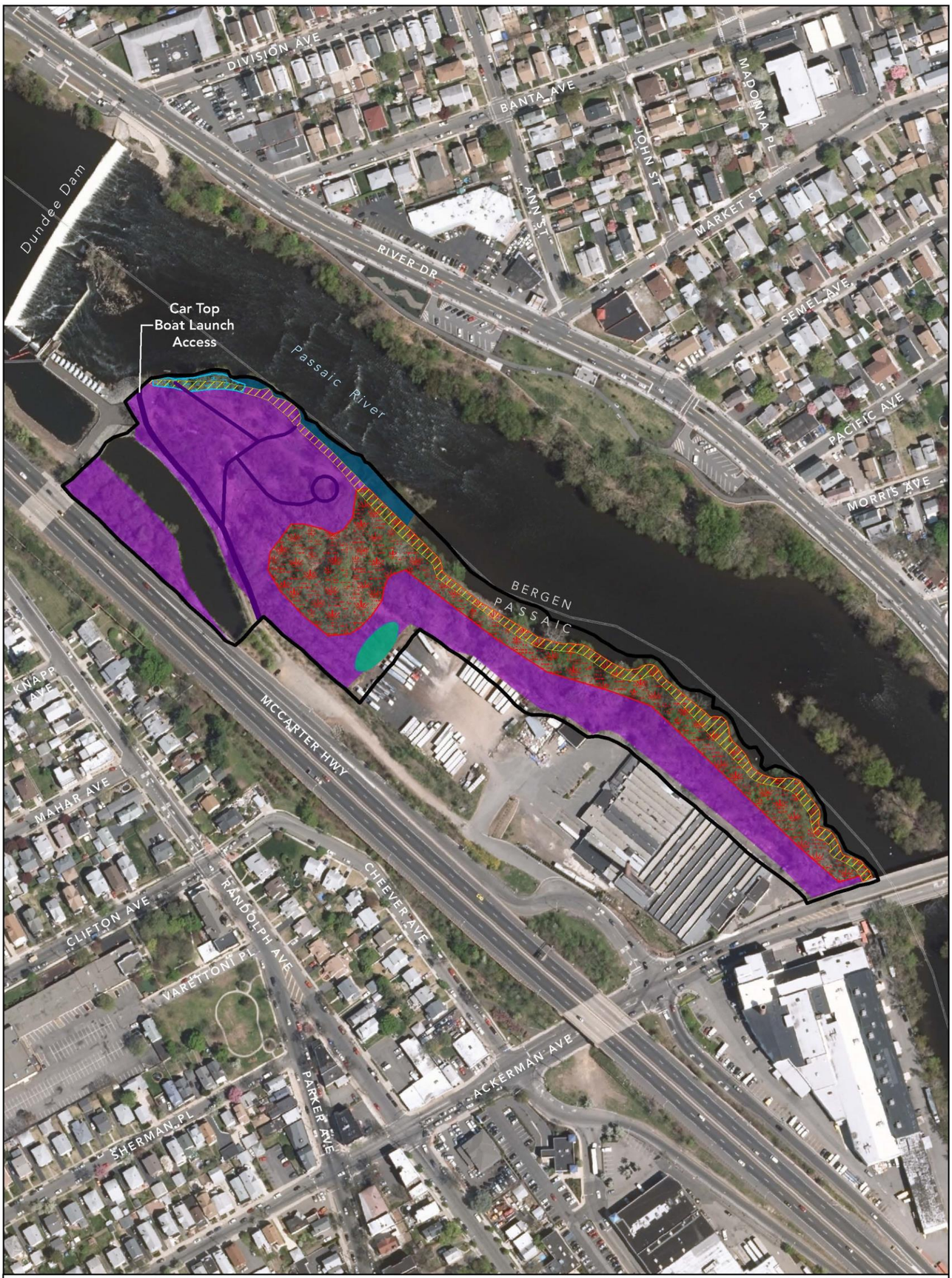
Alternative A is the “Best Buy Plan”

Significance of Restoration in the Region and at the Site

- ✓ Shoreline stabilization will reduce erosion and turbidity in waters.
- ✓ Restoration and enhancement actions would reduce nutrient inputs to the waters and increase opportunity for nutrient transformation.
- ✓ T&E species habitat will be enhanced; stabilizes ecologically significant urban wetlands/riparian areas.
- ✓ Shoreline stabilization and habitat improvements will provide secondary benefits of flood control to a flood prone area.
- ✓ Provides for additional public access and education opportunities.
- ✓ Advancement of TECs and Regional Goals
- ✓ Environmental Justice: Restoration and improvements to underserved communities



Tentatively Selected Plan Design



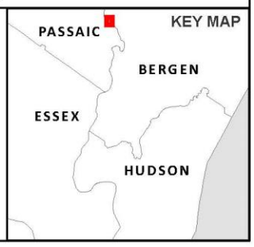
Source: NJGIN NJ 2015 Orthoimagery

Alternative A Map
Clifton Dundee Canal Green Acres Purchase and Dundee Island Preserve, Clifton, New Jersey

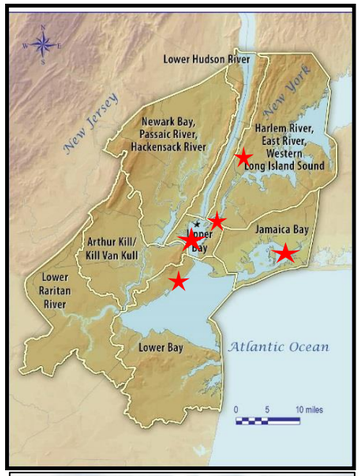
PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- PUBLIC ACCESS
- EMERGENT WETLAND
- FORESTED WETLAND & SCRUB SHRUB WETLAND
- DEBRIS REMOVAL
- HABITAT FOR FISH, CRAB AND LOBSTER
- INVASIVE SPECIES REMOVAL WITH NATIVE PLANTINGS
- SEDIMENT BASIN

0 125 250 Feet



HRE – SMALL SCALE OYSTER RESTORATION



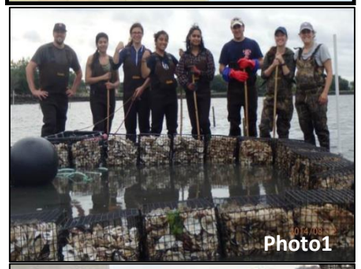


Photo1


Photo2


Photo3


Photo 4

Prior to European colonization, oysters and oyster reefs were key components of the estuarine habitat in HRE. It is believed that approximately 350 square miles of oyster beds were present in the HRE. Principal concentrations occurred long the Brooklyn, Manhattan, and Queens shorelines, Jamaica Bay, and Hudson and East Rivers.

Due to **overharvesting, pollution and habitat disturbances**, **oysters became practically non-existent** by the mid 20th Century. However, with the passage of the Clean Water Act and other environmental legislation, water quality has improved and limited isolated populations do exist in a few areas of the HRE. Initial pilot programs to restore oysters began in the early 2000s, such as the Oyster Restoration Research Partnership Program (ORRP), a partnership of over 30 not-for-profit organizations, Federal (including NYD), state and city agencies, scientists and citizens. ORRP initial programs , along with the NYCDEP, NY/NJ Baykeeper, NY Harbor School, etc. have determined that restored oysters and created oyster beds can survive in the HRE. However, oysters are sessile organisms and offspring are often dispersed into the current with little chance of resettlement. Thus, a more targeted oyster restoration effort, as proposed, in the HRE would promote and enhance the oyster recovery to attain the TEC Goal of 20+ acres of oyster beds by the year 2020 - as well as provide critical scientific information on how to restore oysters more efficiently in the future.

As part of the HRE, five sites were selected for oyster restoration throughout the estuary. The sites were selected based on past successes and/or to work in concert with other ecological improvements. The sites are generally along the shoreline in depths of water that range from 3-12 feet in depth.

Restoration Opportunities/Measures

- Habitat Creation and Improvement
- Shoreline Stabilization
- Public education/access
- Water Quality Improvement

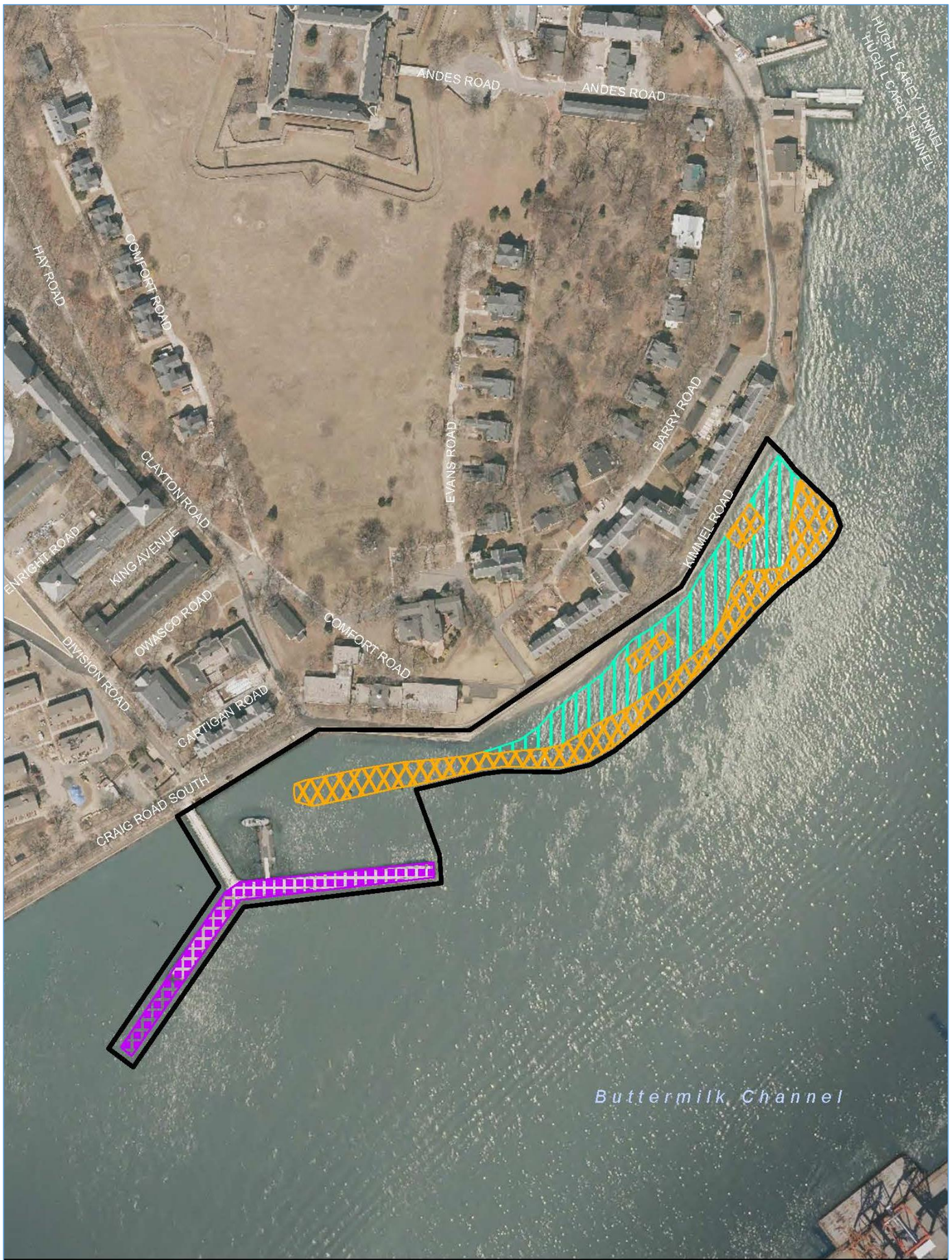
Site	Governors Island	Soundview Park	Jamaica Bay	Naval Weapon Station Earle	Bush Terminal
Partner	NY Harbor Foundation	Hudson River Foundation	NYCDEP	NY/NJ Baykeeper	NY Harbor Foundation
Pilot	Many prior experiments /restoration efforts as part of the ORRP and Harbor School have occurred. The laboratory and aquaculture facilities at the school can grow more than a million oysters per year.	ORRP Phase I 2010-2012 2013 Community Based Restoration of Oyster Reef Habitat in the Bronx River. To date, one of the largest oyster restoration projects in the HRE.	NYCDEP has conducted studies in Jamaica Bay on oysters from 2010-2015 and documented oyster survival. Current oyster pilot is ongoing at this site.	The NY/NJ Baykeeper has conducted oyster restoration at NWS Earle since 2010 on a small 0.25-acre plot. Oyster survival has been documented.	NY Harbor School and Billion Oyster Project Pilot in 2016. Complements other restoration work by NYCDP&R at the adjacent Bush Terminal Piers Park. Close proximity to Harbor School.
Recommended Oyster Restoration Techniques					
Description	✓ **Gabion Blocks** (Photo 1). The blocks are 12x3x3 ft wire cages (smaller cages shown in photo) filled with oyster shells pre-seeded with spat. (1.66 ac) ✓ **Oyster Condos** (Photo 2) - Triangular structures; mimics the rugosity (three dimensionality) of an oyster reef. (1.79 ac) ✓ **Hanging Trays/Super Trays** (Photo 3). The trays are submerged and suspended from a float or pier to serve as larval source for adjacent habitat. (0.68 ac) **Total: 4.13 acres** <u>Rationale:</u> Restoration designed to place reproductive stock (hanging trays) in close proximity to suitable hard substrate (condos and gabion blocks) for settlement. The use of Governors island, in concert with the Harbor School, provides facilities, technical experts and a cost-effective means for construction and maintenance, as well as an excellent teaching/research opportunities for future generations of scientists.	✓ **Spat on Shell (SoS)**. (Photo 4). Produced by the Harbor School using local broodstock, with a veneer layer of mollusk shell on a base of rock/rubble. Suited to lower energy environments with firm substrate, or in combination with other techniques that shelter the SoS from strong currents and smothering by sediments, and prevent sinking into loose substrate. (0.83 ac) ✓ **Gabion Blocks**. (0.14 ac) **Total: 0.97 acres** <u>Rationale:</u> Restoration designed to build on past successes. Restoration will occur in an area with subtidal rock out crops to form a **~2.75** ac reef/bed complex The design would continue to provide excellent research opportunities.	✓ **Oyster Beds (shells, gravel, porcelain)** (1.5 ac) ✓ **Hanging Trays/Super Trays** 200 trays (1ft x 5 ft) place oysters vertically in the water column, with immediate benefits to water quality as oysters filter the water and can disperse veliger (larvae) to nearby constructed reefs, beds (>0.5 ac), or other hard substrate as receiver site. **Total: 2 acres** <u>Rationale</u>: Builds on past success of NYCDEP and provides valuable information on substrates (e.g., shells, gravel, etc.), recruitment, and settlement patterns of oysters spawned from the hanging tray stocks.	✓ **Spat on Shell (SoS)** (3.10 ac) ✓ **Gabion Blocks** (3.20 ac) ✓ **Reef Balls** (Photo 5). Reef balls are half-dome, concrete structures, with holes that allow water to flow through, and fish and other aquatic creatures to inhabit the interior. Although used successfully to construct intertidal reefs, reef balls are better suited to subtidal areas to avoid damage from waves and currents. (1.30 ac) **Total: 7.6 acres** <u>Rationale:</u> Builds on past success of NY//NJ Baykeeper. Security provided by Naval forces would eliminate any potential poaching.	✓ **Spat on Shell (SoS)** (31.65 ac) ✓ **Gabion Blocks** (8.48 ac) provide protection for adjacent spat on shell habitat ✓ **Oyster Condos** (3.49 ac) ✓ **Hanging Trays/Super Trays** (0.1 ac) **Total: 43.72 acres** <u>Rationale:</u> Would serve as a model for the re-utilization of derelict portions of the harbor shoreline and has positive synergistic effect with adjacent park development. The derelict piers provide wave attenuation and depth variability provide habitat diversity. Site is close to Harbor School resulting in reduced transport costs for future placement of oysters. Provides excellent public access, stewardship and future study.
Project Cost	**$4,8830,000**	**$760,000**	**$820,000**	**$7,420,000**	**$32,950,000**

Significance of Restoration in the Region and at the Site

- ✓ Builds/expands on previous successful oyster restoration in the HRE
- ✓ Achieves the HRE Regional Goal of establishing 20 acres of reef habitat across several sites by 2020 and advances the Billion Oyster Program (BOP) to restore one billion live oysters to New York Harbor over the next twenty years.
- ✓ Ecological Uplift includes:
  - **Improve habitat quality for invertebrates, fish and vegetation;**
  - **Improve ecosystem function**
  - **Improve water quality through filtration of nutrients, water turbidity, nitrogen, phosphorous, organic carbon;**
  - **Carbon sequestration**
  - **Stabilize the shoreline to prevent erosion; and**
  - **Wave attenuation**
- ✓ Innovative solution to reutilizing derelict shorelines and piers.
- ✓ Restores an important estuarine species in NY Harbor.
- ✓ Provides unique opportunity to work with Harbor School for construction and maintenance of reefs


Photo 5

Tentatively Selected Plan Design



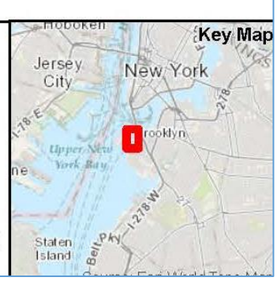
Hudson-Raritan Estuary (HRE) Feasibility Study
Governors Island, New York City, New York

Source: NYS GIS Clearinghouse 2014 Orthoimagery

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- HANGING TRAYS
- GABION BLOCKS
- OYSTER CONDOS

0 200 400 Feet



New York HARBOR FOUNDATION

Tentatively Selected Plan Design

Hudson-Raritan Estuary (HRE) Feasibility Study
Soundview Park, Bronx, New York

Source: NYS GIS Clearinghouse 2014 Orthoimagery

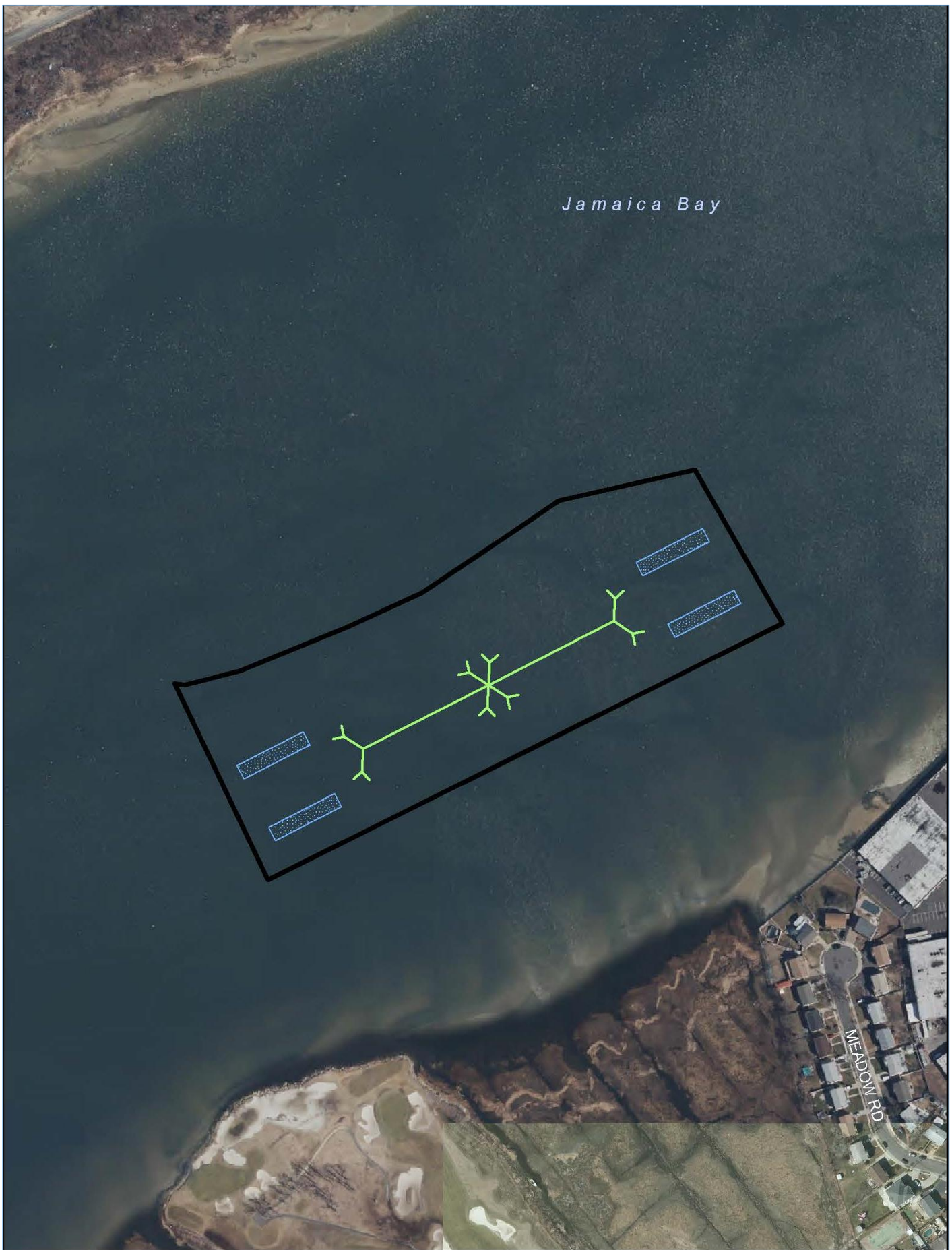
PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- GABION BLOCKS
- SPAT-ON-SHELL*
- EXISTING SPAT-ON-SHELL
- EXISTING HARD ROCK SUBSTRATE
- EXISTING SHELL BASE

*Existing shell base (2013) to be set with 250,000 additional spat on shell

0 100 200 Feet

Tentatively Selected Plan Design



Hudson-Raritan Estuary (HRE) Feasibility Study
Jamaica Bay, Queens, New York

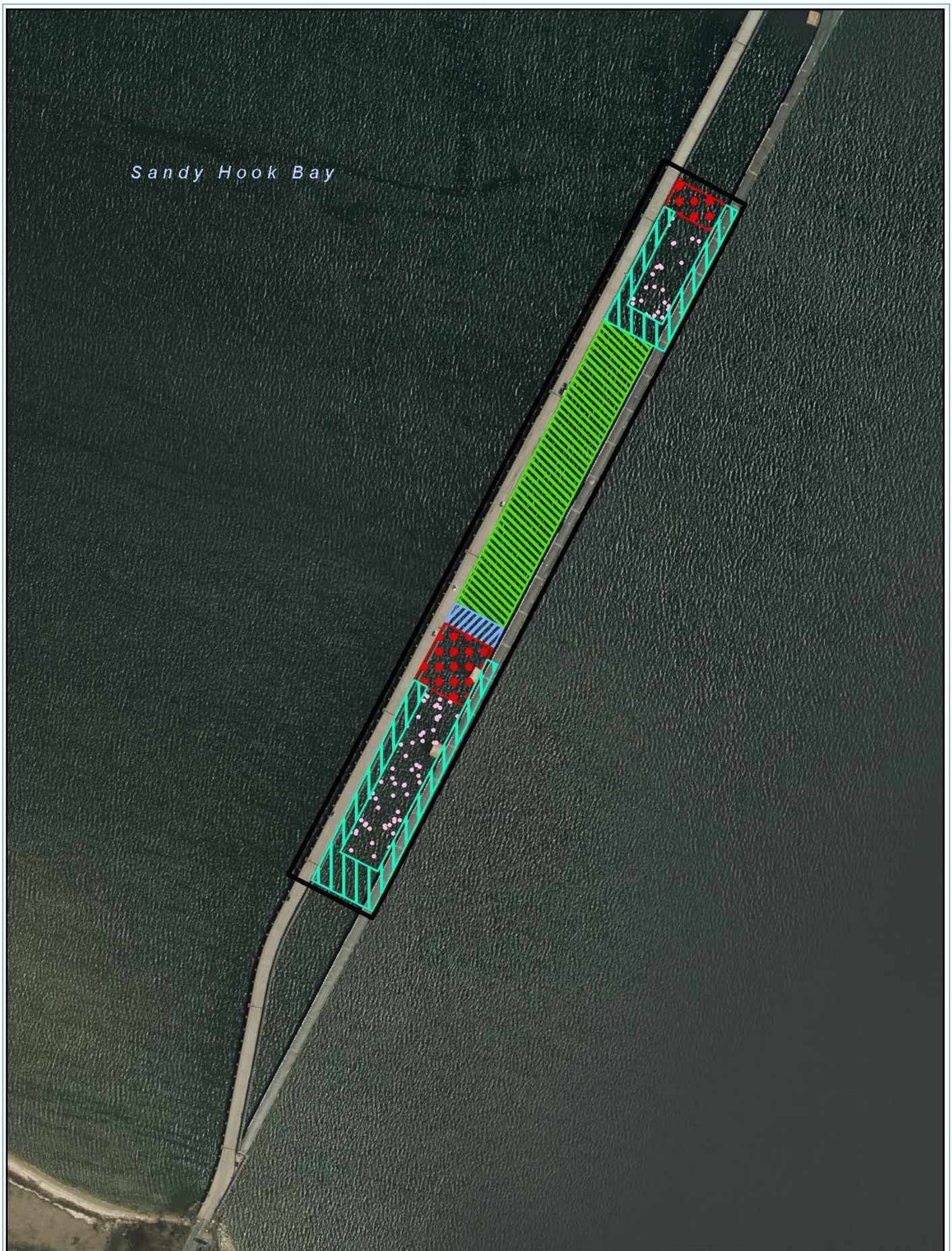
Source: NYS GIS Clearinghouse 2013 & 2014 Orthoimagery

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- OYSTER BEDS (SHELLS, GRAVEL AND/OR PORCELAIN)
- OYSTER STRUCTURES (HANGING SUPER TRAYS AND CABLE)

0 200 400 Feet

Tentatively Selected Plan Design



Hudson-Raritan Estuary (HRE) Feasibility Study
Navy Earle Pier, Middletown, New Jersey

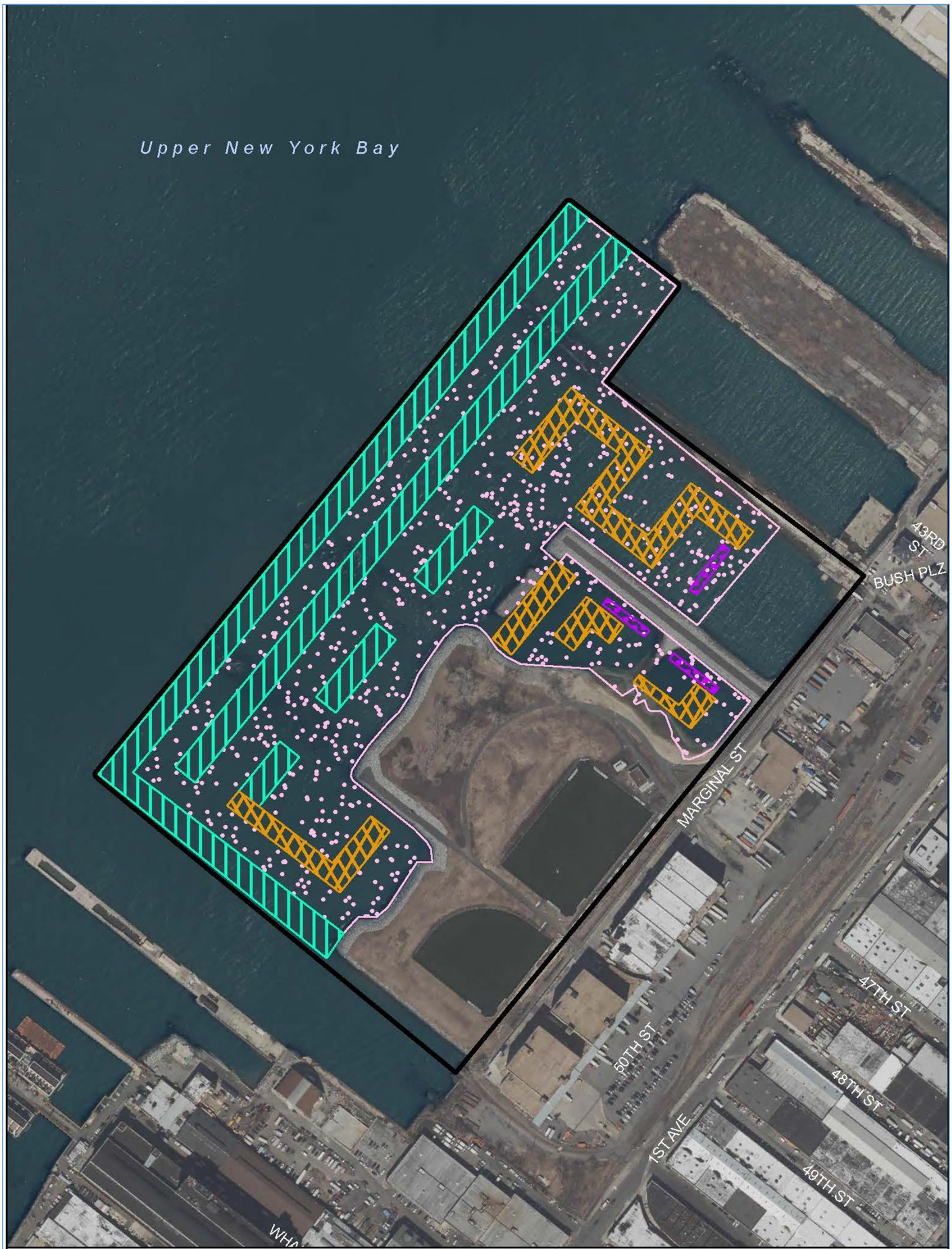
Source: NJGIN 2015 Orthoimagery

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- GABION BLOCKS
- OYSTER CONDOS
- REEF BALLS
- SPAT-ON-SHELL
- EXISTING OYSTER ENHANCEMENT AREA
- OYSTER AREA UNDER DEVELOPMENT

0 300 600 Feet

Tentatively Selected Plan Design



Source: NYS GIS Clearinghouse 2014 Orthoimagery

Hudson-Raritan Estuary (HRE) Feasibility Study
Bush Terminal Park, Brooklyn, New York

PROPOSED MEASURES LEGEND

- SITE BOUNDARY
- OYSTER CONDOS
- GABION BLOCKS
- SPAT-ON-SHELL
- HANGING TRAY

0 250 500 Feet