

HUDSON RARITAN ESTUARY ECOSYSTEM RESTORATION FEASIBILITY STUDY

Public Information Meeting
National Museum of the American Indian
1 Bowling Green, NY

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April 6, 2017

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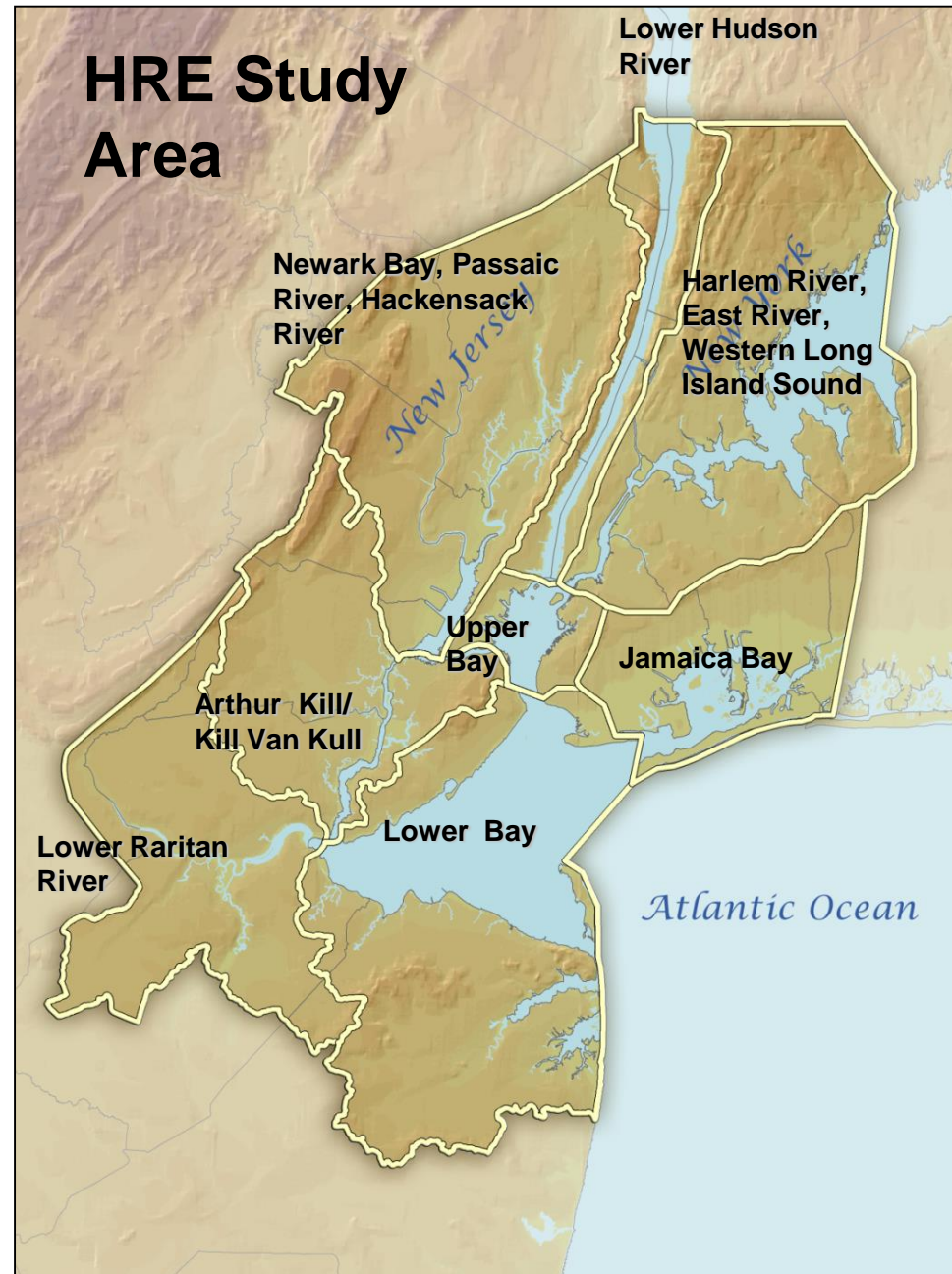


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HUDSON RARITAN ESTUARY (HRE) ECOSYSTEM RESTORATION PROGRAM

- Evaluates ecosystem restoration within the entire Port of NY/NJ
- Restores wetland habitat and function, improves water quality, and quality of life for the Metropolitan Regions' 22 Million citizens
- Study Area: 25 mile radius around the Statue of Liberty



HRE ECOSYSTEM RESTORATION DRAFT INTEGRATED FEASIBILITY REPORT/ENVIRONMENTAL ASSESSMENT

Includes and fulfils the
authorization of 6 parallel
feasibility studies:

- ★ Lower Passaic River Feasibility Study
- ★ Hackensack Meadowlands Feasibility Study
- ★ Bronx River Basin Feasibility Study
- ★ Flushing Creek and Bay Feasibility Study
- ★ Jamaica Bay Feasibility Study



STUDY SPONSORS

Hudson Raritan Estuary Feasibility Study: Port Authority of NY and NJ (PANYNJ)

- ★ Lower Passaic River Feasibility Study: NJDOT/NJDEP
- ★ Hackensack Meadowlands Feasibility Study: NJ Exposition & Sports Authority (NJESA)
- ★ Bronx River Basin Feasibility Study: NYCDEP and Westchester County Department of Planning
- ★ Flushing Creek and Bay Feasibility Study: NYCDEP and PANYNJ
- ★ Jamaica Bay Feasibility Study: NYCDEP



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SIGNIFICANT IMPAIRMENTS IN THE HRE



FUNDING PROVIDED BY THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
PRINTED JULY 2002

Regional Plan Association

Aquatic habitat loss

- Coastal wetlands: 85% loss, 300,000 acres filled
- Freshwater wetlands: 99% loss



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SIGNIFICANT IMPAIRMENTS IN THE HRE (CONT.)



Aquatic habitat loss

Eelgrass beds and Oyster reefs: complete loss via overharvesting, sedimentation, filling and poor water quality



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SIGNIFICANT IMPAIRMENTS IN THE HRE (CONT.)



Shoreline and near-shore habitat modification and loss caused by construction of bulkheads, piers, and placement of shoreline fill



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SIGNIFICANT IMPAIRMENTS IN THE HRE (CONT.)



Decrease in habitat and species diversity, increase in invasive species



SIGNIFICANT IMPAIRMENTS IN THE HRE (CONT.)



High sedimentation caused by increased overland runoff, dredging, shoreline structure, and poor land management

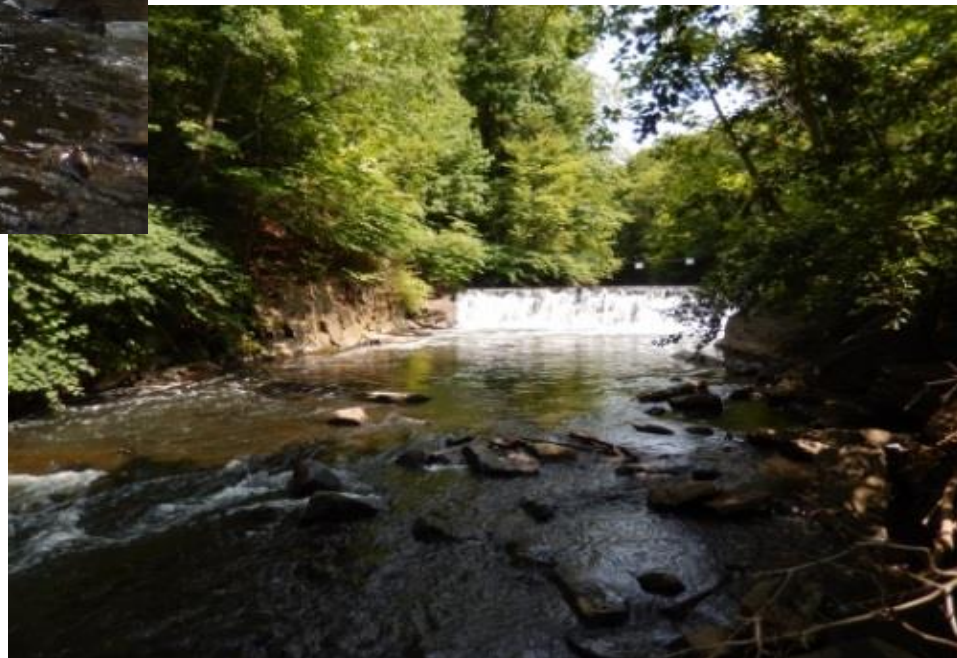
Water quality impairments such as increased turbidity, shoreline erosion, and reductions in wildlife breeding and wintering grounds



SIGNIFICANT IMPAIRMENTS IN THE HRE (CONT.)



Impediments to Fish Passage



RESTORATION NEEDS AND OPPORTUNITIES IN THE HRE

- Restore aquatic habitat: Coastal wetlands, coastal and maritime forests, oyster reefs, eelgrass beds, shorelines and shallows
- Restore and improve tributary connections (fish passage and riparian habitat)
- Improve water quality and sediment quality
- Improve public access
- Protect undeveloped habitat



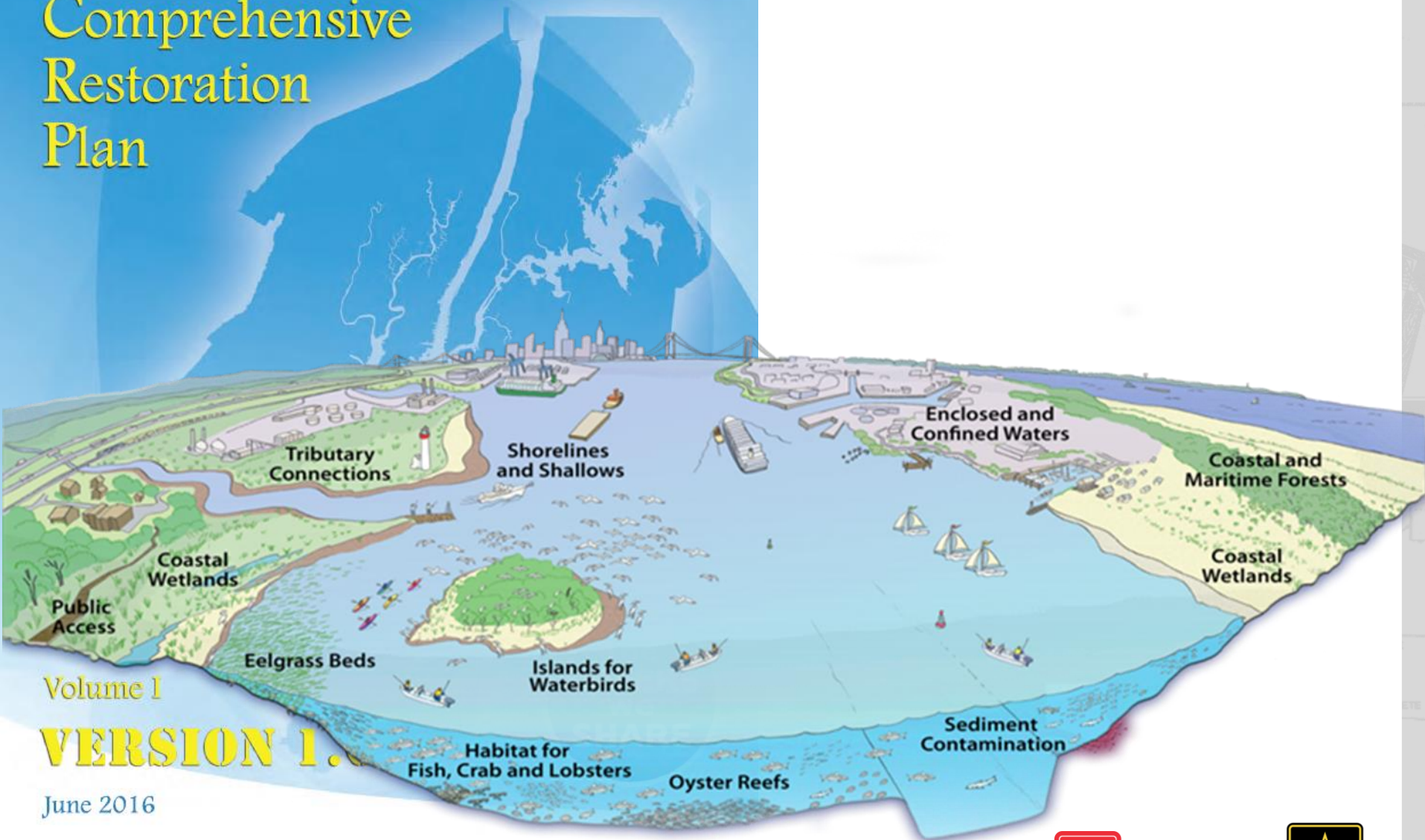
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HUDSON-RARITAN ESTUARY

Comprehensive Restoration Plan

12



Volume 1

VERSION 1.0

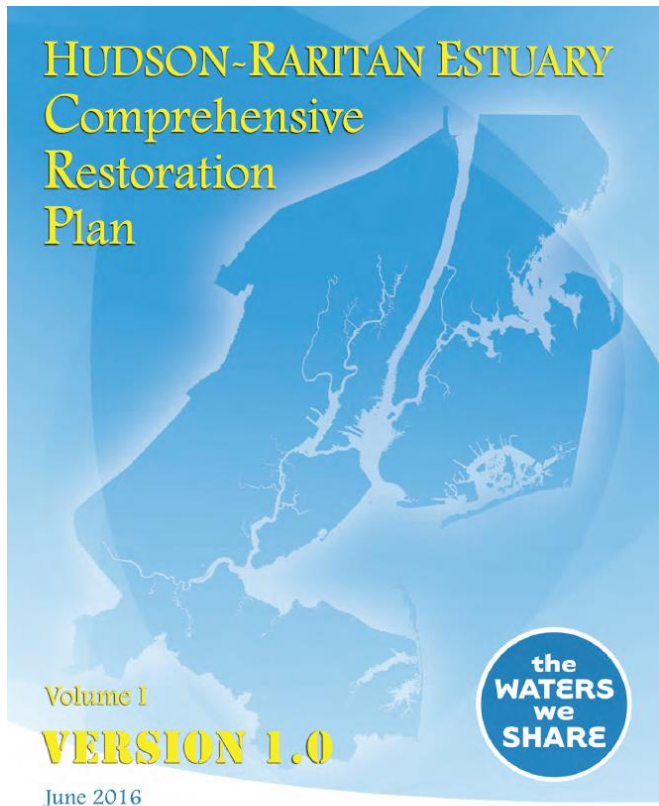
June 2016



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HRE COMPREHENSIVE RESTORATION PLAN



- **SHARED** Vision, Master Plan and Blueprint for a future restored estuary
- Collaboration among 129 organizations
- Regional goals and objectives established by regional partners, scientists and stakeholders through dozens of workshops
- Establishes priority restoration targets: Target Ecosystem Characteristics (TECs) that define goals for important ecosystem properties and features that are of ecological and/or societal value
- Identifies 296 Restoration Opportunities
- Adopted by the NY/NJ Harbor Estuary Program
- Serves as living document and is actively managed to track progress (HEP Restoration Work Group)







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REGIONAL TARGET ECOSYSTEM CHARACTERISTICS

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TEC		HRE Comprehensive Restoration Plan Target Statement
 Wetlands		Create and restore wetlands, at a rate exceeding the annual loss or degradation in the HRE study area, to produce a net gain in acreage
 Habitat for Waterbirds		Restore and protect roosting, nesting, and foraging habitat (i.e., inland trees, wetlands, shallow shorelines) for long-legged wading birds on islands in the HRE study area
Coastal and Maritime Forests		Create a linkage of forests accessible to avian migrants and dependent plant communities from Rockaway Peninsula, NY to the coasts of New York and Raritan Bays to Sandy Hook, NJ
 Oyster Reefs		Establish oyster reefs at several locations in the HRE study area
 Eelgrass Beds		Establish eelgrass beds at several locations in the HRE study area
 Shorelines and Shallows		Create or restore shoreline and shallow sites that meet a 3-zone criterion specified for an integrated site with a vegetated riparian zone, an inter-tidal zone with a stable slope, and illuminated shallow water
 Habitat for Fish, Crab & Lobsters		Create functionally related habitats in each of the eight regions of the Hudson Raritan Estuary
 Tributary Connections		Reconnect and restore freshwater streams, riparian buffers and floodplains to the estuary to provide a range of quality habitats to aquatic organisms
Enclosed and Confined Waters		Upgrade the designated use of all enclosed waterways and tidal creeks within the estuary to match or surpass the designated use of their receiving waters
Sediment Contamination		Isolate or remove one or more sediment zone(s) that is contaminated till such time as all HRE sediments are considered uncontaminated based on the all related water quality standards, related fishing / shelling bans or fish consumption advisories, and any newly-promulgated sediment quality standards, criteria or protocols
Public Access		Improve direct access to the water and create linkages to other recreational areas, as well as provide increased opportunities for fishing, boating, swimming, hunting, hiking, education, or passive recreation
Acquisition		Protect ecologically valuable coastal lands throughout the Hudson-Raritan Estuary from future development through land acquisition



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COMPREHENSIVE RESTORATION PLAN REGIONAL TARGETS THROUGH 2050

TEC		2020	2050
Wetlands		Create a total of 1,000 total acres of wetlands	Continue creating an average of 125 acres per year for a total system gain of 5,000 acres
Habitat for Waterbirds		Enhance at least one island without an existing waterbird population in HRE regions containing islands and create or enhance at least one foraging habitat	All islands provide roosting and nesting sites and have nearby foraging habitat
Oyster Reefs		20 acres of self-sustaining, naturally expanding reef habitat across several sites	2,000 acres of established oyster reef habitat
Eelgrass Beds		Create one test bed in at least three HRE regions	Three established beds in each possible HRE region
Shorelines and Shallows		Develop new shorelines in two HRE regions	Restore all available shoreline habitat in three HRE regions
Habitat for Fish, Crab & Lobsters		Complete a set of two related habitats in each HRE region	Complete four sets of at least two habitats in each HRE region
Tributary Connections		Restore connectivity or habitat within one tributary reach per year	Continue rate of restoring and reconnecting areas



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TARGETS AND STUDY SUB-OBJECTIVES : WETLANDS EXAMPLE



Target Statement

Create and restore coastal and freshwater wetlands, at a rate exceeding the annual loss or degradation, to produce a net gain in acreage.

Sub-Objectives

- Improve the quantity, quality, and complexity of wetland habitat.
- Increase overall diversity and abundance of wetland habitat.
- Increase connectivity of wetland habitats to reduce fragmentation.
- Improve the hydrologic connectivity of the floodplain and the river/estuary.
- Reduce shoreline erosion.
- Reduce invasive species monocultures and replace with diverse native vegetation.
- Restore tidal marsh systems to offset both historical and future losses.

Secondary Benefits

- Provide secondary coastal storm risk management benefits (e.g., wave attenuation, shoreline stability, and shoreline resiliency), serving as potential natural and nature-based features.
- Improve water quality and storage of floodwaters.



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STUDY SITE SELECTION PROCESS

Hudson-Raritan Estuary Restoration Program

400+ sites

Identified by the HRE Restoration Work Group & GIS

296 sites

Included in the HRE Comprehensive Restoration Plan

275 sites

Within the USACE Restoration Mission

**6 “Source”
Feasibility Studies**

**Jamaica
Bay**
6 sites

**Flushing
Creek**
1 site

**Bronx
River**
9 sites

**Hacken-
sack R.**
2 sites

**Lower
Passaic R.**
5 sites

HRE
10 sites

Study Integration

This report includes detailed analysis for 33 of the 275 sites included in the 2016 HRE CRP. The remaining 242 sites could advance as part of future spin-off feasibility studies.

Over 400 sites have been identified for potential restoration by the workgroup

The 2016 HRE CRP identifies 296 potential restoration opportunities

Of the sites included in the HRE CRP, 275 are within the purview of the USACE restoration mission

Site screening for 6 parallel studies to identify priority near-term restoration sites with sponsor readiness. The studies focused on 33 of the 275 sites

Each “source” study focused on priority sites with sponsor readiness (Process in Appendix E)

The 6 “source” studies were consolidated into the HRE feasibility study in 2013 - 2015

33 sites
included in
studies



242 sites
for future
study

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STUDY FORMULATION STRATEGY

- Consideration of both **regional** (Planning Region) and **site-specific** (relevant to habitat type and unique features) problems, needs, opportunities, constraints, considerations, and trade-offs
- Different formulation approach for:
 - ✓ Estuarine marsh/coastal wetland and Riverine habitat (Shoreline)
 - ✓ Jamaica Bay Marsh Islands
 - ✓ Oyster reefs
- Choose the most cost effective alternative at each restoration site that meets planning objectives while avoiding constraints



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STUDY PLANNING OBJECTIVES

- Restore the structure, function, and connectivity, and increase the extent of **estuarine habitat** in the HRE.
- Restore the structure and function, and increase the extent of **freshwater riverine habitat** in the HRE.
- Restore the structure and function, and increase the extent of **marsh island habitat** in Jamaica Bay.
- Increase the extent of **oyster reefs** in the HRE.



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RESTORATION OPPORTUNITIES

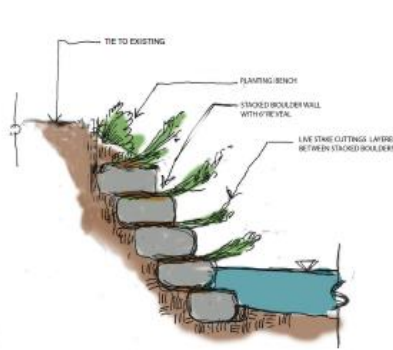
- Habitat restoration and creation (improve biodiversity, biomass, functional habitat)
 - Wetland, forest, riparian buffer, oyster reef, submerged aquatic vegetation
 - Invasive species removal and replanting
- Tributary connections improvements
 - Allow upstream migration of anadromous fish
 - fish ladders, dam removal, weir modifications
 - Restore functional habitat along shorelines
 - Shoreline softening
 - Bank stabilization
- Hydrologic/hydrodynamic improvements
 - Channel modification, in-stream structures, dredging



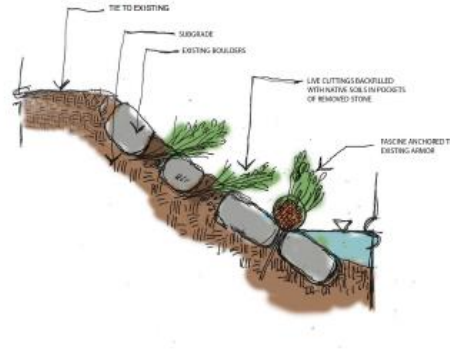
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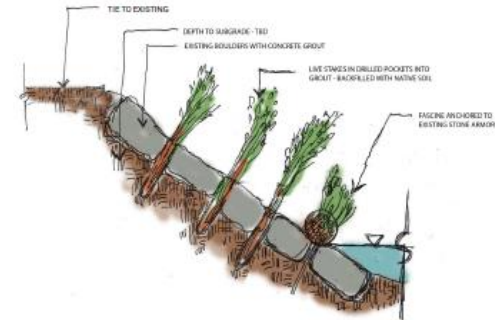
RESTORATION TECHNIQUES



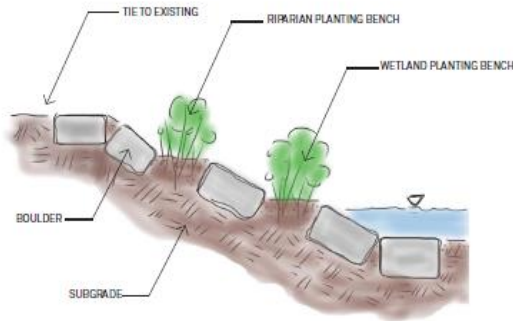
Shoreline Softening Stacked Rock Wall with Brush Layers



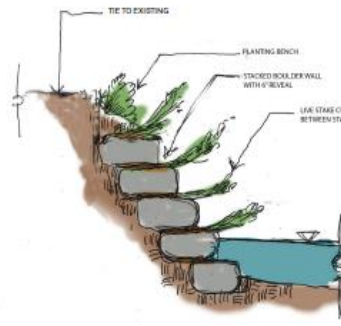
Shoreline Softening Select Rock/Concrete Removal with Native Plant Materials



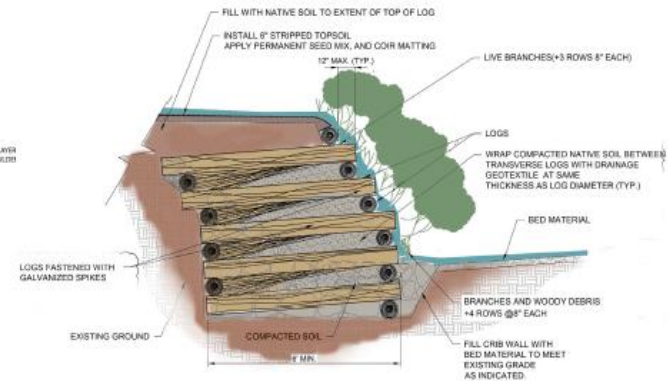
Shoreline Softening Drilling with Native Plant Materials



Bank Stabilization Tiered Rock Slope with Native Plant Benches/Pockets



Bank Stabilization Stacked Rock Wall with Brush Layers



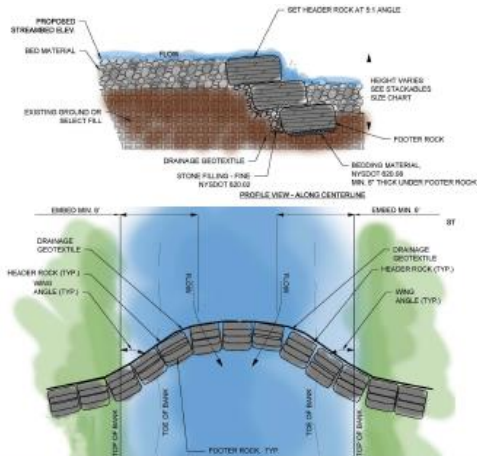
Bank Stabilization Vegetated Crib Wall



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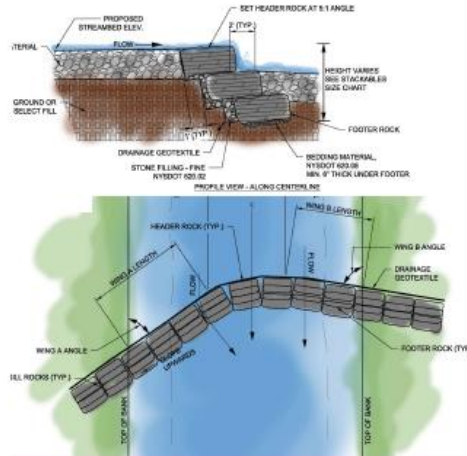


RESTORATION TECHNIQUES



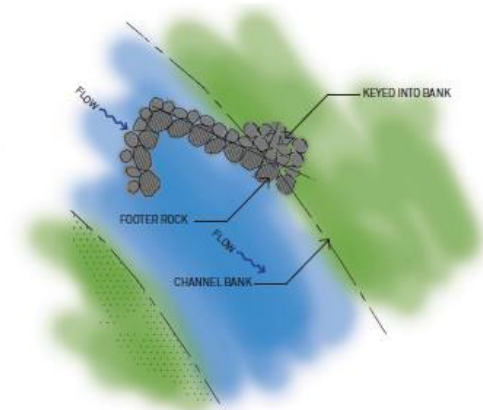
In-stream Structures

Cross Vane



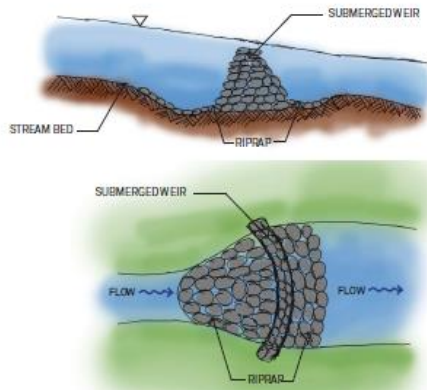
In-stream Structures

Skewed Cross Vane

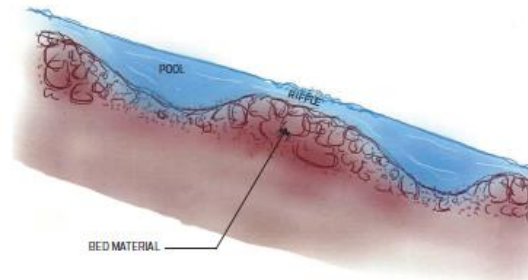


In-stream Structures

J-Hook



Forebay



Bed Restoration



Creation of Riffle Pool Complex



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STUDY-SPECIFIC CONSTRAINTS & CONSIDERATIONS

- Constraints
 - Consistency with existing land use, infrastructure and Federal, state, and local investments
 - Restoration should not have negative economic or social impacts
 - Should not contribute or induce flooding
- Considerations
 - Many municipalities, site, park master plans (e.g., Bronx Zoo, municipal parks)
 - Synergy with other USACE studies (e.g., Passaic Tidal Coastal Storm Risk Management)
 - Lower Passaic River: USEPA Remediation
 - Local policies



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TYPICAL FORMULATION PLANNING PROCESS FOR ESTUARINE MARSH/COASTAL WETLAND AND RIVERINE HABITAT

Develop Alternatives

- Use of region- and site-specific objectives to choose appropriate measures
- **Alternatives for each site**

Determine Costs & Benefits

- Field data collection
- **Evaluation of Planned Wetlands (EPW) model**
- Cost estimates

Use Criteria & Select Plan

- **Cost Effectiveness/ Incremental Cost Analysis (CE/ICA) ["Best Buy" Plan Selected]**

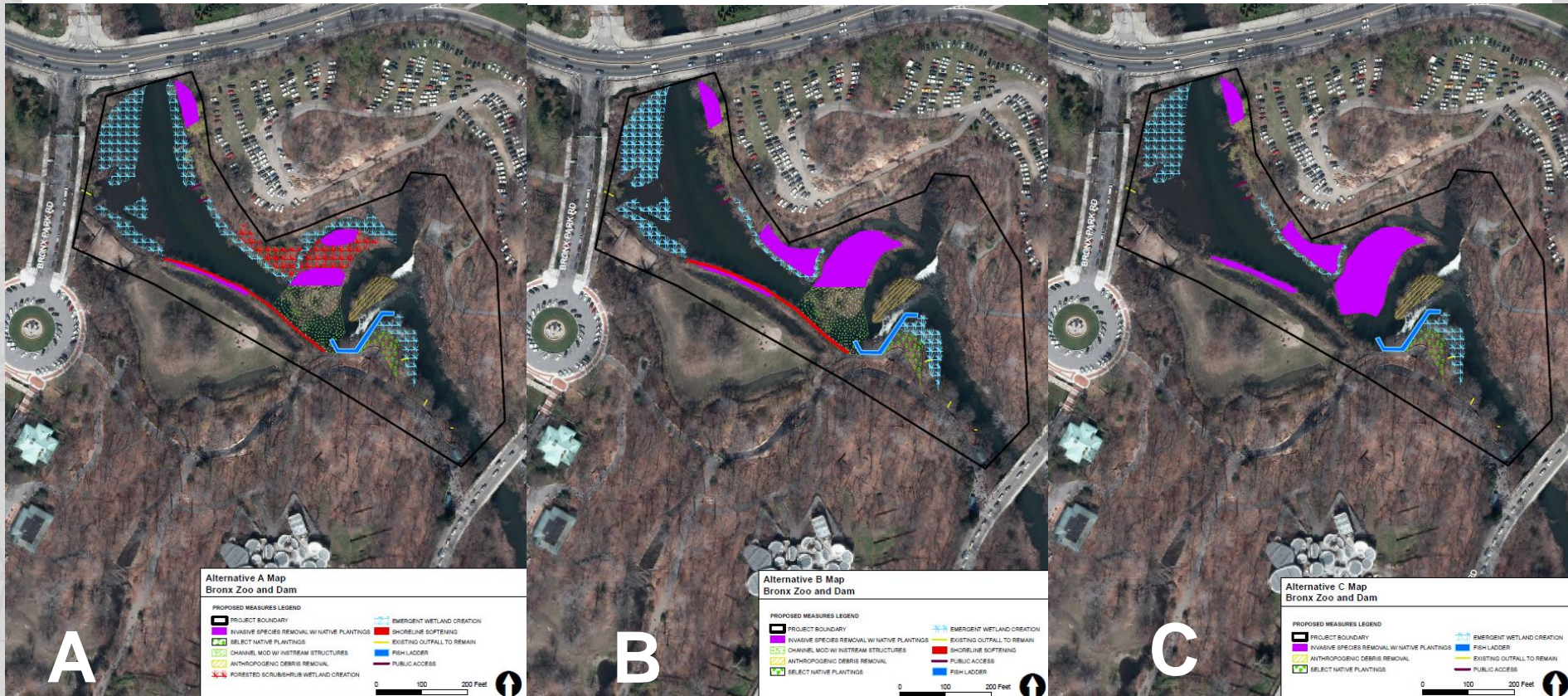


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FORMULATE ALTERNATIVE PLANS

Analyze and Compare Solutions



ECOSYSTEM BENEFITS

TEC	Metric	Output/Unit
Wetlands	EPW-estimated ecological uplift	AAFCUs ¹
Habitat for Waterbirds		
Coastal and Maritime Forests		
Oyster Reefs ²	Kilograms (kg) fish and shellfish. Area gained. Gallons of water filtered	Per one (1) acre of functional oyster reef: 141,570,000 gallons of water filtered daily ³ ~1,050 kg of fish and larger mobile crustaceans
Eelgrass Beds	EPW-estimated ecological uplift	AAFCUs
Shorelines and Shallows	EPW estimated ecological uplift SVAP estimated stream rank	AAFCUs SVAP score ⁴
Habitat for Fish, Crab, and Lobsters		
Tributary Connections		

¹AAFCUs: Average Annual Functional Capacity Units from Evaluation of Planned Wetlands (EPW)

² Oyster reef restoration benefits are measured by the gain in the extent of oyster habitat providing improved fish and benthic habitat and water quality. Monitoring data collected from regional pilots were used to demonstrate benefits. Metrics for oyster restoration will be further developed between draft and final report.

³ Assumes 65 adult oyster per square foot.

⁴ SVAP: Stream Visual Assessment Protocol



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PRELIMINARY COSTS

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- First Level Costs Developed for each alternative
- Costs include:
 - ✓ Construction Cost
 - ✓ 1% Monitoring Costs
 - ✓ 3% Monitoring and Adaptive Management
 - ✓ Contingency ranged from 29-40% based on Abbreviated Risk Analysis (ARA)
 - ✓ Preconstruction Engineering and Design
 - ✓ Construction Management
 - ✓ Real Estate Admin Costs Placeholder: \$6,800/site



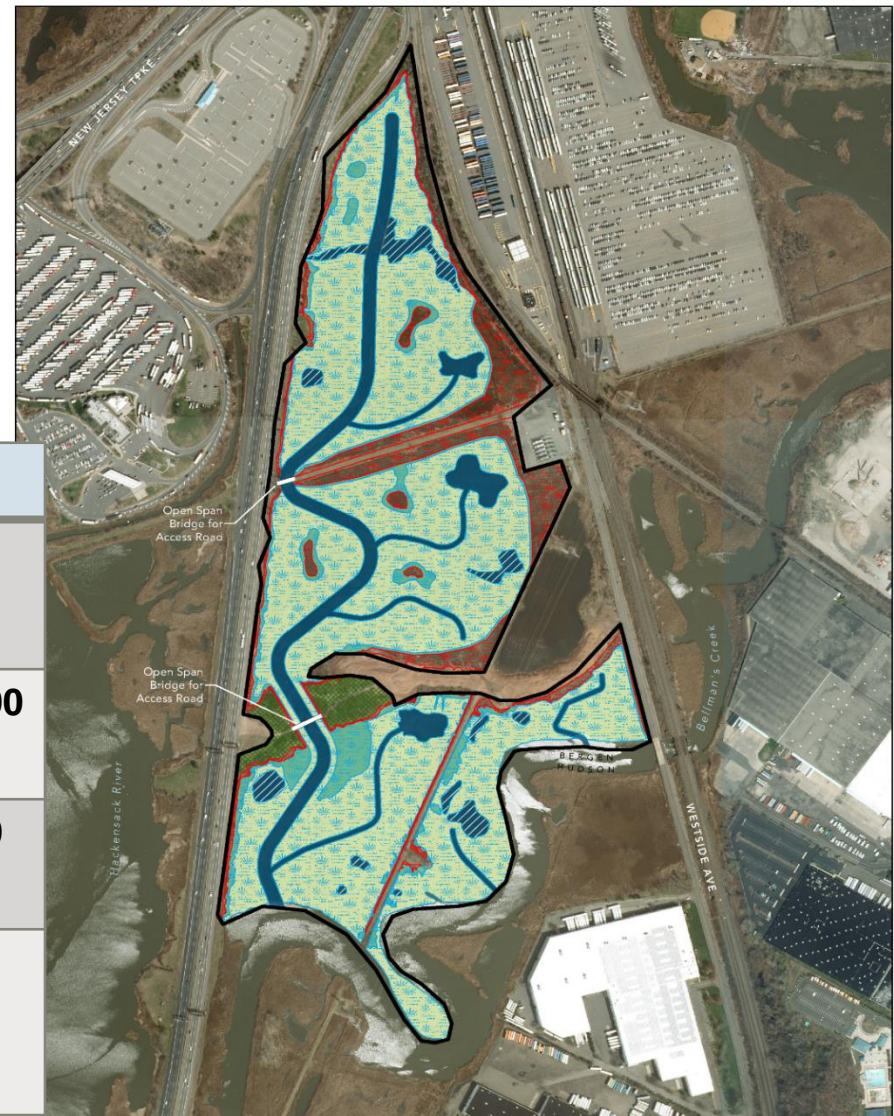
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COST EFFECTIVENESS/ INCREMENTAL COST ANALYSIS (CE/ICA) WITH MULTIPLE ALTERNATIVES (EXAMPLE- APPENDIX M)

	A	B	C
AAFCUs	306.02	307.25	292.22
Total Cost	\$63,700,000	\$56,400,000	\$41,660,000
Annual Cost	\$2,475,320	\$2,191,650	\$1,610,870
Average Cost/ AAFCU	\$8,080	\$7,130	\$5,500

- Alternatives B and C- Best Buy Plans
- Alternative C selected as most cost effective= TSP



Alternative A Map
Meadowlark Marsh, New Jersey Meadowlands

Source: NJGIN NJ 2015 Orthomage

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



MARSH ISLAND FORMULATION

Leveraging Lessons Learned



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- Islands selected based on:
 - ✓ Constructability, bathymetry and hydrodynamics
 - ✓ Minimum sand volumes for maximum wetland acreage and sustainability
- Ecological output for given acre of marsh island is constant while cost dependent upon existing depth and cost of sand material and material transport.
- Size of marsh influenced by amount of contiguous and sustainable acreage within the 1974 regulatory footprint with given range of elevations.
- Minimum island size: Cost constraints on mob/demob
- Maximum island size: Existing depth (contour) where sand placement becomes more expensive and less-cost effective
- 50% subsidence of sand following placement



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OYSTER RESTORATION FORMULATION

- Advances Regional CRP Oyster Target and Goal (20 acres by 2020)
- NYC Billion Oyster Program
- Expansion of oyster restoration pilots conducted in 2011
- Recommendations resulting from ongoing pilots (determined techniques, reef size)
- Locations:

- 1 Governors Island
- 2 Bush Terminal
- 3 Naval Weapons Station Earle
- 4 Soundview Park
- 5 Jamaica Bay

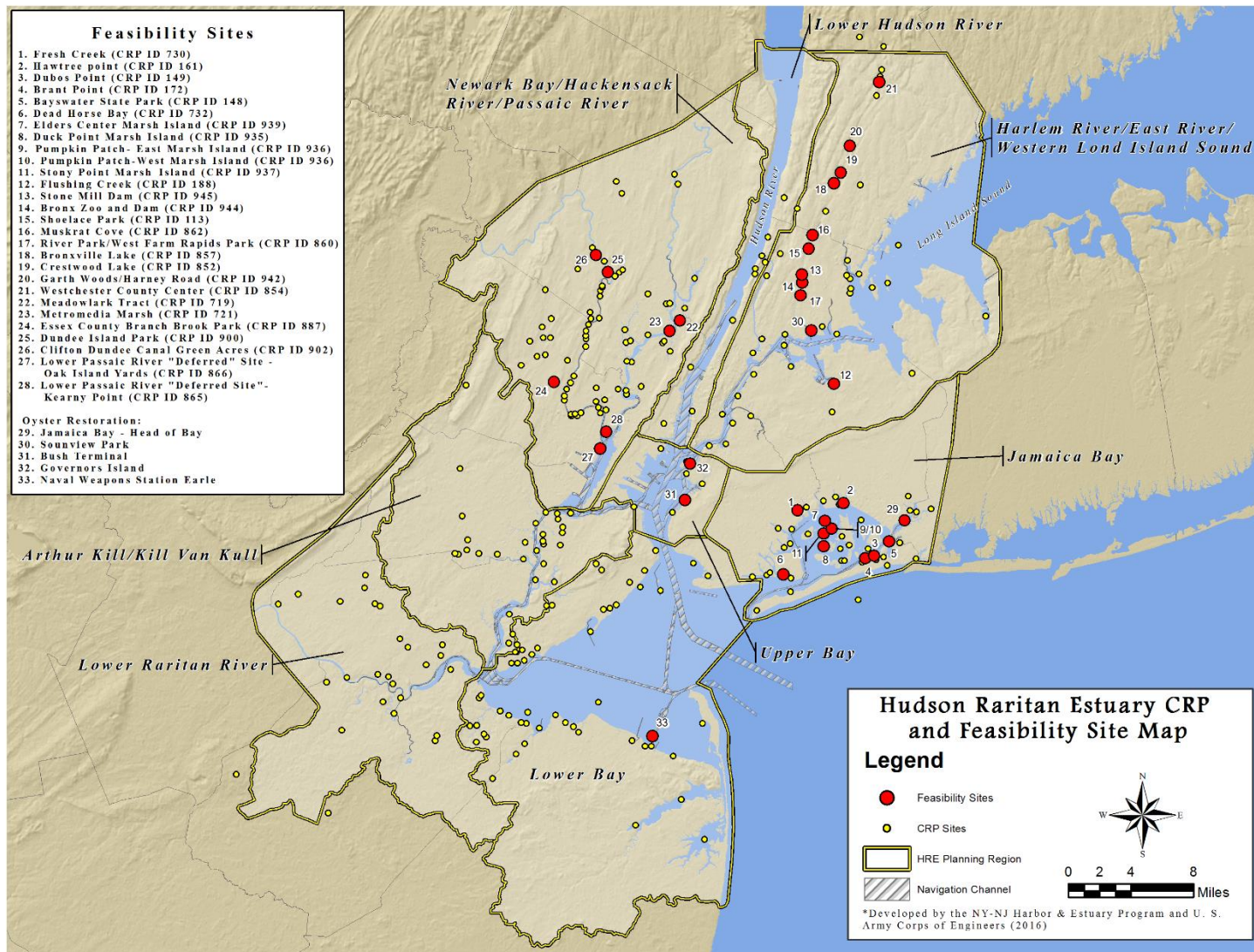


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HRE TENTATIVELY SELECTED PLAN

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33 Sites Recommended for Construction and
 ~ 242 Sites for Future Feasibility Studies

TENTATIVELY SELECTED PLAN NEAR-TERM RECOMMENDED SITES (APPENDIX K)

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Newark Bay, Hackensack River and Passaic River Planning Region

Hackensack River (2 sites): Meadowlark and Metromedia Marshes

Lower Passaic River (3 sites): Essex County Branch Brook Park, Dundee Island Park, Clifton Dundee Canal Green Acres

Lower Passaic River "Tier II" (2 sites): Kearny Point and Oak Island Yards

East River, Harlem River, Western Long Island Sound Planning Region

Flushing Creek (1 site)

Bronx River (9 sites): Stone Mill Dam, Bronx Zoo and Dam, Shoelace Park, Muskrat Cove, River Park/West Farm Rapids Park, Westchester County Center, Bronxville Lake, Crestwood Lake, Garth Woods/Harney Road

Jamaica Bay Planning Region

Perimeter sites (6): Fresh Creek, Hawtree Point, Dubos Point, Brant Point, Bayswater State Park, Dead Horse Bay

Marsh Islands (5 sites): Elders Center, Duck Point, Stoney Point, Pumpkin Patch East and Pumpkin Patch West

Upper Bay

Liberty State Park- Previously authorized in WRDA 2007

Oyster Restoration (5 sites)

Governors Island, Naval Station Earle, Soundview Park, Bush Terminal and Jamaica Bay



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TENTATIVELY SELECTED PLAN

- Habitat restored/create:
 - ✓ 360 acres of estuarine wetland habitat
 - ✓ 12 acres of freshwater riverine wetland habitat
 - ✓ 81 acres of coastal and maritime forest habitat
 - ✓ 5.5 acres of riparian forest habitat
 - ✓ 57 acres of oyster habitat
 - ✓ Installation of 2 fish ladders
 - ✓ Modification of 3 weirs
 - ✓ 3.83 miles of bank stabilization
 - ✓ 2.35 miles of stream channel restoration
- Leveraging resources from partners and stakeholders to restore the Hudson-Raritan Estuary
 - ✓ Advancing goals of the HRE Comprehensive Restoration Plan



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TENTATIVELY SELECTED PLAN

By Planning Region

Planning Region	Wetland Habitat (Acres)	Oyster Habitat (Acres)	Fish Passage (Ladders)	Riparian Buffer (Freshwater) (LF/ Acres)	Coastal/ Maritime Forest (Acres)	DRAFT First Level Cost
Jamaica Bay	220	2	0	0	77	\$289,580,000
East River, Harlem River, Western Long Island Sound	15	1	2	13,255 LF ^a 6 ^b	0	\$111,180,000
Newark Bay, Hackensack River and Passaic River	140	0	0	1 acre ^a 24 ^b	10	\$198,160,000
Upper Bay	0	48	0	0	0	\$37,830,000
Lower Bay	0	8	0	0	0	\$7,420,000
Grand Total	375	59	2	13,255 LF/31	88	\$644,170,000

^a Bank Stabilization (LF: Linear Feet)

^b Channel modification (acres)



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STATUS OF ENVIRONMENTAL COMPLIANCE

- **Environmental Assessment - NEPA Review**

- Integrated into feasibility report

- **Status Of Compliance**

- USEPA- Awaiting comments from NEPA Review
- Draft Fish and Wildlife Coordination Act Report (Appendix G)
- Endangered Species Act (Initial Planning Region informal consultation occurred- Appendix G; USFWS and NMFS for all sites ongoing)
- Magnuson-Stevens Fishery Conservation & Management Act/Essential Fish Habitat - for all sites (ongoing- Appendix F)
- Coastal Zone Management Act (ongoing- Appendix J)
- National Historic Preservation Act (ongoing coordination to develop Programmatic Agreements with each State (State Historic Preservation Offices) and Tribes (Appendix I)
- Water Quality Certificate (Section 401(b)) (conditional expected- with site-specific acquired during PED)
- Clean Air Act – ongoing; anticipate Record of Non-Applicability Expected for all sites except marsh islands



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SPONSOR/PARTNER SUPPORT

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Study and Construction Sponsors fully support the TSP:

- Port Authority of NY/NJ
- NJ State Department of Environmental Protection
- NY City Department of Environmental Protection
- NJ Sports Authority & Exposition Authority
- Westchester County Department of Planning

Construction Sponsors:

- NY State Department of Environmental Conservation
- NY City Department of Parks & Recreation
- NY/NJ Baykeeper
- NY Harbor Foundation
- Hudson River Foundation



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HRE FEASIBILITY STUDY NEXT STEPS

- **Concurrent Reviews – Public, Agency Technical Review, Independent External Peer Review (45 days + 15 day extension): May 1, 2017**
- **Letters of Support and Comments**
- Agency Decision Milestone (July/August 2017):
 - HQUSACE continued agreement with Tentatively Selected Plan (from August 2016);
 - Agreement on Feasibility Level Analysis
 - Address Comments
- Detailed Level Designs/Cost Estimates
- Final Integrated Feasibility/EA Report (Jan 2018)
- **Chief's Report (Oct 2018) and Authorization**

Questions?

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