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East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study –

Ecological Valuation of Alternatives & Assessment of Mitigation Requirements

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Agenda

- Project Background and Objectives
- Ecological Functional Assessment
- Habitat Valuation – Habitat Equivalency Analysis (HEA)
- Impact Assessment and Mitigation Selection
- Summary

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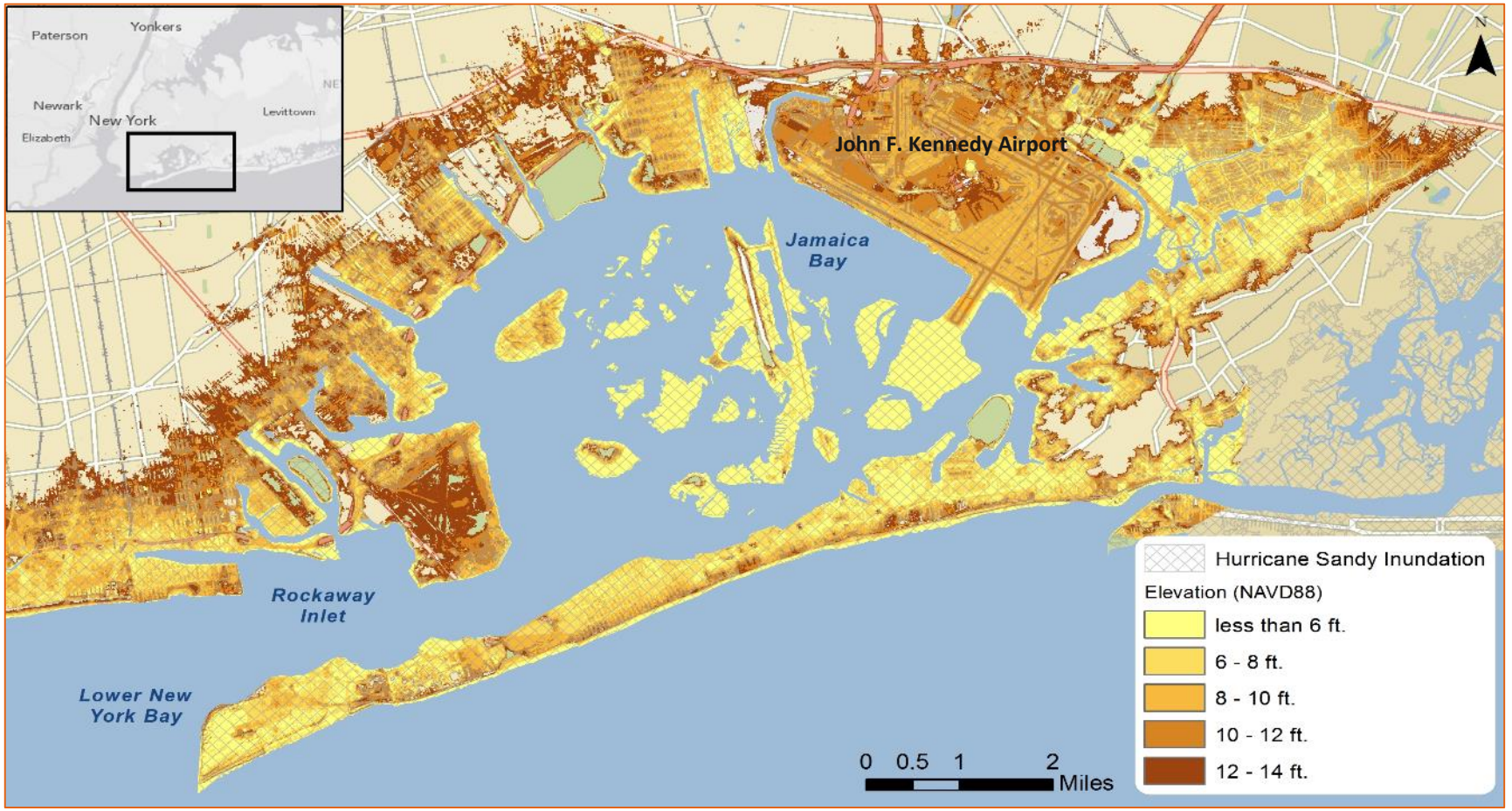
Project Study Area



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Project Study Objective

As a result of the devastation associated with Hurricane Sandy, the goal of the study is to address vulnerability to coastal storm erosion in a way that is sustainable over the long-term, both for the natural coastal ecosystem and for the communities.

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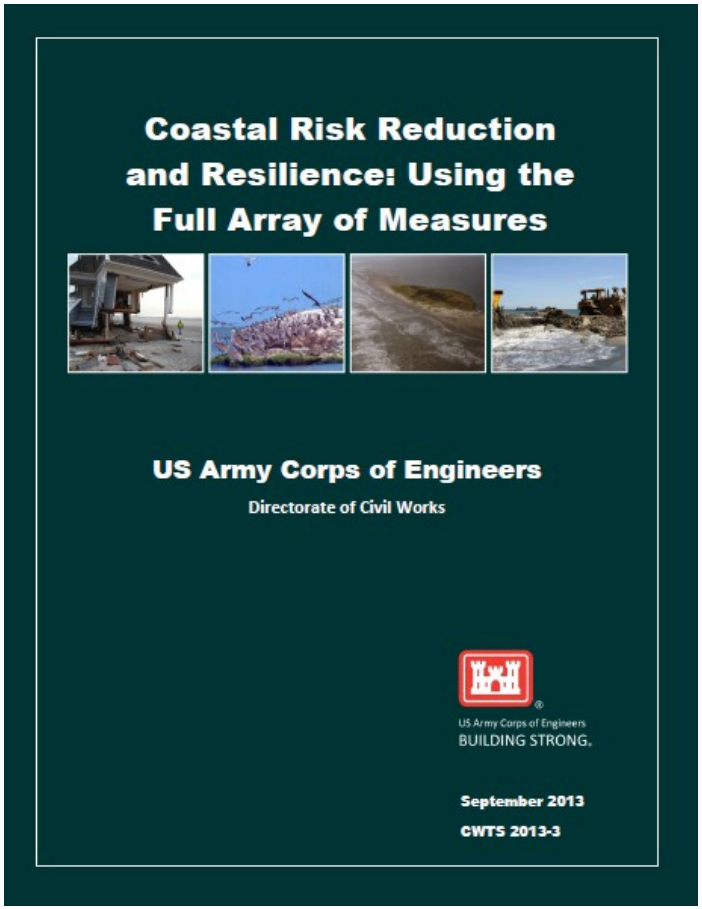
Coastal Risk Reduction and Resilience

The USACE planning approach supports an integrated approach to reducing coastal risks and increasing human and ecosystem community resilience through a combination of natural, nature-based, non-structural and structural measures.



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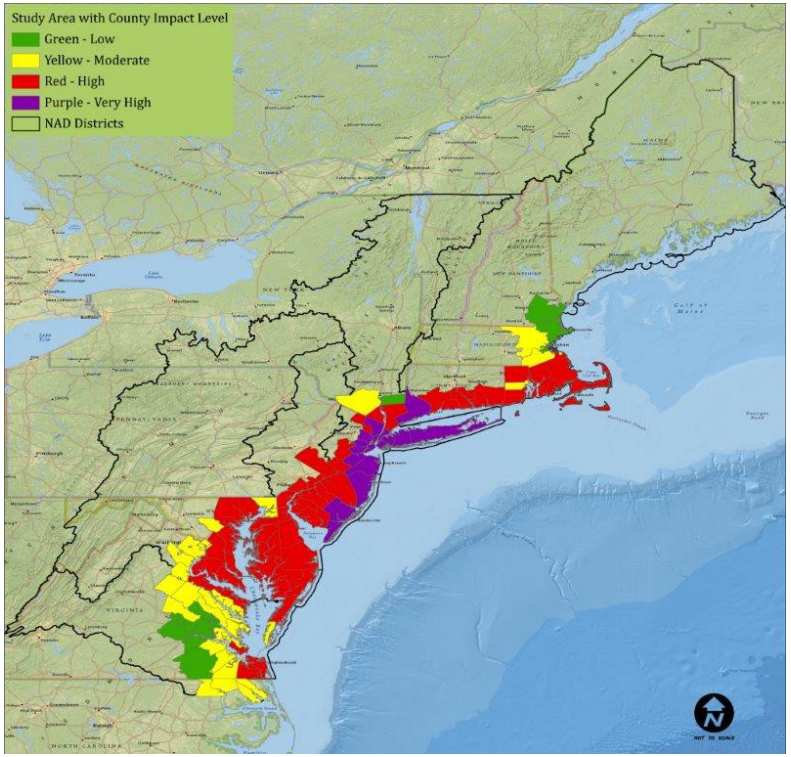
North Atlantic Coast Comprehensive Study

Support resilient coastal communities and robust sustainable coastal landscape systems, considering future sea level rise and climate change scenarios, to reduce risk to vulnerable populations, property, ecosystems, and infrastructure.



www.nad.usace.army.mil/CompStudy

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Regulatory Directive - October 2015

"Directs agencies to develop and institutionalize policies to promote consideration of ecosystem services, where appropriate and practicable, in planning, investments and regulatory contexts."

https://www.whitehouse.gov/sites/default/files/omb/memoranda/2016/m-16-01.pdf

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Consideration of Ecosystem Services

- Integrate a combination of natural, nature-based, non-structural and structural measures.
- Developed a unique tool that evaluates benefits (or losses) of ecological services across a range of identified habitat types of which may not have equal value or service to the impacted ecosystem.

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Design Approach

Phase 1:

- Inventory of proposed projects in project area
- Screening of suitable CSRM measures
- Identification of ecological restoration opportunities
- Plan formulation – multiple alternative plans

Phase 2:

- Engineering analysis and costing
- Hydrodynamic assessment
- Ecological impact and mitigation requirements
- Selection of Tentatively Selected Plan

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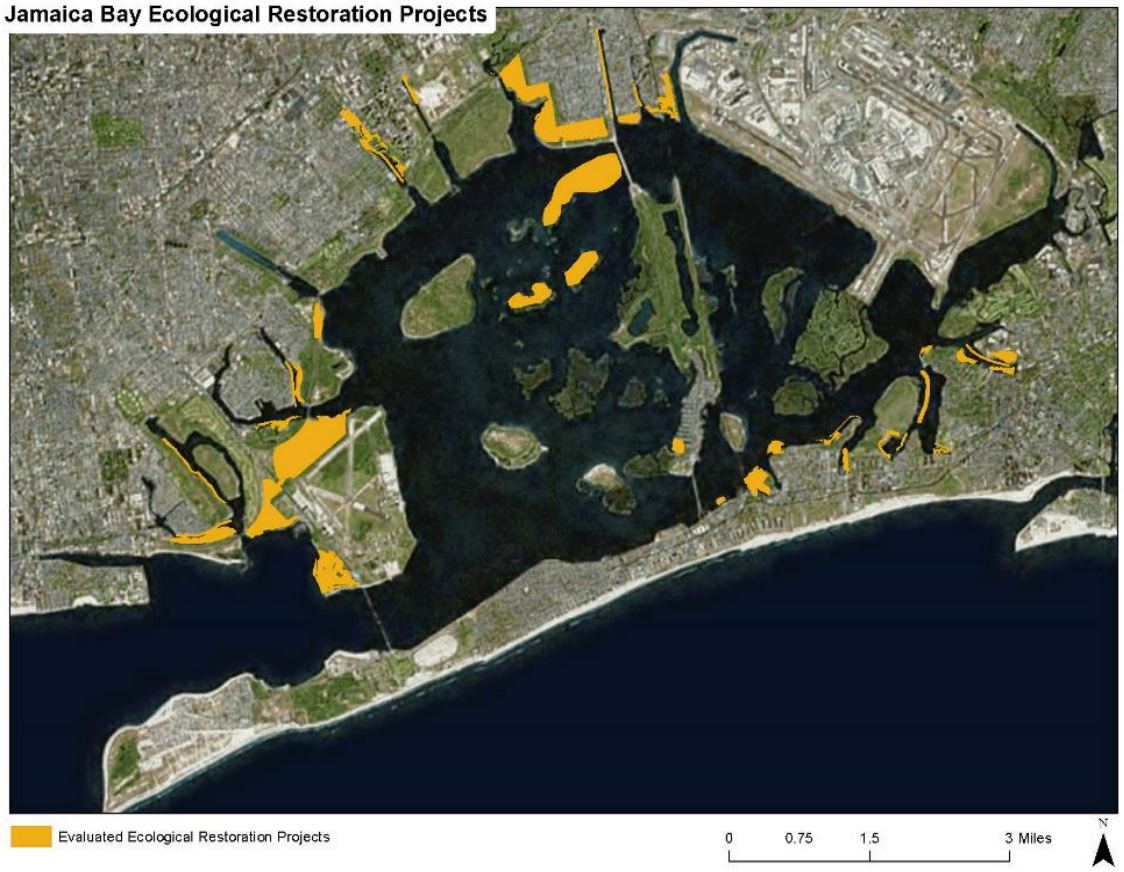
Phase 1: Inventory of Ecological Restoration Opportunities



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Phase 1: Develop Ecological Functional Assessment Framework

Developed framework to evaluate benefits of ecological restoration across multiple habitat types:

- Benthic Index for Biotic Integrity (B-IBI) for sub-tidal and intertidal mudflat habitats.
- Evaluation of Planned Wetlands (EPW) for coastal wetlands.
- Modified EPW for upland maritime forests and shrublands

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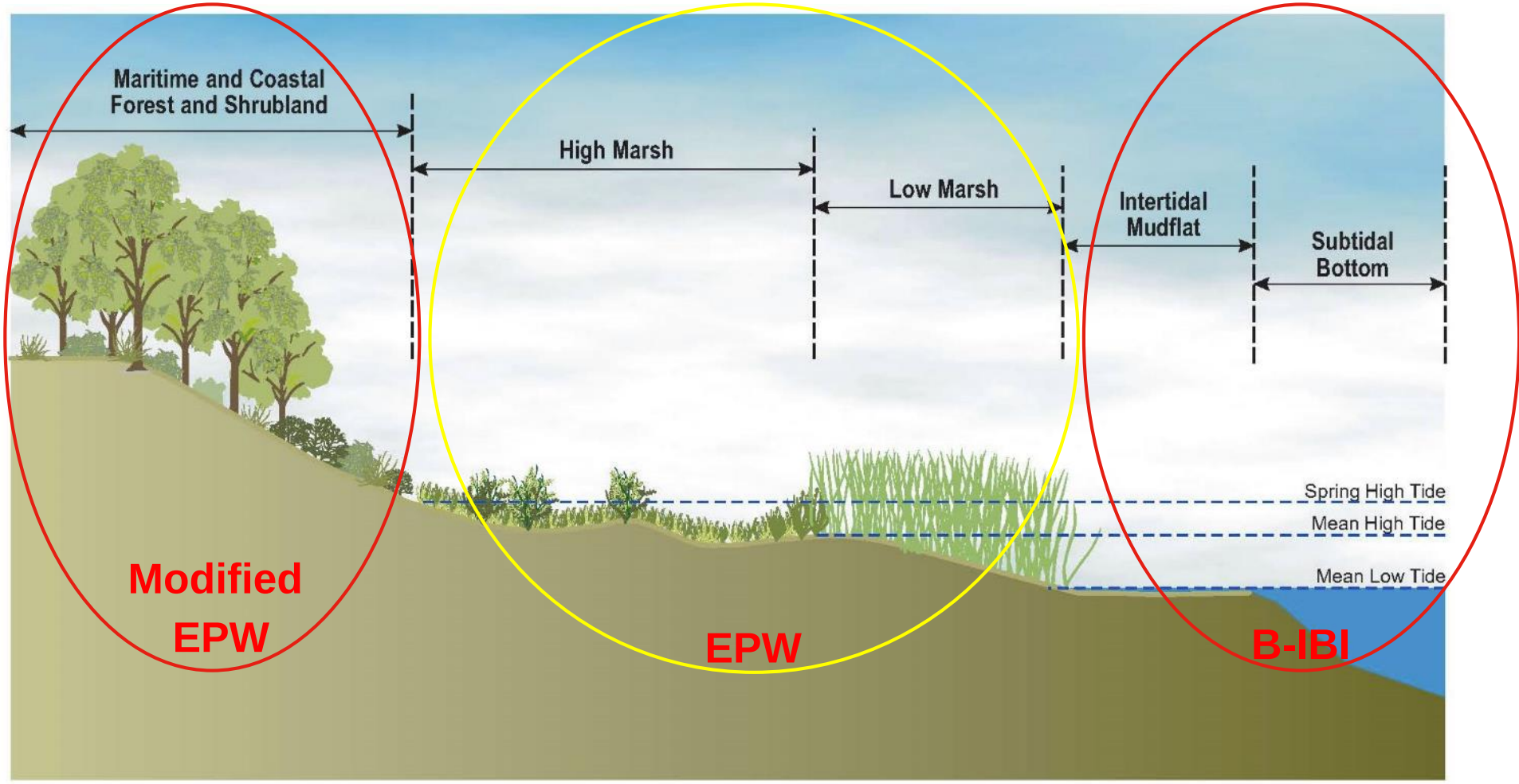
Ecological Functional Assessment



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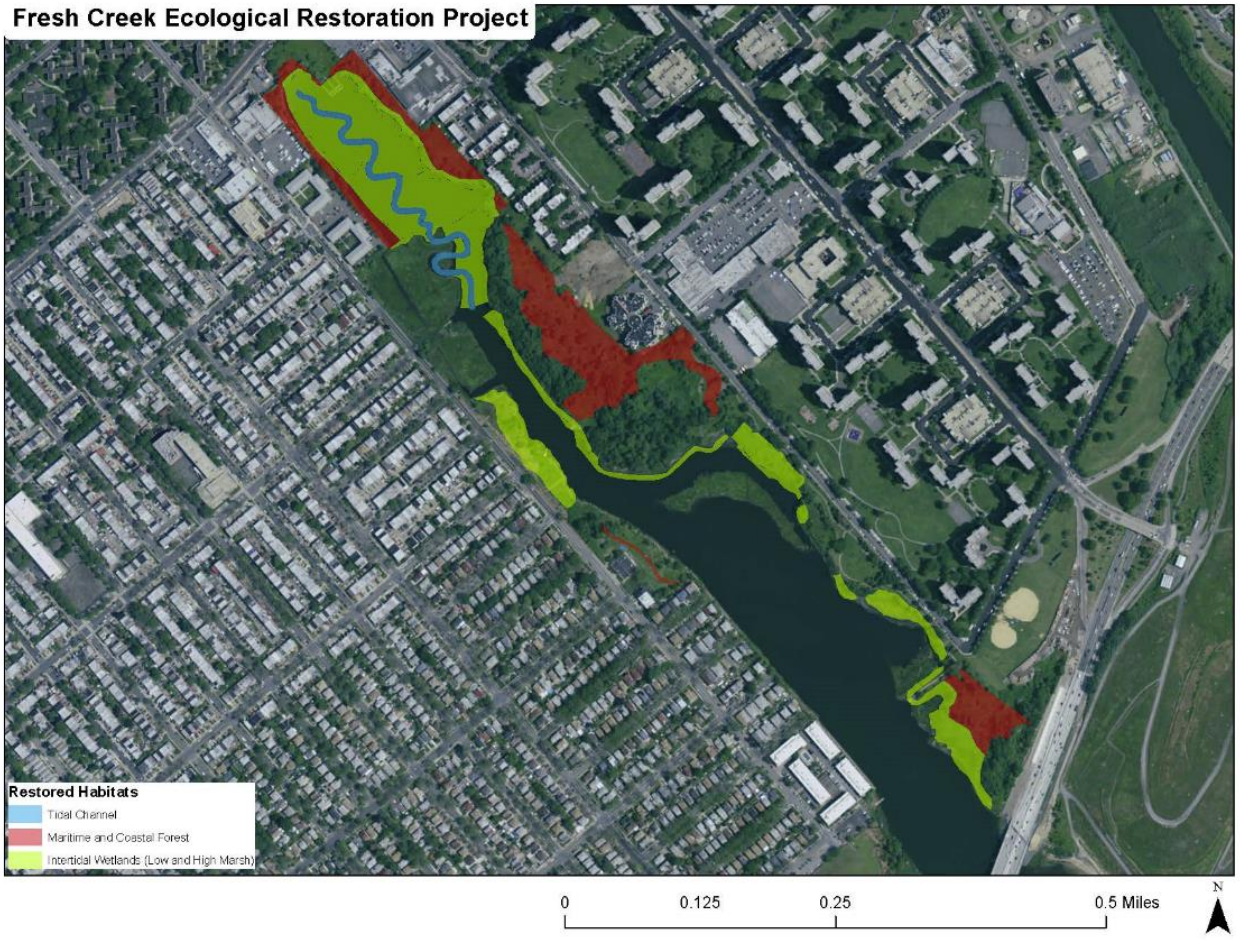
Example Restoration Plan



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Unit of Measure

Functional Capacity Index (FCI): A relative index of a site's capacity to perform an ecological function

- A unit-less number from 0 to 1.
- Based on relationship between "elements" (or variables) each scored to evaluate a specific function

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Phase 2: Habitat Valuation

- While the ecosystem assessment tool quantifies impacts in 3 habitat types (i.e., subtidal, wetland, upland), it inherently assumes services provided to Jamaica Bay are equivalent across different habitat types.
- By pairing the assessment tool with a Habitat Equivalency Analysis (HEA), the revised tool provides a means to comprehensively evaluate the loss of ecological service across a wider range of habitats of which may not have equal value or service to the Jamaica Bay ecosystem.

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So What is HEA?

- HEA is a technique used to estimate/negotiate the restoration required to offset a natural resource injury.
  - Normally applied to Natural Resource Damage Assessment
- Critical variables that support HEA:
  - Estimate of area impacted by project
  - Service loss as a percent of baseline service
  - Period of time which the service loss occurs

HEA Conceptual Example

- Project disturbs 1 acre of wetland habitat that provides 50% service to a sensitive species.
- Loss is equal to 0.5 “service acre years” (SAYs)
  - 1 acre x 1 year x 0.5 service loss = 0.5 SAYs
- However, benefits of subsequent restoration efforts occur over time. HEA adjusts this benefit based upon a discount rate. Produces a final metric of “discounted service acre years (DSAYs) which incorporates the annualized discount and sums across the SAYs over the life of a project

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HEA Variable #1 – Impacted Area

- Habitats were mapped across each of the alternative alignments, and temporary and permanent impacts calculated.
- Habitat types include:
  - Oyster Reef
  - Marsh Islands
  - Intertidal Mudflats
  - Subtidal Bottom
  - Intertidal Wetland
  - Intertidal Non-native wetland
  - Rip Rap/Bulkhead
  - Beach
  - Dune
  - Forest/Shrubland
  - Ruderal
  - Urban

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HEA Variable #2 – Service Loss

Level of current ecological service or function based upon field data and ecological assessment results.

- B-IBI for subtidal bottom and intertidal mudflat
- EPW for intertidal wetlands
- Modified EPW for uplands

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HEA Variable #3 – Recovery Period

Habitat	Recovery Period (Years)
Oyster Reef	1
Marsh Islands	5
Intertidal Mudflats	3
Subtidal Bottom	3
Intertidal Wetland	5
Intertidal Non-Native Wetland	5
Beach	1
Dune	5
Maritime and Coastal Forest and Shrubland	30
Bulkhead/Rip Rap	1
Ruderal	1

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Analytical Hierarchy Process

- HEA assumes habitat restored = habitat injured.
- However, habitats that are injured versus those restored may not be equivalent with respect to the services they provide to the resources of interest.
- HEA methodology was modified to accommodate a quantitative descriptor of relative habitat quality.
  - More effective tool to quantify losses and gains when the injured and restored habitats may be different.
- A decision analysis tool, the AHP, is a modification to the HEA process that provides weighted rankings of the identified habitats.

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AHP – Resources of Interest

- Submerged aquatic veg.
- Coastal wetland veg.
- Coastal upland veg.
- Benthic invertebrates
- Blue crab
- Horseshoe crab
- American lobster
- Oyster
- Mussels (blue)
- Mussels (ribbed)
- Clams
- Migratory fish
- Resident fish
- Diamondback terrapin
- Wading birds
- Seabirds
- Waterfowl
- Shorebirds
- Osprey
- Passerine birds
- Mammals
- Insects

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AHP – Weighted Rankings & Habitat Equivalency Factors

Habitat	Weighted Ranks	Habitat Equivalency Factors
Oyster Reef	0.091	0.78
Marsh Islands	0.116	0.99
Intertidal Mudflats	0.111	0.96
Subtidal Bottom	0.107	0.92
Intertidal Wetland	0.116	1.00
Intertidal Non-Native Wetland	0.087	0.75
Beach	0.080	0.69
Dune	0.079	0.68
Maritime and Coastal Forest and Shrubland	0.082	0.71
Rip Rap	0.068	0.58
Ruderal	0.062	0.53

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Impact Assessment – DSAY Metric

Modified HEA facilitates a metric of loss associated with each alternative plan in terms of ecological service. This then facilitates a target to select appropriate mitigation to offset these impacts.

Alternative	Service Loss (DSAYs)
Plan A	-1000
Plan B	-1500
Plan C	-3000

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Mitigation Selection

Project Name	Total Adjusted DSAYs	Estimated Construction Costs	Costs Per dSay
Shellbank Creek Habitat Restoration	117.5	$21,615,701	$183,974
Marine Park West Side Marsh Restoration	105.6	$4,725,000	$44,755
Floyd Bennett Field Wetlands Center and Habitat Creation	2039.3	$63,509,723	$31,143
Mill Basin Habitat Restoration	97.5	$10,214,112	$104,803
Dead Horse Bay Habitat Restoration	1319.9	$59,873,406	$45,363
Fresh Creek Habitat Restoration	331.4	$37,252,938	$112,418
Hendrix Creek Ecological Restoration	46.5	$2,450,000	$52,641
Motts Basin Habitat Restoration	130.3	$12,571,785	$96,480
Bayswater State Habitat Restoration	46.8	$3,480,116	$74,305
Bayswater City Habitat Restoration	36.8	$1,155,000	$31,378
Conch Basin Habitat Restoration	101.0	$3,041,500	$30,121
Dubos Point Habitat Restoration	88.8	$5,935,391	$66,806
Brant Point Habitat Restoration	39.0	$8,687,248	$222,548
Vernam Barbados Habitat Restoration	319.6	$10,920,000	$34,165
Sunset Cove Ecological Restoration and Resiliency Project	171.3	$7,240,000	$42,255
Elders Marsh Island	752.4	$30,960,000	$41,150
Pumpkin Patch Marsh Island	430.5	$17,200,000	$39,958
Duck Point Marsh Island	411.7	$15,910,000	$38,649

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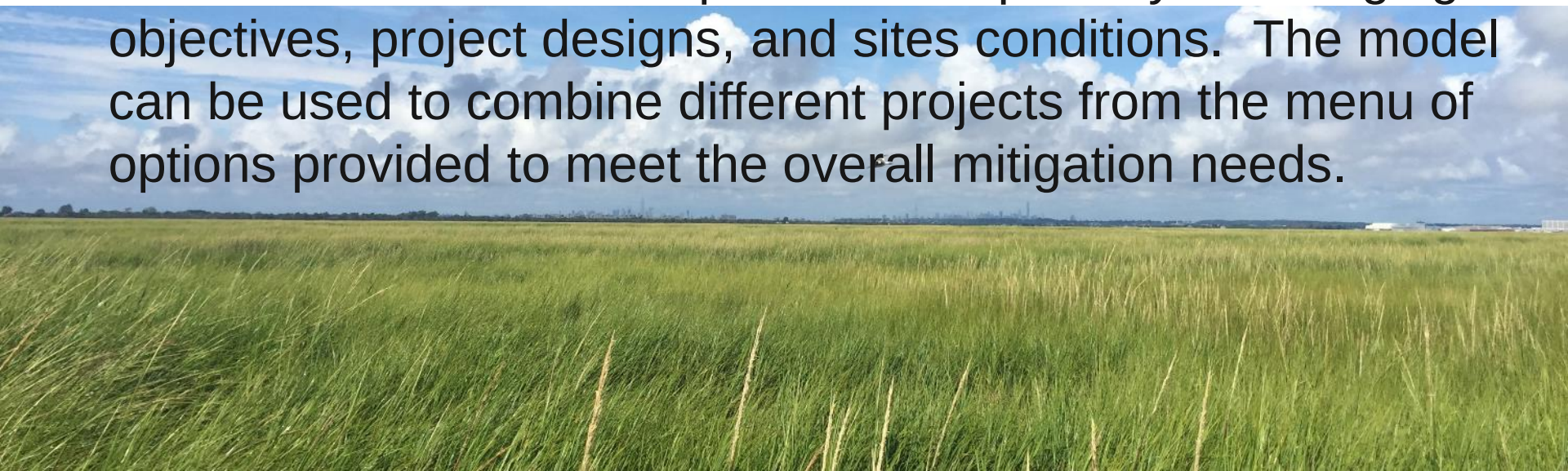
Summary

Framework for ecological, and economic, informed decisions with respect to compensatory mitigation across range of habitats critical to Jamaica Bay.

Modified HEA framework provides adaptability to changing objectives, project designs, and sites conditions. The model can be used to combine different projects from the menu of options provided to meet the overall mitigation needs.



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