US Army Corps of Engineers®
New York District

NEW YORK –NEW JERSEY HARBOR AND TRIBUTARIES COASTAL STORM RISK MANAGEMENT STUDY

Draft Tier 1 EIS

INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A10:

Tier 1 Conceptual Mitigation and Monitoring Plan

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1 Introduction

Storms have historically severely impacted the NY/NJ Harbor region, including Hurricane Sandy most recently, causing loss of life and extensive economic damages. In response, the U.S. Army Corps of Engineers (USACE) New York District is investigating measures to manage future flood risk in ways that support the long-term resilience and sustainability of the coastal ecosystem and surrounding communities, and reduce the economic costs and risks associated with flood and storm events for the NYNJHAT Study Area (USACE 2019). The alternative concepts proposed would help the region manage flood risk that is expected to be exacerbated by relative sea level rise.

In 2012, Hurricane Sandy caused considerable loss of life, extensive damage to property, and massive disruption to the North Atlantic Coast. The effects of this storm were particularly severe because of its tremendous size and the timing of its landfall during high tide. Twenty-six states were impacted by Hurricane Sandy, and disaster declarations were issued in 13 states. New York (NY) and New Jersey (NJ) were the most severely impacted states, with the greatest damage and most fatalities in the NY Metropolitan Area. For example, a storm surge of 12.65 feet above normal high tide was reported at Kings Point on the western end of Long Island Sound and 9.4 feet at the Battery on the southern tip of Manhattan. Flood depths due to the storm tide were as much as nine feet in Manhattan, Staten Island, and other low-lying areas within the NY Metropolitan Area. The storm exposed vulnerabilities associated with inadequate coastal storm risk management (CSRM) measures and lack of defense to critical transportation and energy infrastructure.

Devastation in the wake of Hurricane Sandy revealed a need to address the vulnerability of populations, infrastructure, and resources throughout the entire North Atlantic coastal region. At the time of the publication of this report, Hurricane Sandy was the second costliest hurricane in the nation's history and the largest storm of its kind to hit the East Coast. To address the impacts and concerns associated with devastating storms, the USACE has proposed measures to manage coastal storm risk in the NY/NJ Harbor and its tributaries.

The NYNJHAT study was identified as a Focus Area of Analysis at continued risk of coastal storm damage, as part of the North Atlantic Coast Comprehensive Study (NACCS). The NACCS was completed under the authority of P.L. 113-2, the Disaster Relief Appropriations Act of 2013, which was passed into law to assist in the recovery and long-term resilience of coastal communities impacted by Hurricane Sandy in 2012. The USACE North Atlantic Division was authorized by P.L. 113-2 to commence the NACCS to investigate CSRM strategies for areas impacted by the storm. The 2015 NACCS Report identifies nine high-risk focus areas along the Atlantic Coast that warrant additional analyses to address coastal flood risk, including the NYNJHAT area. The current study builds upon the NACCS analysis, and upon the NY-NJ Harbor and Tributaries Interim Report (USACE 2019), an informational report that documented the existing conditions and planning framework for this study.

This study is a joint effort of the USACE New York District and two non-federal sponsors, the New Jersey Department of Environmental Protection (NJDEP) and New York State Department of Environmental Conservation (NYSDEC). The New York State Department of State (NYSDOS) and New York City Mayor's Office of Climate and Environmental Justice (NYCMOCEJ) are study partners.

1.1 Purpose and Need for a Mitigation and Monitoring Plan

The Conceptual Mitigation and Monitoring Plan is an element of an integrated feasibility report and Tier 1 EIS and describes potential environmental impacts, pursuant to the National Environmental Policy Act (NEPA). Mitigation, as defined by the Council on Environmental Quality (40 CFR § 1508.20) includes (a) avoiding the impact by not taking a certain action or parts of an action; (b) minimizing the impact by limiting the degree of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating or restoring the effected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; (e) compensating for the impact by replacing or providing substitute resources or environments.

The NYNJHAT EIS will be conducted in two stages or tiers. The Tier 1 EIS is a broad-level review, and a future Tier 2 EIS will consist of subsequent specific detailed reviews. The Tier 1 review identifies and evaluates the issues that can be fully addressed and resolved, notwithstanding possible limited knowledge of the project. In addition, it establishes the standards, constraints, and processes to be followed in the specific detailed reviews. The Tier 1 review and all specific detailed reviews collectively comprise a complete environmental review addressing all required elements. Tiering the EIS resolves the "big-picture" issues so that subsequent studies can focus on project-specific impacts and issues. It also allows environmental analyses for each Tier 2 project to be conducted closer in time to the actual construction phase, or as funds become available for construction.

This Conceptual Mitigation and Monitoring Plan covers impacts identified during the Tier 1 analysis and only addresses the compensatory mitigation method. The other forms of mitigation exercised prior to considering compensatory mitigation (e.g., avoidance, minimization, reduction of impact) are addressed in the Environmental Impacts section of the EIS. The plan identifies and describes the mitigation activities proposed and the estimated cost of the effort. The general purpose of this plan is to provide a systematic approach for improving resource management outcomes and a structured process for recommending decisions, with an emphasis on uncertainty to improve management. In addition, the plan establishes the framework for effective monitoring, assessment of monitoring data and decision making for implementation of adaptive management activities in the project area.

2 Study Area

The project Study Area for the Tier 1 EIS includes NY and New Jersey Harbor and tidally affected tributaries encompassing all of New York City (NYC), the Hudson River (HR) to Troy, NY; the lower Passaic, Hackensack, Rahway, and Raritan Rivers; and the Upper and Lower Bays of NY Harbor, Newark, Jamaica, Raritan and Sandy Hook Bays; the Kill Van Kull, Arthur Kill and East River tidal straits; and western Long Island Sound. The Study Area covers more than 2,150 square miles and comprises parts of 25 counties in NJ and NY, including Bergen, Passaic, Morris, Essex, Hudson, Union, Somerset, Middlesex, and Monmouth Counties in NJ; and Rensselaer, Albany, Columbia, Greene, Dutchess, Ulster, Putnam, Orange, Westchester, Rockland, Bronx, New York, Queens, Kings, Richmond, and Nassau Counties in NY.

The Study Area has been separated into nine Planning regions based on the hydrologic unit codes (HUCs) from the Watershed Boundary Dataset of the U.S. Geological Survey (USGS) (Figure 2-1).

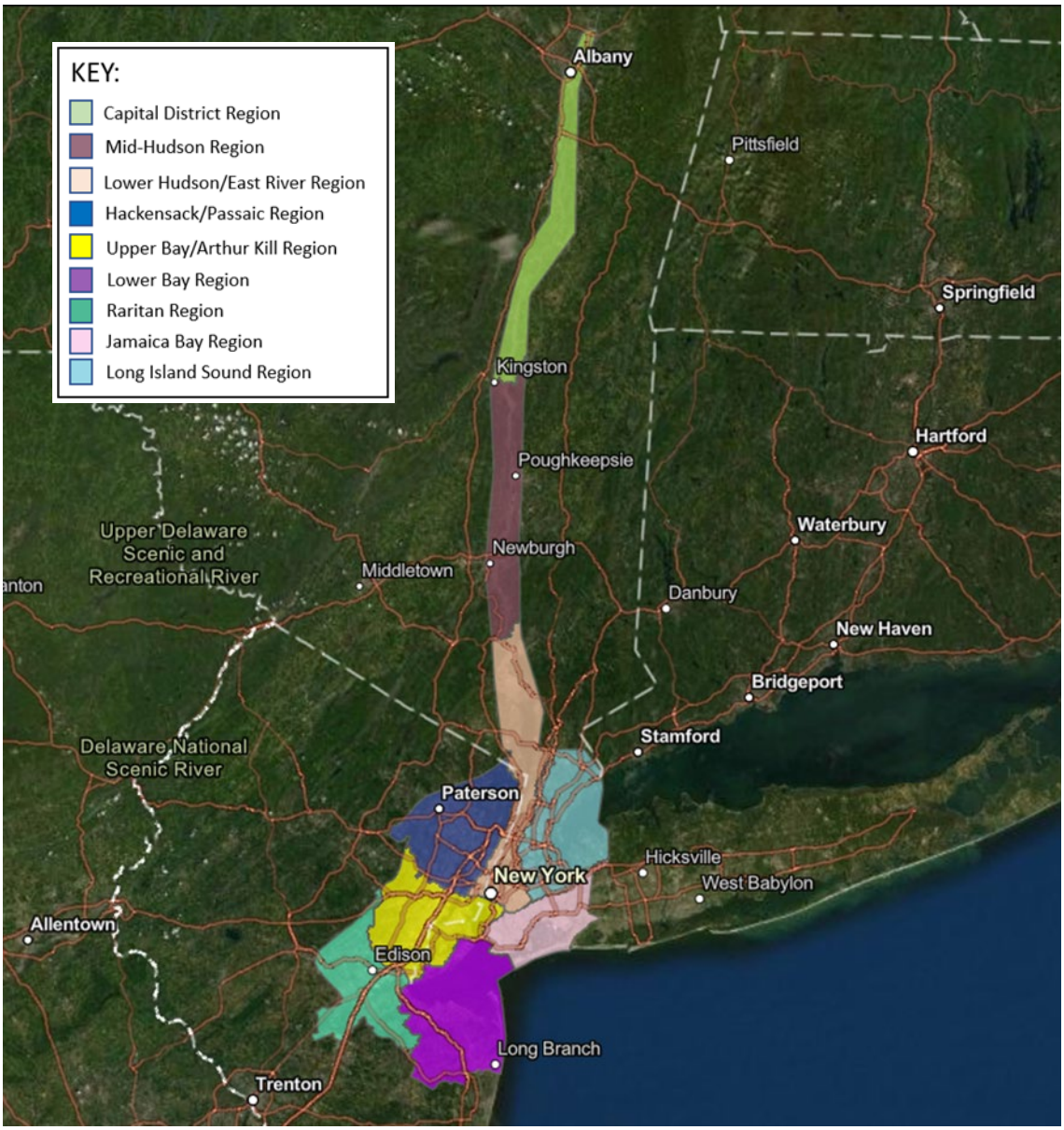

Figure 2-1: Overview of USACE New York-New Jersey Harbor and Tributaries Study Area and Planning Regions

3 Tentatively Selected Plan (TSP) Description

The TSP is Alternative 3B – Multi-basin SSBs With Shore-Based Measures. The TSP includes a combination of coastal storm risk management (CSRM) measures that function as a system to manage the risk of coastal storm damage in the New York Metropolitan Area, including a combination of shore-based and in-water measures. These measures are located within the Hackensack/Passaic, Upper Bay/Arthur Kill, Lower Hudson/East River, Long Island Sound and Jamaica Bay Planning Regions. The TSP measures include storm surge barriers (SSBs), Shore-Based Measures (SBMs), complementary Induced Flooding-Mitigation Features (IFFs) and Risk Reduction Features (RRFs) as well as nonstructural measures and natural and nature-based features described in more detail as follows:

The TSP includes SSBs and complementary SBMs at Jamaica Bay, Arthur Kill, Kill Van Kull, Gowanus Canal, Newtown Creek, Flushing Creek, Sheepshead Bay, Gerritsen Creek, Hackensack River, Head of Bay, Old Howard Beach East, and Old Howard Beach West. The SBMs would provide land-based CSRM and include floodwalls, levees, elevated promenades, buried seawalls/dunes, revetments, berms, bulkheads, pedestrian/vehicular gates, and road raisings. Ringwalls and SBMs will also be considered under the TSP, to be further refined for the Final Integrated FR/Tier 1 EIS.

RRFs would provide CSRM in areas behind SSBs that may experience high frequency flooding when the barriers are not operated.

IFFs would provide CSRM in areas in front of SSBs that may experience induced flooding due to operation of the SSBs.

Nonstructural measures to be included in the TSP may include structure elevations and floodproofing. Currently, conceptual nonstructural measure locations are located throughout the Study area; however, nonstructural measures and locations will be further refined for the Final Integrated FR/Tier 1 EIS.

Natural and nature-based features (NNBF) to be included in the TSP consist primarily of natural features such as wetlands and living shorelines that may provide both CSRM and ecological enhancement. Specific NNBF types and locations will be further refined for the Final Integrated FR/Tier 1 EIS. At this time, it is anticipated they will be located in areas that experience high frequency coastal flooding.

While the TSP will improve coastal flood risks in the project area, it will not totally eliminate flood risks; therefore, residual risk for flooding still remains a threat to life and property. It is essential that flood risk be proactively communicated to residents in accessible and thoughtful ways.

This assessment only includes structural measures of the TSP. Structural measures included in the TSP are show in Table 3-1 by Planning Region, and on Figures 2-2 and 2-3.

Figure 3-1. Regional Overview of All Features Included in the TSP.

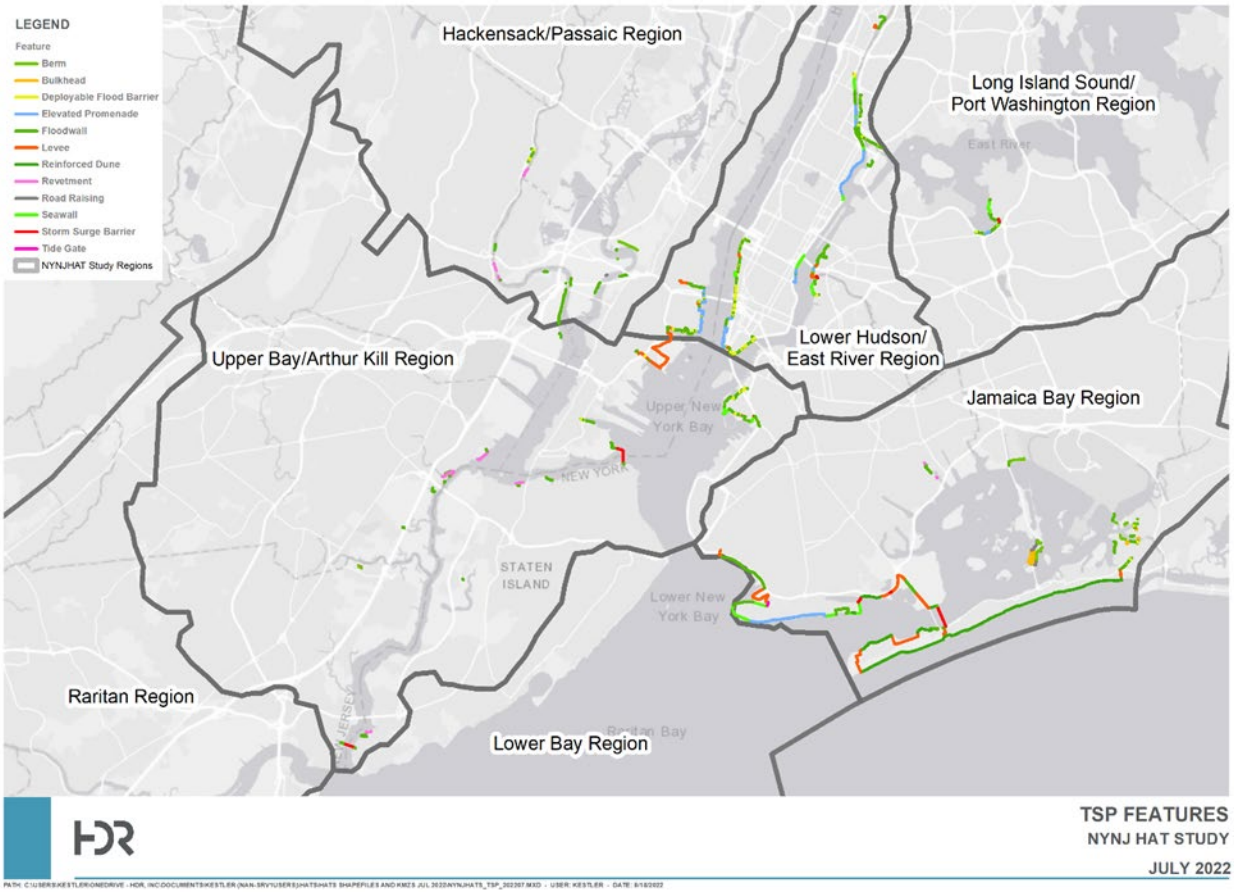

Figure 3-2. Features Included in the TSP per Planning Region

Table 3-1: Structural measures included in the TSP, by Planning Region.

Planning Region	Storm Surge Barriers	Tide Gates	Floodwalls	Levees	Elevated Promenades	Buried Seawalls/Sand Dunes	Seawalls	Revetments	Berms	Bulkheads	Pedestrian/Vehicular Gates	Road Raising
Capital District												
Mid-Hudson												
Lower Hudson/East River	●		●	●	●		●				●	
Upper Bay/Arthur Kill	●	●	●	●			●	●	●		●	
Lower Bay												
Hackensack/Passaic			●					●	●		●	●
Raritan Region												
Long Island Sound	●		●		●		●					
Jamaica Bay	●	●	●	●	●	●	●	●	●	●	●	●

● = Included in the Planning Region

4 Impacts Associated with the TSP

4.1 Marine/Estuarine Deepwater and Subtidal

Impacts are anticipated to the marine/estuarine subtidal zone in the Study Area during construction and operations and maintenance activities, depending on the measure and existing conditions. For in-water construction activities, impact-producing factors are similar to other marine ecosystem zones and include: physical seabed/land disturbance, sediment suspension, discharge/release and withdrawals, habitat conversion, and noise. These impacts include physical alterations to the habitat, including changes in water depth, bathymetry, hydrodynamics, and sediment suspension and deposition.

Direct permanent impacts from foundation installation and structure installation include the replacement of benthic habitat with hard-bottom habitat in marine/estuarine deepwater and nearshore subtidal habitats. These impacts are expected to occur during the construction of in-water measures such as the SSBs and tide gates, but would only occur within a small percentage of the available marine/estuarine deepwater and subtidal habitat in the Study Area.

Direct impacts to benthic fauna would occur from habitat disturbance. Based on previous studies, the re-establishment of marine benthic communities varies between six months to a year after the project's completion, depending on substrate type (Wilber and Clarke 2007). Direct impacts could occur during construction site preparation and dewatering activities which increase turbidity. In areas where the sediment is predominately sand, temporary impacts would be minimal as sand settles out of the water column quickly. Suspension of sediments is anticipated to be negligible due to implementation of site-specific construction BMPs and SWPPPs and expected to cause short-term, temporary impacts to sessile species. Mobile benthic species are anticipated to move from the areas of construction to more suitable habitat. Shellfish and sessile benthic communities will experience injury and mortality from contact with construction equipment and foundation installation within the vicinity of the placement of new structures.

Construction of in-water structures could cause changes to the marine/estuarine subtidal community composition and attraction of structure-oriented invertebrates. The foundation and structure installations can produce the artificial "reef effect," attracting numerous species of algae, shellfish, and other invertebrates. The loss of this benthic habitat is expected to be offset by the introduction of new, hard-bottom substrate that will support new benthic communities. Biofouling of underwater structures could also occur, causing a long-term permanent impact.

Pelagic marine fish species and life stages generally occur in the middle and upper levels of the water column and would be impacted in the subtidal marine/estuarine zone. Life stages potentially impacted include planktonic egg and larval stages of many marine and estuarine species, as well as schooling pelagic adults and juveniles, which are not generally associated with bottom habitats. Many of these species are transient, spending only a portion of their life cycle in the project area

for spawning, growth, or development, while others are anadromous, migrating through the project area to upstream spawning sites.

A variety of fish species and life-stages occupy the estuarine subtidal zone and commonly occur in tidal creeks and backwater bays that could potentially be impacted by the planned measures. These include the larval and early juvenile life-stages of estuarine-spawning species, which use these areas as nurseries for growth and development. Others include resident and transient forage species that provide an important trophic link between estuarine and marine environments. Shallow-water pelagic fish species and life-stages are generally tolerant of rapidly changing environmental conditions, often exhibiting daily or tide-dependent movements. Many of these species could temporarily be displaced by construction activities. Displaced individuals are expected to occupy nearby estuary subtidal zones that provide suitable habitat, then return when construction is completed.

Construction of shore-based measures (including deployable flood barriers, seawall, buried seawall/dune, floodwall, floodwall with park, stone toe-protection, and rock sill structure) may result in temporary impacts to the subtidal zone, depending on proximity to the water. Direct impacts to fish species in shallow water areas could occur during construction site preparation and dewatering activities which increase turbidity. In areas where the sediment is predominately sand, temporary impacts would be minimal as sand settles out of the water column quickly. Demersal fish (e.g., flounder, hake) may experience displacement during construction activities due to noise, vibration, and physical disturbance of the benthic habitats. These impacts are expected to be temporary for mobile species that can move to adjacent suitable habitat during the duration of construction. No impacts are expected from levees because they are set back from the shoreline.

Temporary in-water impacts include increased turbidity during construction activities and resuspension of sediments into the water column during foundation installation, dredging, dewatering, and excavation and fill activities. Temporary and localized impacts to water quality from vessel anchoring and dewatering activities may occur but are expected to return to pre-existing conditions rapidly following active construction. Spills or leaks of fuels, lubricants, and coolant from construction equipment could adversely impact water resources. Site-specific SPCCs would be developed and implemented to prevent spills and minimize the potential impacts for any inadvertent spills. With implementation of SPCCs and BMPs, impacts from spills or leaks are anticipated to be minor. Water quality is anticipated to return to baseline conditions after construction activities are completed.

Direct impacts to marine/estuarine deep benthic resources are anticipated during operation of tide gates and SSBs. Indirect impacts during barrier closure include temporary changes to hydrology and water quality, such as increases in turbidity and sediment suspension. Increased noise and vibration would be temporary and limited to the duration of barrier closure. Mobile benthic organisms are anticipated to move away from the area of operation to more suitable habitat. Sessile

benthic communities may experience direct mortality during gate barrier closure and potential smothering from suspended sediments.

4.2 Marine/Estuarine Intertidal

Impacts to the estuary intertidal zone are similar to the anticipated impacts to the estuary subtidal zone. For in-water construction activities, impacts may include: physical seabed/land disturbance, sediment suspension, discharge/release and withdrawals, habitat conversion, and noise. These impacts include physical alterations to the habitat, including changes in water depth, bathymetry, hydrodynamics, and sediment suspension and deposition. Few impacts to the estuary intertidal zone are anticipated from construction of the shore-based measures, however, turbidity and sediment deposition could occur when activities such as scouring at the toe of structural measures and the hardening of shore-based structures contributes to runoff that enters an estuary.

Direct permanent impacts from foundation installation and structure installation include the replacement of benthic habitat with hard-bottom habitat. These impacts are expected to occur during the construction of in-water measures such as the SSBs and tide gates, which have the potential to produce significant impacts to a small percentage of the available marine/estuarine intertidal habitat.

Direct impacts to benthic species that inhabit the estuary intertidal zone would occur from habitat disturbance. Direct impacts could occur during construction site preparation and dewatering activities which increase turbidity. In areas where the sediment is predominately sand, temporary impacts would be minimal, and restricted to high tide events as sand settles out of the water column quickly. Suspension of sediments is anticipated to be negligible due to the restricted duration of inundation and implementation of site-specific construction BMPs and SWPPPs. Mobile benthic species are anticipated to move from the areas of construction to more suitable habitat. Shellfish and sessile benthic communities will experience injury and mortality to individuals from contact with construction equipment and foundation installation. This loss of individuals will be localized within the vicinity of the placement of new structures.

Shallow-water marsh fish species and life-stages generally occur in the intertidal and subtidal marsh habitat. Many are resident, spending their entire life cycle within the estuary and salt marsh. These species or life-stages may occupy high salt marsh, low salt marsh, or tidal creeks, commonly moving between the intertidal and subtidal areas on flood and ebb tides, are highly tolerant to fluctuations in salinity and water temperature and can often endure low (<0.5 ppm) DO concentrations. Many of these species could temporarily be displaced by construction activities. Displaced individuals are expected to occupy nearby estuary intertidal zones that provide suitable habitat, then return when construction is completed.

Direct impacts to marine/estuarine intertidal benthic resources are anticipated during operation of tide gates and SSBs. Indirect impacts during barrier closure include temporary changes to hydrology and water quality, such as increases in turbidity and sediment suspension. Increased

noise and vibration would be temporary and limited to the duration of barrier closure. Mobile benthic organisms are anticipated to move away from the area of operation to more suitable habitat, as determined by the duration and extent of tidal inundation. Sessile benthic communities may experience direct mortality during gate barrier closure and potential smothering from suspended sediments.

4.3 Submerged Aquatic Vegetation (SAV)

Submerged Aquatic Vegetation (SAV) is important habitat for many benthic organisms and larval and juvenile fish. Habitat disturbance, resuspension of sediments, and changes in DO and salinity ranges due to prolonged flooding may result in impact to SAV. Impacts to SAV are anticipated to be minor in the Study Area with NYNJHAT study implementation during construction and operations and maintenance depending on the measure and existing conditions. The following are impact producing factors to SAV: physical seabed disturbance, sediment suspension, discharge/release and withdrawals, and habitat conversion.

Impacts to SAV may occur in the vicinity of Gateway National Recreation Area at Sandy Hook, within the Lower Bay Region. SAV is mapped on the bay side of Sandy Hook, within the Gateway Recreation Area, to the north of Monmouth Hills and to the southwest of Navesink Beach (NJDEP 2022). SAV habitat was also documented in the Navesink and Shrewsbury Rivers in 1983, 1980 and 2015.

Shallow water habitats of the lower HR (including Haverstraw Bay), Mid-HR, and Capital District also have mapped areas of SAV, however, they are not near the proposed project measures. Because the footprint of the measures proposed in NYNJHAT study are not located in the mapped area of SAV, impacts from construction are expected to be minor.

Within JB, SAV has been limited by anthropogenic activities, including nutrient loading, eutrophication, dredging, infrastructure and residential development (USACE 2020). SAV is no longer present in the Region. There is no documented SAV within the Hackensack/Passaic, Upper Bay/Arthur Kill, and Raritan Region (USACE 2020 and NJDEP 2022), and no SAV has been reported in the Long Island Sound Region.

During the Summer of 2012, the NYSDEC noted that water celery, a native, freshwater - oligohaline SAV species, was absent in HR locations where it was previously observed, possibly due increased sediment transport that occurred during Hurricane Irene and Tropical Storm Lee which prevented the submerged plants from receiving sunlight. However, within the past decade, SAV has largely recovered in the die-off areas of the mid-lower HR, as documented by recent 2016-2018 air photography surveys performed by NYSDEC (NYSDEC 2022). The NYNJHAT Study is expected to have a net benefit to SAV by protecting not only coastal zones, but also areas upstream within the HR from the devastating effects of storm surges.

4.4 Wetlands

Excavation and fill activities associated with some measures, such as an elevated promenade and seawall, may permanently impact wetlands and their transition zones through removal of vegetation and filling. Foundation installation may cause long-term permanent impacts to wetland habitat through vegetation removal and conversion to impervious surfaces. The SSBs and tide gates could cause permanent changes in hydrology which could lead to secondary impacts to wetlands through scouring or sedimentation. Construction of buried seawall and dune features will affect wetlands in the JB Planning Region under Alternative 3B. Moderate impacts to estuarine and marine wetlands may also occur from construction of levees and berms in the Hackensack/Passaic Region and construction of floodwalls and revetments in the Upper Bay/Arthur Kill Region. Construction is also expected to impact wetlands in the Lower Hudson/East River and Long Island Regions from levees and other shore-based measures, but will result in lesser impacts in these Regions, with fewer wetlands and fewer crossings.

Temporary impacts to wetlands, vegetation, surface waters, and floodplains will occur during the construction of shore-based measures, including deployable flood barriers, elevated promenades, seawalls, buried seawall/dunes, levees, and floodwalls. Preparation of the construction sites would require clearing and grading of vegetation that could result in temporary wetland habitat impacts. Any temporary impacts to vegetation are anticipated to be replaced on-site and in-kind. Dewatering activities may cause temporary direct impacts to wetland areas during construction, but dewatered areas will be returned to pre-existing conditions post construction. Potential dredging in wetlands and intertidal habitats would also cause temporary impacts during construction, and adjacent transition areas may also be temporarily affected by clearing and soil disturbance. Temporary impacts would be managed through implementation of site-specific SWPPPs and construction BMPs.

Beneficial long-term impacts to wetlands from the wetland creation and restoration measure are anticipated. Wetlands would provide improved water quality, flood control, and ecological benefits to wildlife and fisheries resources. As the project measures become more defined and site-specific surveys are completed to determine areas of wetland creation and restoration, the impacts will be quantified during the Tier 2 evaluation.

During operations and maintenance of the proposed in-water measures, potential impacts to wetlands may occur, but are anticipated to be low overall. When the barriers are in the open position, no impacts would occur to wetlands. When the barriers are in the closed position, minor temporary impacts are anticipated, such as short-term changes in hydrology, sediment resuspension and minor increases in turbidity during operation. Secondary flooding from barrier closure could also occur, causing higher inundation within wetlands. However, an intended beneficial impact of closing the barriers during significant storm events, would be the reduction of risk to wetlands from flooding and erosion damage associated with storm surge. Without the

proposed project measures, the Study Area will continue to experience catastrophic damages and loss of valuable natural resources like those seen during Hurricane Sandy.

To determine site-specific impacts and potential mitigation requirements, site-specific wetland delineation surveys would be conducted for the development of the Tier 2 EIS and/or permit applications. Wetland delineation survey scope will be based on project location and design.

4.5 Uplands and Riparian Areas

Excavation and fill activities associated with the measures may permanently impact uplands and riparian areas through removal of vegetation and filling. Foundation installation may cause long-term permanent impacts to uplands and riparian areas through vegetation removal and habitat conversion to impervious surfaces. Installation of some of the shore-based measures such as seawall and floodwalls may impact riparian areas by reducing or eliminating their connection to streams and tidal waters. During construction, the SSBs and tide gates could cause permanent changes in hydrology, which could lead to secondary impacts to uplands and riparian areas through scouring or sedimentation.

Temporary impacts to uplands and riparian areas will result from the construction of shore-based measures. Preparation of the construction sites would require clearing and grading of vegetation that could result in temporary impacts within uplands and riparian areas. Any temporary impacts to vegetation are anticipated to be replaced on-site and in-kind. Dewatering activities and associated increases in water may cause temporary direct impacts to uplands and riparian areas during construction but would not cause long-term permanent impacts as dewatered areas will be returned to pre-existing conditions post construction.

During operations and maintenance of the proposed measures, potential negative impacts to uplands and riparian areas from storm surge and tide gate measures may occur. When the barriers are in the open position, no impacts would occur to uplands and riparian areas. When the barriers are in the closed position, which would be when storm surge was expected, uplands and riparian areas behind the barrier would benefit from the protection measures. However, moderate impacts could occur from secondary flooding from barrier closure, causing higher inundation within uplands and riparian areas in front of the barrier. Other minor temporary impacts to uplands and riparian areas are anticipated, such as short-term changes in hydrology.

Mitigation for construction within uplands and riparian areas may be required in regulated areas. Site-specific mitigation plans will be developed to offset project impacts to floodplains and will be developed as part of the Tier 2 EIS.

5 Compensatory Mitigation Requirements and Guidance (Federal, State, NYC)

Compensatory mitigation for impacts associated with construction and operation of the TSP will follow all applicable Federal (Corps), State (NY and NJ) and municipal (NYC) laws, regulations and guidance protocols. Corps regulations stipulate that the recommended plan must contain sufficient mitigation measures to ensure that the plan selected will have no more than negligible net adverse impacts on fish and wildlife resources, including impacts of the mitigation measures themselves. Corps guidance also requires a cost effectiveness analysis and an incremental cost analysis for recommended environmental restoration and mitigation plans. The mitigation and monitoring plan will be reviewed and revised as needed as specific design details are made available following site-specific impact analyses conducted under the future Tier 2 EIS.

5.1 Federal Compensatory Mitigation Guidelines

The following laws and Corps guidance documents are pertinent to the development and implementation of the NYNJHATS Mitigation and Monitoring Plan:

- CECW-PC 31 August 2009 Memo: Implementation Guidance for Section 2036(a) of the Water Resources Development Act of 2007 (WRDA 07) – Mitigation for Fish and Wildlife and Wetlands Losses" – requires: 1) monitoring until successful, 2) criteria for determining ecological success, 3) a description of available lands for mitigation and the basis for the determination of availability, 4) the development of contingency plans/adaptive management plans, 5) identification of the entity responsible for monitoring; and 6) establish a consultation process with appropriate Federal and State agencies in determining the success of mitigation.
- ER 1105-2-100 dated 22 April 2000, Planning Guidance Notebook, Section C-3 e. Mitigation Planning and Recommendations
- Compensatory Mitigation for Losses of Aquatic Resources; Final Rule; Federal Register, Volume 73, No. 70, April 10, 2008.
- Water Resource Reform and Development Act (WRRDA) 2014, Section 1040 Fish and Wildlife Mitigation.
- Water Infrastructure Improvements for the Nation Act (WIIN Act) 2016, Sections 1162 Fish and Wildlife Mitigation, and 1163 Wetlands Mitigation. Implementation Guidance has not been issued by USACE HQ.
- CECW-P 02 February 2018 Memo Implementation Guidance for Section 1162 of the Water Resources Development Act of 2016 (WRDA 2016) - Fish and Wildlife Mitigation. Section 1162 authorizes the use of Preconstruction, Engineering Design funds to satisfy

mitigation requirements through 3rd party arrangements or acquire lands for mitigation requirements.

- 16 November 2017 Memorandum for the Commanding General of the U.S. Army Corps of Engineers - Implementation Guidance for Section 1163 of the Water Resources Development Act of 2016 (WRDA 2016), Wetlands Mitigation. Rescinds CECW-P 06 November 2008 Memorandum Implementation Guidance for WRDA 2007 – Section 2036 (c). Establishes the following criteria for the use of mitigation banks and in-lieu fee credits as a mitigation alternative: a) demonstration of an approved mitigation banking instrument; b) the mitigation bank and/or in-lieu fee program operates within the service area of the impact; c) completion of a functional analysis of the potential credits using the approved Corps of Engineers certified habitat assessment model specific to the region; d) demonstration that the statutory (and regulatory) mitigation requirements, including monitoring or demonstrating mitigation success have been met; and e) purchase of credits prior to award of a construction contract for the project.

5.2 State (NY and NJ) Mitigation Guidelines

Impacts to regulated habitat are located within the states of NJ and NY. For NY State, the following regulations are pertinent to the development and implementation of a compensatory mitigation program in the state's coastal zone:

- NY State's Freshwater Wetlands Act (Article 24, Title 23 of Article 71 of the Environmental Conservation Law) does not specifically address wetland mitigation.

  However, a supplemental NYSDEC guidance document addresses compensatory mitigation under the authority of Article 24 and ECL-15, the States Protection of Open Water Act, as follows:

  - Priority requirements are to first avoid and then minimize project impacts
  - Compensatory mitigation should preferably be "in-kind"
  - Compensatory mitigation preferably should be "on-site
  - The preferred order of compensatory mitigation is wetland restoration, then creation, and finally enhancement.
  - Mitigation proposals should be based on plans containing clear specific detail, short and long term goals and measurable performance criteria.
  - Mitigation preferably should be completed prior to starting the permitted project or concurrently with it.

NYSDOS administers the state's Coastal Zone Management Program, advocating for specific, desired coastal actions while simultaneously coordinating programs, activities, and decisions which affect the coast. The Waterfront Revitalization and Coastal Resources Act authorizes NYSDOS, through the CZM to coordinate among disparate agencies, management of the state's coastal zone. While NY's CZM program promotes a variety of statewide coastal issues, Coastal Policy #44 most directly addresses coastal habitat restoration, as follows:

Preserve and protect tidal and freshwater wetlands and preserve the benefits derived from these areas. - "Tidal wetlands include the following ecological zones: coastal fresh marsh, intertidal marsh, coastal shoals, bars and flats, littoral zone, high marsh or salt meadow, and formerly connected tidal wetlands. These tidal wetland areas are officially delineated on the Department of Environmental Conservation's Tidal Wetlands Inventory Map."

In administering its Tidal Wetlands Permit Program, in accordance with the Tidal Wetland Act of 1973 (Article 25, Title 3, Section 25) NYSDEC regulates and defines the "littoral zone" as "The tidal wetland zone that includes all lands under tidal waters which are not included in any other category, extending seaward from shore to a depth of six feet at mean low water."

NY's Coastal Erosion Hazard Areas law (ECL, Article 34) and The Waterfront Revitalization of Coastal Areas and Inland Waterways law (ECL, Article 42) authorizes the Coastal Management Program to advocate for the preservation of coastal wetlands and their benefits, broadly defined above to include shallow, unvegetated littoral areas, as well as vegetated tidal and freshwater wetlands. However, compensatory mitigation is not specifically described as a means of preserving coastal habitats, or their functions under Policy #44..

- NYC administers its own coastal zone management program. The NYC Waterfront Revitalization Program (WRP) was originally adopted in 1982 and approved by NYSDOS for inclusion in the NY State Coastal Management Program. The WRP establishes the city's policies for development and use of the waterfront and provides a framework for evaluating discretionary actions in the coastal zone, including wetland impacts and compensatory mitigation alternatives. .

For NJ, the following regulations are pertinent to the development and implementation of a compensatory mitigation program in the state's coastal zone:

- NJ Freshwater Wetlands Protection Act, N.J.S.A. 13:9B; Freshwater Protection Act Rules N.J.A.C. 7:7A: Outlines requirements for compliance with Sections 401 and 404 of Clean Water Act. The compensatory mitigation hierarchy for state open water greater than 1.5 acres as outlined in the Freshwater Wetlands Protection Act Rules is as follows:
    - On-site restoration, creation, or enhancement.
    - Purchase of in-kind credits from a mitigation bank with a service area that includes the area of disturbance.

- Off-site restoration, creation, or enhancement in the same watershed as disturbance.
- Monetary contribution to the NJ In-lieu fee program.
- Upland preservation.
- Land donation in accordance with Freshwater Wetland Act Rules.
- The Act requires a mitigation ratio of 2:1 for wetland restoration or creation, and a minimum mitigation ratio of a 3:1 for wetland enhancement. The purchase of wetland mitigation credits is based on a 1:1 mitigation ratio.

- N.J.A.C. Coastal Zone Management Rules: NJ CZMA includes tidal and non-tidal waters, waterfronts, and on land areas regulated under the following regulations: the Coastal Area Facility Review Act (CAFRA), the Waterfront Development Law, the Hackensack Meadowlands Reclamation and Development Act, and the Wetlands Act of 1970. For NJ, intertidal and subtidal shallows are defined as all permanently (subtidal) or temporarily (intertidal) submerged areas from the spring high water line to a depth of four feet below mean low water.
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  NJ's CZMA establishes compliance and mitigation requirements related to Sections 401 and 404 of the Clean Water Act for tidal wetland and open water resources. It also sets forth general requirements for mitigation of shellfish habitat, submerged vegetation habitat, and riparian zones. These include:
  - Requirements for shellfish habitat mitigation (N.J.A.C. 7:7-17.9);
  - Requirements for submerged vegetation habitat mitigation (N.J.A.C. 7:7-17.10);
  - Requirements for intertidal and subtidal shallows and tidal water mitigation (N.J.A.C. 7:7-17.11);
  - Requirements for riparian zones mitigation (N.J.A.C. 7:7-17.12);
  - Requirements for wetland mitigation (N.J.A.C. 7:7-17.13);
  - Requirements for credit purchase (N.J.A.C. 7:7-17.15); and
  - Requirements for in-lieu fee payment at (N.J.A.C. 7:7-17.16).

6 Roles and Responsibilities

The USACE New York District will be responsible for the proposed mitigation construction and monitoring until the initial success criteria (to be determined under the future Tier 2 analysis/EIS) are met. Initial construction and monitoring will be funded in accordance with all applicable cost-share agreements with the non-federal sponsor.

It should be noted that the individual states (NY and NJ) might require mitigation beyond what has been determined to be appropriate by the functional assessment analysis due to their use of a ratio-based mitigation approach. In event this occurs, the non-federal sponsor will be required to pay the mitigation costs that exceed what is necessary to meet the federal requirements.

The USACE New York District will monitor (on a cost-shared basis) the completed mitigation to determine whether additional construction, invasive plant species control, and/or plantings are necessary to achieve initial success criteria. If, during the monitoring period the mitigation is failing to meet the success criteria, the USACE New York District will consult with the NYSDEC/NYSDOS and NJDEP to determine the appropriate management or remedial actions required to achieve ecological success. The non-federal sponsor will perform any additional monitoring of the site as part of their O&M obligations once the USACE New York District has determined that the mitigation goals are met.

The USACE New York District will retain the final decision on whether the project's required mitigation benefits are being achieved and whether remedial actions are required. If additional site modifications are deemed necessary to achieve ecological success, the USACE New York District will implement the appropriate measures in accordance with the adaptive management plan. The adaptive management measures will be subject to cost-sharing requirements, availability of funding, and current budgetary and other guidance.

7 Habitat Mitigation Alternatives

7.1 In-Kind Mitigation

The USACE New York District will pursue in-kind, in-place wetland mitigation as a first priority in compensating for impacts on a site-specific basis. If external (off-site) locations are deemed necessary due to a lack of area (or habitats) on site to perform appropriate habitat restoration, creation or enhancement, a list of potentially suitable opportunities within the region has been identified (Table 7-1) and will be further evaluated during the future Tier 2 Analysis. Habitat quality for impact sites and potential mitigation sites will be assessed using a functional assessment methodology appropriate for the types of habitats under consideration and approved by the Corps Ecosystem Restoration Planning Center of Expertise (EcoPCX).

Table 7-1: List of Potential Mitigation Opportunities within the NYNJHATS Study Area. Source: Restoration Working Group.

Project	Location	Coordinates	Material Type Used	Material placement / purpose	Volume Needed
Alley Creek, Little Neck Bay	East River, LI Sound	40° 46.239'N 73° 45.358'W	A	Elevation change/wetland restoration	5,000 CY / Acre - 5 acres = 25,000
Arlington Marsh	Arthur Kill	40° 38.597'N 74° 10.405'W	A/B	Elevation change/wetland restoration	2,000 CY / Acre - 10 acres = 20,000
East Newark Waterfront Park	Passaic River	40° 43.984'N 74° 9.098'W	A	Fresh water wet meadow	One Acre - depth not determined. Clean sand-FY 2022
Ferry Point Park	East River, LI Sound	40° 48.655'N 73° 50.343'W	A	Elevation change/wetland restoration	5,000 CY / Acre - 2 acres = 10,000
Four Sparrow Marsh	Jamaica Bay	40° 36.136'N 73° 54.355'W	A	Elevation change/wetland restoration	3,000 CY / Acre - 3 acres = 9,000
Fresh Creek - HRE	Jamaica Bay	40° 38.215'N 73° 52.596'W	A	Elevation change/wetland restoration/channel restoration	3ft clean material over 35 acres= 170,000 CYD
Goose Pond Wetland, Broad Channel	Jamaica Bay	40° 36.647'N 73° 49.345'W	A	Elevation change/wetland restoration	5,000 CY / Acre - 2 acres = 10,000
HRE - Naval Station Earle Oyster Reef	Lower Bay	40° 26.867'N 74° 3.377'W	C/D	Subtidal reef base	(complement/replacement of shell in gabions)

Project	Location	Coordinates	Material Type Used	Material placement / purpose	Volume Needed
HRE - Pumpkin Patch East Marsh Island	Jamaica Bay	40° 37.694'N 73° 50.495'W	A	Elevation change/wetland restoration	352,000 CYD
HRE - Pumpkin Patch West Marsh Island	Jamaica Bay	40° 37.353'N 73° 51.125'W	A	Elevation change/wetland restoration	328,000 CYD
HRE - Stony Creek Marsh Island	Jamaica Bay	40° 36.664'N 73° 51.066'W	A	Elevation change/wetland restoration	152,000 CYD
HRE- Bush Terminal Oyster Reef	Upper New York Bay	40° 39.282'N 74° 1.082'W	C/D	Subtidal reef base	(complement/replacement of shell in gabions)
HRE- Duck Point Marsh Island	Jamaica Bay	40° 37.637'N 73° 51.673'W	A	Elevation change/wetland restoration	214,000 CYD
HRE- Elders Point Marsh Island	Jamaica Bay	40° 38.116'N 73° 50.831'W	A	Elevation change/wetland restoration	285,000 CYD
HRE- Head of Jamaica Bay	Jamaica Bay	40° 37.541'N 73° 45.620'W	C/D	Subtidal reef base	(complement/replacement of shell in gabions)
Hudson River Reefs - Dobbs Ferry Reef	Lower Hudson River	41° 0.991'N 73° 53.100'W	D	Subtidal reef base	5,000 CY / Acre - 5 acres = 25,000
Hudson River Reefs - Hastings On-Hudson Reef	Lower Hudson River	40° 59.227'N 73° 53.342'W	D	Subtidal reef base	5,000 CY / Acre - 5 acres = 25,000
Hudson River Reefs - Irvington Reef	Lower Hudson River	41° 2.976'N 73° 52.493'W	D	Subtidal reef base	5,000 CY / Acre - 5 acres = 25,000
Hudson River Reefs - North West Yonkers	Lower Hudson River	40° 57.721'N 73° 53.779'W	D	Subtidal reef base	5,000 CY / Acre - 5 acres = 25,000
Hudson River Reefs - Riverdale	Lower Hudson River	40° 54.209'N 73° 55.014'W	D	Subtidal reef base	5,000 CY / Acre - 5 acres = 25,000
Hudson River Reefs - Sleepy Hollow	Lower Hudson River	41° 6.465'N 73° 52.109'W	D	Subtidal reef base	5,000 CY / Acre - 5 acres = 25,000
Hudson River Reefs - Yonkers	Lower Hudson River	40° 56.004'N 73° 54.367'W	D	Subtidal reef base	5,000 CY / Acre - 5 acres = 25,000

Project	Location	Coordinates	Material Type Used	Material placement / purpose	Volume Needed
Hutchinson River, Pelham Bay Park	East River, LI Sound	40° 51.865'N 73° 48.634'W	A	Elevation change/wetland restoration	1,000 CY / Acre - 5 acres = 5,000
Idlewild Park, Hook Creek Park	Jamaica Bay	40° 38.945'N 73° 44.492'W	A	Elevation change/wetland restoration	1,000 CY / Acre - 10 acres = 10,000
Lemon Creek	Raritan Bay	40° 30.698'N 74° 11.931'W	A	Elevation change/wetland restoration	1,000 CY / Acre - 5 acres = 5,000
Liberty Island Aquatic Reef	Upper New York Bay	40° 41.590'N 74° 2.787'W	C	Subtidal reef base	1,400 CY / Acre - 20 acres = 28,000
Liberty Island Aquatic Reef	Upper New York Bay	40° 41.590'N 74° 2.787'W	D	Subtidal reef base	5,000 CY / Acre - 20 acres = 100,000
Liberty State Park	Upper New York Bay	40° 41.590'N 74° 2.787'W	B/C	Rock revetment/channel stabilization	1–3-foot boulders: 22,800 CY gravel/cobble mix: 10,500 CY
Lincoln Park West	Hackensack River	40° 43.730'N 74° 5.536'W	A	Elevation change/wetland restoration	1600 CY / Acre - 10 acres = 16,000
Lower Bay Reef (rock)	Lower Bay	40° 32.308'N 74° 0.235'W	C/D (large rock)	Subtidal reef base	TBD
Mott Basin, Jamaica Bay Park	Jamaica Bay	40° 35.969'N 73° 46.798'W	A	Elevation change/wetland restoration	5,000 CY / Acre - 2acres = 10,000
Old Bridge Waterfront Park	Raritan Bay	40° 27.573'N 74° 14.872'W	A/D	Rock jetty, rock revetment/ beach nourishment	TBD
Rockaway Community Park	Jamaica Bay	40° 36.148'N 73° 46.979'W	A	Elevation change/wetland restoration	5,000 CY / Acre - 2 acres = 15,000
Rockaway Reef (rock)	NY Bight	40° 33.955'N 73° 49.522'W	C/D (large rock)	Subtidal reef base	222 acres needed
Saw Mill Creek	Arthur Kill	40° 36.573'N 74° 11.402'W	A	Clean Cap for restoration	TBD
Sawmill Creek WMA	Hackensack River	40° 46.040'N 74° 6.973'W	A	Elevation change/wetland restoration	TBD
Snakapin Lagoon	East River, LI Sound	40.80511537582989, -73.85625321360934	A	Elevation change/wetland restoration	5,225 CY / Acre - 2 acres = 10,500

Project	Location	Coordinates	Material Type Used	Material placement / purpose	Volume Needed
Spring Creek - HRE	Jamaica Bay	40° 39.046'N 73° 50.956'W	A	Elevation change/wetland restoration	1,000 CY / Acre - 2 acres = 2,000
Turtle Cove, Pelham Bay Park	East River, LI Sound	40° 51.529'N 73° 48.215'W	A	Elevation change/wetland restoration	5,000 CY / Acre - 4 acres = 20,000

Source: RWG 2021 (portion of)
NOTES:
TBD – To be determined

7.2 Out-of-Kind Mitigation

In the event that additional mitigation sites are deemed necessary, and there are no in-kind sites available within the region, the USACE New York District will pursue out-of-kind and/or out-of-place wetland mitigation. If external (off-site) locations are deemed necessary due to a lack of area (or habitats) on site to perform appropriate habitat restoration, creation or enhancement, a list of potentially suitable Beneficial Uses of Dredged Material (BUDM) sites within the region has been identified (Table 7-1) and will be further evaluated during the future Tier 2 Analysis.

On a broad regional/watershed scale, a variety of potential out-of-kind mitigation options could be exercised under the programmatic umbrella of addressing the short- and long-term goals for implementing the Hudson-Raritan Estuary (HRE) Comprehensive Restoration Program (CRP) (USACE 2016 and USACE 2020). The CRP serves as a blueprint for a multi-agency partnership (including the Port Authority of NY and NJ and the NY–NJ Harbor Estuary Program) to achieve long-term, large-scale ecological restoration in the NY/NJ region. The CRP provides a comprehensive strategy for habitat restoration and promotes a framework of mutually agreed-upon restoration goals and objectives developed by the scientific community, regulators, municipalities and key regional stakeholders (Table 7-2). These include habitat enhancement creation and restoration projects throughout the estuary and surrounding watershed. Potential mitigation projects could address individual or multiple "Target Ecosystem Characteristics" outlined in the CRP, depending on project size, geographic location, and habitat complexity. Depending on project impact location, certain in-kind mitigation activities (e.g., wetland creation/restoration) could also contribute to the CRP goals and objectives.

Example TECs which specifically address habitat enhancement/restoration opportunities throughout the HRE include:

- Coastal Wetlands;

- Islands for Water Birds.
- Coastal and Maritime Forests
- Oyster Reefs
- Eelgrass Beds
- Shorelines and Shallows
- Habitat for Fish, Crabs and Lobsters
- Tributary Connections
- Enclosed and Confined Waters

The CRP provides initial recommendations for prioritizing certain types of habitat enhancement or restoration efforts in the various HRE Planning regions, based on available habitat features, historical and present-day degradation factors, precedent projects completed or underway in each region and perceived site limitations or constraints – these include:

- **Jamaica Bay**
    - Coastal wetlands;
    - Oyster reefs;
    - Eelgrass beds;
    - Islands for waterbirds;
    - Shorelines and shallows;
    - Coastal/maritime forests
- **Lower Bay**
    - Oyster reefs;
    - Coastal wetlands;
    - Eelgrass beds;
    - Habitat for fish, crabs and lobsters;
    - Tributary connections/fish passage;
    - Shorelines and shallows;
    - Islands for waterbirds;

- Coastal/maritime forests

- **Lower Raritan River**
  - Coastal wetlands;
  - Coastal forests/riparian corridors;
  - Oyster reefs;
  - Tributary connections/fish passage
- **Arthur Kill/Kill Van Kull**
  - Coastal wetlands;
  - Shorelines and shallows;
  - Tributary connections/fish passage;
  - Islands for waterbirds;
  - Coastal forests/uplands
- **Newark Bay/Hackensack River/Passaic River**
  - Coastal/Freshwater wetlands;
  - Coastal forests/riparian corridors;
  - Shorelines and shallows;
  - Tributary connections/fish passage
- **Lower Hudson River**
  - Coastal wetlands;
  - Habitat for fish/crabs/lobsters;
  - Oyster reefs;
  - Shorelines and shallows
- **Harlem River/East River. Western Long Island Sound**
  - Shorelines and shallows;
  - Islands for waterbirds;
  - Coastal wetlands;
  - Oyster reefs;

- Eelgrass beds;
- Tributary connections/fish passage

- **Upper Bay**
  - Coastal wetlands;
  - Shallows and shorelines;
  - Oyster reefs

Finally, the USACE and United States Environmental Protection Agency (USEPA) 2008 Final Compensatory Mitigation Rule emphasize that the process of selecting locations for compensatory mitigation sites should be driven by a watershed approach and watershed needs identified within the analysis. Specific wetland creation, restoration, preservation and protection projects should best address those needs. Off-site, out-of-kind mitigation actions to offset project construction and operational impacts could be selected based on CRP recommendations within the CRP to ensure that the HATS mitigation projects benefit the Hudson-Raritan Estuary and watershed, while also meeting federal, state and municipal mitigation requirements.

Table 7-2: Short-term (2020) and Long-term (2050) goals and objectives of the HRE CRP (USACE 2016).

Coastal Wetlands	One new wetland that provides at least five primary functions in each HRE region (1,200 total acres)	Continue restoration at a rate of 400 acres per year for a total system gain of 15,200 acres
Islands for Waterbirds	Enhance at least one island in each of the four main island groups within the HRE study area	All islands in the four main island groups provide roosting and nesting sites
Coastal and Maritime Forests	Establish one new forest of at least 50 acres and rehabilitate at least 200 additional acres of existing forest.	Establish 500 acres of new forest among three sites, and rehabilitate another 500 acres of existing forest.
Oyster Reefs	500 acres of reef habitat across 10-20 sites	5,000 acres of established oyster reef habitat
Eelgrass Beds	Create one test bed in each HRE region	Three established beds in each HRE region capable of supporting eelgrass
Shorelines and Shallows	Establish new shorelines and shallows sites in three HRE regions	Restore all available shorelines and shallows sites in three HRE regions, and two sites in other planning regions
Habitat for Fish, Crab, and Lobsters	Complete a set of two functionally related habitats in each HRE region	Complete four sets of at least two functionaly related habitats in each HRE region
Tributary Connections	One less barrier per year to passage between at least three different inland habitats	Continue reconnecting habitats at a rate of one project per year until all barriers within the HRE study area are removed or made passable
Enclosed and Confined Waters	Improve the water quality or environmental conditions of eight confined water bodies to meet their current designated use classification	Improve the water quality or environmental conditions of eight confined water bodies to meet the criteria of their receiving waters
Sediment Contamination	Isolate or remove at least 25 acres of contaminated sediment	Isolate or remove at least 25 acres every 2 years
Public Access	Create one access point and upgrade one access point in each of the HRE regions per year	All waters of the HRE are accessible within a short walk or public transit trip

7.3 Wetland Mitigation Banks and In-lieu Fee Programs

In the event that no reasonable (on-site or off-site) mitigation sites are available (for projects occurring in NJ), The USACE New York District will assess the availability of mitigation credits at banks on the State of NJ Approved Wetlands Mitigation Banks List during the Preconstruction Engineering Design (PED) Phase when permits are acquired. Presently, a comparable list (or mitigation banking program) does not exist for NY State, thus mitigation banking is unlikely to be a feasible in option in the foreseeable future in NY.

NJ operates its own In-lieu Fee Program through its Wetland Mitigation Fund. However, this option is lower in the mitigation hierarchy structure than on-site restoration or off-site mitigation, of which opportunities exist within the region. Therefore, as authority(s) responsible for administering Section 404 of the Clean Water Act, it is unlikely that the states of NY and NJ would approve a monetary contribution. In NY, the Wetland Trust (TWT) operates a Corps-Approved In-Lieu fee program among 15 service areas throughout the state; however, none encompass the NY-NJ metropolitan area in which project impacts are likely to occur.

7.4 Preliminary Cost Estimate

Currently, the estimated conceptual parametric mitigation costs for the TSP, which was used to inform Cost Engineering, is around $1.8B (roughly <6% of construction costs) which includes monitoring and a 35% contingency. Monitoring cost estimates for the TSP are expected to total approximately $142M which is approximately 8% of the total mitigation cost.

Note that the cost estimate will be refined pending the results of the functional assessment for potential mitigation site(s) and the cost effectiveness/incremental cost analyses and updated as necessary in the Tier 2 EIS(s).

8 Monitoring and Reporting

An effective monitoring program will be required to determine if the mitigation performed is consistent with original project goals and objectives. Information collected under this monitoring plan will provide insights into the effectiveness of mitigation and adaptive management strategies and indicate where goals have been met, if actions should continue, and/or whether more aggressive management is warranted. The information generated by the monitoring plan will be used by the USACE New York District in consultation with the non-federal sponsor to guide decisions on operation changes that may be needed to ensure that the mitigation project meets the success criteria.

Federal wetland mitigation rules require monitoring until success criteria is met and do not establish a minimum required monitoring period. The NJ Freshwater Wetlands Protection Act Rules require a minimum monitoring period of five years for any wetland enhancement, restoration, or creation, and establish specific criteria for determining success. Therefore, for cost estimating purposes, the USACE New York District assumes a minimum monitoring period of **five years** for any compensatory mitigation. Monitoring is not to exceed 10 years. Should the compensatory mitigation measures be achieved in less than five years, monitoring will cease or be continued by the non-federal sponsor at their cost.

The specific components of the monitoring program, including parameters/performance indicators, success criteria, number and location of monitoring stations, and data management/analysis protocols will be developed collaboratively with natural resource agencies and other stakeholders. Performance indicators (i.e., the observable physical, chemical or biological attributes that are used to determine if a habitat restoration project meets its stated objectives) and mitigation success criteria will be based on, or closely related to, design objectives and the ability to discern functional "uplift" over the duration of the monitoring program. Some of these attributes/indicators will be specified in Federal/State permit conditions; others may be selected in addition to permit requirements by the Corps, to enable accurate monitoring and tracking of restored wetlands and other aquatic habitats, to support the adaptive management program, and to ensure long-term sustainability and self-maintenance of the mitigation projects.

Anticipated post-construction monitoring attributes and indicators for marine/estuarine open waters and shallow subtidal habitats may include:

- Bathymetric surveys
- Hydrodynamic surveys
- Water quality characterization (dissolved oxygen, temperature, transparency/turbidity, salinity, nutrients, etc.);
- Substrate characterization (organic content, grain size, contamination/toxicity, etc,)

- Benthic macroinvertebrate surveys (density, biomass and species richness);
- Finfish and microcrustacean utilization surveys (seine, trawl, traps, etc.)

Anticipated post-construction monitoring attributes and indicators for intertidal and freshwater wetlands may include:

- Routine wetlands delineation surveys (to establish and monitor jurisdictional boundaries) using the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*;
- Percent vegetative cover, stem densities, and average stem height of emergent plants within permanent 1-meter square sample plots (tidal marshes and emergent freshwater marshes);
- Stem densities, and average stem height of woody plants within permanent 10-meter square sample plots (scrub/shrub and forested freshwater wetlands);
- Soils characterization (to determine hydric conditions capable of supporting wetland indicator species;
- Surveys for the presence and extent of any invasive plant species.

Anticipated post-construction monitoring attributes and indicators for upland habitats may include:

- Stem densities, and average stem height of woody plants within permanent 10-meter square sample plots;
- Surveys for the presence and extent of any invasive plant species.
- Wildlife surveys (birds, mammals, reptiles/amphibians, pollinators, etc.)

8.1 Reporting

The USACE New York District will prepare an annual Monitoring Report summarizing the results of monitoring efforts conducted for compensatory mitigation and describing any necessary adaptive management measures.

The format of the report will contain, but not be limited to: 1) Executive Summary; 2) Requirements and goals of approved mitigation proposal that have been achieved 3) Documentation including wetland delineations, stream survey locations and results, habitat assessment worksheets, topographical surveys, photos, and field notes; 4) suggested adaptive management measures and their estimated costs.

The Year 1 report will include "as built" drawings of each mitigation project completed, illustrating site conditions, topography, planted areas, site dimensions, and water supply and control features (if applicable). Any deviations from the original mitigation plan will be

documented and the report will include photographs taken from established reference points. Subsequent monitoring reports will summarize field observations of aquatic/wetland/upland habitat development, vegetation cover, hydrology, and use by wildlife..

Figures contained within the report will include but not be limited to: 1) mitigation site location on a USGS topographic map; 2) mitigation site delineated on an aerial; 3) mitigation site delineated on tax map; and 4) preconstruction and post construction habitat type map.

Appendices will include but not be limited to: 1) permits; 2) as-built plans; 3) vegetation species table and wetland delineation data sheets (if applicable); 4) photograph logs and location maps; and 5) soil/substrate characterization reports.

The USACE New York District will complete the Monitoring and Adaptive Management Report by 31 December each year the monitoring is conducted. The USACE New York District will post the report on its webpage and will submit the report to the Corps Headquarters (Corps HQ) for inclusion to the annual mitigation report that is submitted to Congress and posted on the Corps HQ website.

9 Adaptive Management

The basic principle of adaptive management is "learning by doing" – the approach relies on the accumulation of credible evidences to support a decision that demands action (Walters and Holling 1990). If established early in the planning phase, and implemented throughout the assessment phase, adaptive management can be a powerful tool to systematically assess and improve the performance of restored or constructed ecosystems.

The main requirements of an adaptive management program are to:

- Measure the condition of the system using selected indicators.
- Assess progress towards specified goals and performance criteria.
- Make a decision regarding corrective actions needed.

The main actions are:

- Doing nothing (waiting for conditions to improve).
- Doing something (implementing corrective actions, based upon data collected).
- Changing the goal (realizing that the project will not reach the original goal, and that an alternative system state is acceptable.

The third action is controversial; however, there are instances of projects that do not meet the original performance criteria, but nevertheless achieve an ecologically viable system state (Simenstad and Thom 1996). In addition, the lessons learned from "failed projects" can be incorporated into successive projects within a program or geographic region of interest.

Adaptive management differs from traditional ecosystem management in that it recognizes and prepares for uncertainty and stochastic natural events or disturbance. Uncertain conditions can be associated with hydrology, weather, variation in growth and reproduction of plants and animals, care and handling of transplant materials, effects of natural predators/grazers, and unforeseen human changes upon the landscape. Pastorok et al. (1997) recommended that restored habitats be constructed using a mosaic of habitats that vary in time and space, to maximize the potential for achieving a highly functional outcome, given the effect of natural and man-made disturbance on the restored system. These authors likened this to a "bet-hedging" strategy, or a "safe-fail" approach, which contrasts with the traditional fail-safe approach of standard engineering design.

A comprehensive adaptive management plan may be prepared and implemented across the entire suite of constructed in-water, wetland and upland mitigation projects, during post- construction monitoring. The advantage of monitoring select ecosystem attributes and incorporation of an adaptive management approach is that problems and deviations from the expected functional equivalency trajectory will be detected early on and adjustments can be made to correct for any

perceived problems or deficiencies. For example, if wetland vegetation communities fail to coalesce by the specified target date, topographic surveys and hydrologic measurements can be conducted to determine if the underlying cause is failure to meet pre-determined soils, flood frequency, or elevation criteria. If elevation/hydroperiod is comparable to that of regional reference or control sites, then soil drainage characteristics could be investigated as a potential cause. Soil percolation tests could be conducted, and soil amendments could be used to promote appropriate drainage characteristics and establish hydric soils, if desired. Remedial transplants could be performed using a tighter planting unit spacing to promote more rapid coalescence and achieve functional equivalency within the desired time frame. Initial and remedial transplants may need to be protected from avian and mammalian grazers/predators using fences, nets, wires, or other structures. Should these preventative measures be deemed inadequate, predator/grazer control may be required on a periodic or seasonal basis.

As another example, failure of a subtidal or open-water macroinvertebrate community to achieve reference biomass/density or community composition within the desired time frame could be related to incorrect bathymetry, sub-optimal hydrodynamics (resulting in low dissolved oxygen), or a lack of organic matter and/or microbial biomass in newly developed benthic habitats. If the physical/hydrologic conditions are determined to be within design specifications or comparable to reference, then organic matter amendments could be used to provide a supplemental detrital base to stimulate microbial production and provide food for benthic organisms.

The constructed mitigation projects, including wetlands and uplands, will be designed to operate and function with minimal or required maintenance or human intervention after vegetation establishment. However, periodic maintenance and adaptive management activities may include soil treatments, weed control, vegetation protection, and supplemental planting as necessary to meet site-specific project goals and objectives. Soil treatments may include application of amendments such as fertilizer and mulch. Vegetation manipulations may include weed control, staking woody tree stems, and installing protective barriers around individual plants or portions of sites to provide protection from wildlife.

Adaptive management techniques may also be used to control the proliferation of invasive and/or nuisance plant species within wetland and upland mitigation sites. Both spring and fall surveys should be conducted at all wetland and upland mitigation areas during the growing season throughout the post-construction monitoring period to identify State-listed noxious weeds and invasive species. If present, weeds/invasives should be chemically treated or mechanically/manually removed before establishing large colonies that are hard to eradicate. Only herbicides deemed safe for application near water should be used to control weeds in wetland or riparian areas, applied according to the manufacturers' printed recommendations and according to federal regulations governing herbicide application.

9.1 Potential Barriers to Adaptive Management

Although adaptive assessment and management has become widely accepted in a range of natural resource disciplines including restoration ecology, there remain regulatory, institutional and economic barriers to successful implementation. Maintaining continuity of project staff, funding, and data storage over the life of a restoration project can be challenging. A data management system should be developed for the mitigation monitoring program and should include provisions to transfer data to alternate media as technology advances. Within a regulatory and institutional framework, there may be a tendency to avoid flexible, adaptive approaches. There may exist fear among project proponents or managers of admitting uncertainty or failure, or to experiment with alternative solutions. When adaptive management is recognized by all stakeholders as an integral part of the mitigation/restoration process, many of these fears may be allayed; and uncertainties, stochastic events or disturbance may be recognized as critical elements in the function and development of natural, self-sustaining ecosystems.

10 List of Preparers

The following technical experts contributed to the preparation of this plan.

Preparer	Title	Firm	Discipline
David S. Davis, MA	Technical Advisor	HDR	Conceptual Mitigation and Monitoring Plan/Technical Review
David J. Yozzo, PhD	Senior Ecologist	HDR	Conceptual Mitigation and Monitoring Plan
Jesse Miller	Biologist	USACE New York District	Environmental Analysis
Jenine Gallo	Regional Technical Specialist	USACE New York District	Wildlife Biologist
Cheryl R. Alkemeyer	Senior Physical Scientist	USACE New York District	NEPA Lead, Environmental Analysis

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