US Army Corps of Engineers®
New York District

Integrated Hurricane Sandy General Reevaluation Report and Environmental Impact Statement

Atlantic Coast of New York

East Rockaway Inlet to Rockaway Inlet and Jamaica Bay

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December 2018, amended as of July 2019

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Appendix D

Environmental Compliance

Attachment D1

USFWS Final Coordination Act Report

FINAL FISH AND WILDLIFE COORDINATION ACT SECTION 2(b) REPORT

ATLANTIC COAST OF NEW YORK, EAST ROCKAWAY INLET TO ROCKAWAY INLET AND JAMAICA BAY REFORMULATION STUDY

KINGS, QUEENS, AND NASSAU COUNTY, NEW YORK

Prepared for:

U.S. Army Corps of Engineers
New York District
New York, New York

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December 2018

EXECUTIVE SUMMARY

This final Fish and Wildlife Coordination Act (FWCA) Report has been prepared at the request of the U.S. Army Corps of Engineers (Corps) in partial fulfillment of section 2(b) of the FWCA (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq*.). The purpose of the FWCA is to ensure equal consideration of fish and wildlife conservation. This FWCA report provides the U.S. Fish and Wildlife Service's (Service) comments on the biological issues relevant to the Corps' *Atlantic Coast of New York, East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study*. Section 2(b) of the FWCA requires that the final report of the Secretary of the Interior: (1) determine the magnitude of the direct, indirect, and cumulative impacts of the proposed projects on fish and wildlife resources, and (2) make specific recommendations as to measures that should be taken to conserve those resources.

The Corps' Recommended Plan includes a suite of measures along the shoreline of the Atlantic Ocean and Jamaica Bay. These measures include construction of a composite seawall and artificial dune; beach nourishment; construction of thirteen new groins and the modification of five existing groins; the construction of floodwalls, berms, and bulkheads along the Jamaica Bay shoreline; and the construction of nature-based features on the bay shoreline. The Study Area provides ecologically significant habitat for a number of regional and state important species. In recognition of this, the Service identified this area as a Significant Habitat and Habitat Complex. At the state and local levels, New York State Department of State identified it as a State Significant Coastal Fish and Wildlife Habitat, and Audubon New York designated it as an Audubon Important Bird Area. Portions of the Feasibility Study Area are included in the National Park Service's Gateway National Recreation Area.

In the short-term, the Corps' Recommended Plan will have direct and indirect impacts on fish and wildlife resources and their supporting ecosystems. The initial construction of the project will affect approximately 10 miles (mi) of subaerial, intertidal, nearshore, and subtidal marine habitats. Beach nourishment volumes for initial beachfill is estimated at 804,000 cubic yards, to be dredged from a sand borrow area located approximately 2 mi off the Rockaway Atlantic Coast shoreline. Project impacts include habitat modification, disturbance to fish and wildlife, turbidity, and burial of benthic organisms. Over the long-term, the composite seawall, floodwalls, berms, and bulkheads will permanently alter the habitat, resulting in potentially in long-term impacts to fish and wildlife trust resources.

In the course of its review, the Service has determined that the proposed project could have significant ecological impacts to fish and wildlife communities and habitats including the maritime dune and beach, estuarine bay shoreline, intertidal areas, wetlands, and bottom habitats. The Service has provided a number of recommendations that if implemented would assist the Corps in mitigating the potential adverse impacts identified in this report. The Corps has indicated that certain components of the project require further development and coordination with Federal, State, and local agencies and public review. Consequently, the Service requests continued coordination with the Corps as project designs are further developed so that any necessary revisions or supplements to the 2(b) report can be provided.

Finally, this report does not constitute a Biological Opinion under section 7 of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.). The Corps prepared a Biological Assessment (BA) in Appendix D2-A of the Revised Draft Hurricane Sandy General Reevaluation Report and Environmental Impact Statement dated August 2018. The Service will review the BA and transmit their findings in a separate document.

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I. INTRODUCTION

This Final Fish and Wildlife Coordination Act (FWCA) Report was prepared pursuant to the FWCA of 1958, as amended (48 Stat. 401, as amended 661 *et seq*.) and provides conservation and planning assistance to the U.S. Army Corps of Engineers' (Corps) *Atlantic Coast of New York, East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study (Reformulation Study)*.

This Final FWCA Report builds on the U.S. Fish and Wildlife Service's (Service) Planning Aid Letter dated August 18, 2016, the Draft FWCA Report dated October 2018, and contains information on fish and wildlife resources (including threatened and endangered species), an assessment of project impacts, recommendations to avoid and minimize project-related impacts, and recommendations for additional monitoring and investigations over the 50-year life of the proposed project. The information provided herein is based on site visits conducted by the Service, current and ongoing studies, and literature review.

The Draft FWCA Report was sent to the Corps, the National Park Service (NPS), the New York State Department of Environmental Conservation (NYSDEC), and the National Oceanic and Atmospheric Administration (NOAA) for their review and comments. Comments from the Corps, the NOAA, the NPS, and the NYSDEC, the Service were incorporated into this Final FWCA Report.

II. PURPOSE, SCOPE AND AUTHORITY

A. PURPOSE

The Corps' primary objective of the proposed study is to examine coastal storm risk management problems and opportunities for the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Study Area (Study Area). The goal is to identify solutions that will reduce Atlantic Ocean shoreline and Jamaica Bay vulnerability to storm damage over time, in a way that is sustainable over the long-term, both for the natural coastal ecosystem and for communities (U.S. Army Corps of Engineers 2018).

The purpose of this FWCA consultation is to document the potential impacts upon fish and wildlife resources expected from the implementation of the proposed project, recommend measures to mitigate impacts of the project, and to conserve and protect fish and wildlife resources.

B. SCOPE

The Corps identified the Study Area as "the Atlantic Coast of New York City between East Rockaway Inlet and Rockaway Inlet, and the water and lands within and surrounding Jamaica Bay, New York. The Study Area also includes the low-lying Coney Island section of Brooklyn, which can be overtopped by floodwaters that flood the Brooklyn neighborhoods surrounding Jamaica Bay" (U.S. Army Corps of Engineers 2018). In order to delineate the FWCA analysis area, the Service identified all areas within, and adjacent to, the Corps' identified Study Area that would be directly or indirectly impacted by the Recommended Plan.

Therefore, the Service has identified the FWCA analysis area as extending in a westerly direction approximately 11 miles (mi) from the East Rockaway Inlet to the Rockaway Inlet. The beaches west of the project footprint have been included as sediment transport may be impacted by the creation and extension of groins in the Study Area. The southern boundary extends 500 meters (m) into the nearshore waters of the Atlantic Ocean south of the Rockaway Peninsula shoreline in consideration of the turbidity, which will occur as a result of the beach nourishment. The northern boundary of the FWCA analysis area extends 500 m into the waters of Jamaica Bay north of the Rockaway Peninsula shoreline in consideration of turbidity that will occur as a result of the construction of high frequency flooding risk reduction features (HFFRRF) on the bay side of the Rockaway Peninsula. Additionally, the FWCA analysis area includes the waters of Motts Basin and approximately 700 feet (ft) of its shoreline, located in the eastern reach of Jamaica Bay, and approximately 1000 ft of shoreline and adjacent waters in Lawrence, NY, just east of the Rockaway Turnpike. Lastly, the borrow area and a 600-m buffer is included in the FWCA analysis area.

The scope of temporal effects includes short- to long-term impacts on a time scale from months to years due to the construction and the 50-year life and maintenance period of the proposed project. Many of the proposed elements of the project include the construction of hardened structures (*i.e.*, composite seawall, bulkhead, etc.). Impacts from these elements may extend well beyond the 50-year project life, especially once maintenance and renourishment efforts have ceased and in light of sea-level change projections.

C. AUTHORITY

The Reformulation Effort for East Rockaway Inlet to Rockaway Inlet and Jamaica Bay was authorized by the House of Representatives, dated September 27, 1997, as stated within the Congressional Record for the U.S. House of Representatives. It states, in part:

> "*With the funds provided for the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York project, the conferees direct the Corps of Engineers to initiate a reevaluation report to identify more cost-effective measures of providing storm damage protection for the project. In conducting the reevaluation, the Corps should include consideration of using dredged material from maintenance dredging of East Rockaway Inlet and should also investigate the potential for ecosystem restoration within the project area*."

Further, the Disaster Relief Appropriations Act (DRAA) of 2013 (Public Law [PL] 113-2) was enacted in part to "improve and streamline disaster assistance for Hurricane Sandy, and for other purpose". The DRAA directed the Corps to:

> "*…reduce future flood risk in ways that will support the long-term sustainability of the coastal ecosystem and communities and reduce the economic costs and risks associated with large-scale flood and storm events in areas along the*

Atlantic Coast within the boundaries of the North Atlantic Division of the Corps that were affected by Hurricane Sandy" (PL 113-2).

III. RELEVANT STUDIES, PROJECTS, AND REPORTS

Additional proposed or constructed federal projects within the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Study Area are described below. As per the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq*.), these actions should be considered in the Corps' cumulative effects analysis for the proposed project.

A. RELEVANT STUDIES, PROJECTS, AND REPORTS WITHIN, AND ADJACENT TO, THE STUDY AREA

1. Federal Projects

Numerous federal projects have been funded, authorized, and carried out along the Rockaway shoreline and within Jamaica Bay. The names of these projects are listed below. Descriptions of the projects are provided in Appendix A.

- Rockaway Beach Erosion Control and Hurricane Protection Project
- East Rockaway Inlet Federal Navigation Channel Project
- Rockaway Inlet Federal Navigation Channel Project
- Atlantic Coast of New York City (NYC) – Rockaway Inlet to Norton Point, Shore Protection Project
- Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, NY, Storm Damage Reduction Project
- Hudson Raritan Estuary Project, Ecosystem Restoration Feasibility Study
- Jamaica Bay, Marine Beach, and Plumb Beach Ecosystem Restoration Feasibility Study
- Spring Creek Park (North) Ecosystem Restoration Project
- Gerritsen Creek – Marine Park Ecosystem Restoration Project
- West Pond Breach Repair
- Fort Tilden Shore Access and Resiliency Project
- Jamaica Bay Marsh Island Restoration: Elders East, Elders West, Yellow Bar Hassock, Black Wall, and Rulers Bar
- North Atlantic Coast Comprehensive Study
- New York New Jersey (NY NJ) Harbor and Tributaries Coastal Storm Risk Feasibility Study

2. Federally-Authorized/Funded State or Local Actions

Additional projects, which are proposed or currently underway, that are relevant to the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay are listed below. Descriptions of the projects are provided in Appendix A.

- Arverne Urban Renewal Development
- Spring Creek (South) Storm Resilience and Ecosystem Restoration Project
- Jamaica Bay Self-Sustaining Oyster Population Project
- Rockaway Boardwalk Project
- Plumb Beach Coastal Storm Management Project
- Breezy Point Risk Mitigation System

3. Completed and Ongoing Studies and Reports

New York City Department of Environmental Protection's (NYCDEP) *"Jamaica Bay Watershed Protection Plan 2016 Update"* (New York City Department of Environmental Protection 2016) provides a summary of the completed and ongoing projects being carried out within Jamaica Bay. A list of these projects is found below. Project descriptions are provided in Appendix A.

- Ribbed Mussel Pilot Project at Fresh Creek Tributary
- Oyster Reef Pilot Project at Jamaica Bay
- Head of Bay Oyster Project
- Jamaica Bay Wastewater Treatment Plant Upgrades
- Long-term Control Plan for Jamaica Bay and Tributaries
- Area-wide Sewer Improvements
- Floating Wave Attenuator Study
- Spring Creek South Storm Resilience and Ecosystem Restoration Project
- Paerdegat Basin Natural Area and Ecology Park
- Green Infrastructure – Jamaica Bay Watershed

The Science and Resilience Institute at Jamaica Bay is a partnership among academic institutions, nongovernmental organizations, and community groups that is active in research and other efforts pertaining to Jamaica Bay. More information about this institute can be found in Appendix A.

IV. THE STUDY AND FWCA ANALYSIS AREA

A. DESCRIPTION OF THE STUDY AREA

The Study Area is located at the southwestern end of Long Island within the embayed section of the Atlantic Coastal Plain Province. As a result of the weight of the last ice sheet and subsequent postglacial rebound, or rise, of the land, the embayed section is the area of most recent submergence, and is characterized by broad peninsular tracts, drowned river estuaries, and a series of coastal terraces. The width of the Coastal Plain proper, not including the Continental Shelf, is narrowest in the north near the NY Bight Study Area. The Coastal Plain Province of the Bight includes all of Long Island. Low topographic relief characterizes the region with most of the area being less than 30 m in elevation but ranging from sea level to nearly 120 m above (U.S. Fish and Wildlife Service 1997).

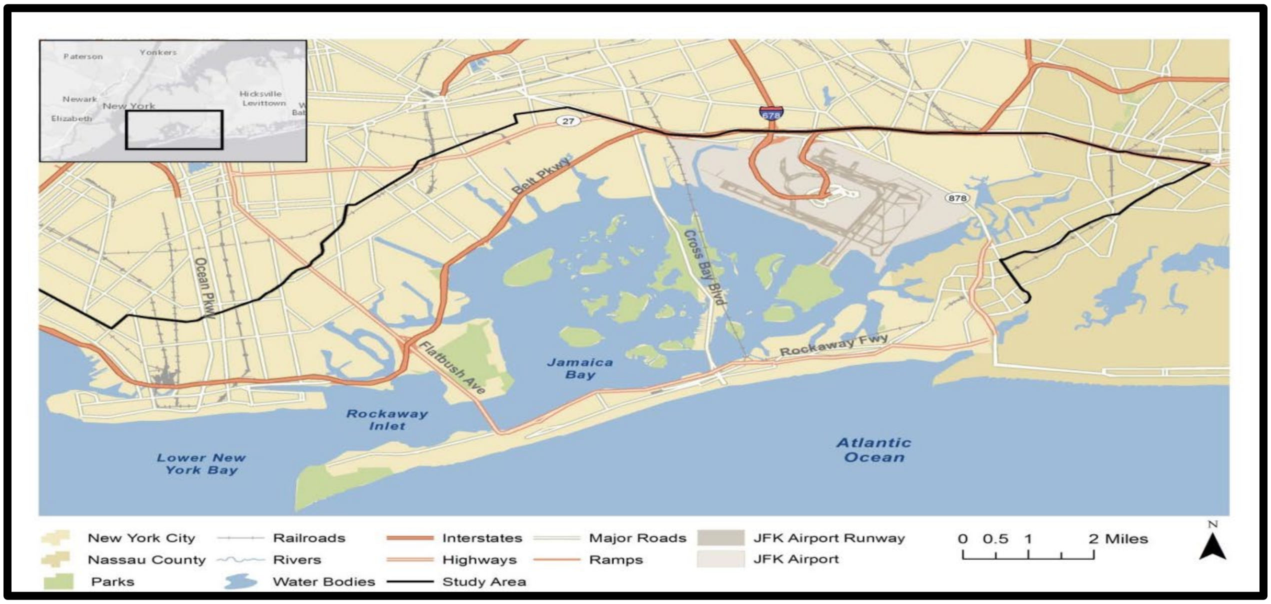

Figure 1. Study Area including the land and waters of the Rockaway Peninsula, Jamaica Bay, and Coney Island. (U.S. Army Corps of Engineers 2016a).

Rockaway Peninsula

Rockaway Peninsula is a developed barrier peninsula comprised of extensive residential and commercial development and associated infrastructure, NYC-owned/managed beaches, a private beach community, private beach clubs, and NPS beaches including upland parcels that are part of the Gateway National Recreation Area (GNRA). The Rockaway Peninsula is flanked by Jamaica Bay to the north and the Atlantic Ocean to the south. It is approximately 10 mi in length and varies between 0.4 mi and 0.9 mi in width. The Rockaway Peninsula is characteristically low-lying and flat. Ground elevations rarely exceed +10 ft North American Vertical Datum of 1988 (NAVD88), except within the existing dune field. Elevations along the Jamaica Bay shoreline generally range from +5 ft NAVD88, increasing to +10 ft NAVD88 further south toward the Atlantic coast (U.S. Army Corps of Engineers 2018).

Approximately 6 mi of the 10-mi long Rockaway Peninsula are characterized as urban development, consisting of residential, commercial, industrial development, high-rise buildings, boardwalks, subways, and roads. The ocean beach is bordered to the north by the boardwalk and other structures. To the east, the beach narrows and contains numerous groins (U.S. Fish and Wildlife Service 1997).

The remaining 4 mi of the peninsula consist of a mix of relatively undeveloped barrier island areas comprised of units of the GNRA, and residential developments including Breezy Point Cooperative and Roxbury. The GNRA property contains an approximately 200-acre (ac) natural area at the western tip of the Rockaway Peninsula with an accreting wide ocean beach, beachgrass dunes, grassland/shrub thicket, and fringing saltmarshes on the bayside (U.S. Fish and Wildlife Service 1997).

Jamaica Bay

Jamaica Bay connects with Lower NY Bay to the west through Rockaway Inlet. Jamaica Bay is a saline to brackish, eutrophic (nutrient-rich) estuary. The bay measures approximately 10 mi at its widest point east to west and approximately 4 mi at its widest point north to south. The mean depth of the bay is approximately 13 ft with maximum depths reaching 30 to 50 ft in the navigation channels and borrows pit areas, historically created to obtain fill material for various development projects around Jamaica Bay. The bay has a semidiurnal tidal range averaging 5-6 feet.

Heavily urbanized areas of Queens, Kings, and Nassau Counties surround the bay. As a result, the bay's bottom and shorelines have been modified over time and its ecological functions and values have been significantly altered. About 12,000 of the original 16,000 ac of wetlands in the bay, mostly around the perimeter of the bay, have been filled. As noted above, extensive areas of the bay have been dredged for navigation channels and to provide fill for the local airports and other construction projects; there have also been extensive modifications to the freshwater and brackish creeks. Specifically, an estimated 125 million cubic yards (cy) of material was removed from the bay and substantial modifications to the tidal inlet connections with Atlantic Ocean (New York City Department of Environmental Protection 2007) were made. The majority of the bay's freshwater inputs are now from the sewage treatment facilities, which contribute between 259 and 287 million gallons of treated effluent per day (New York City Department of Environmental Protection 2007; Waldman 2008).

The bay experiences annual algal blooms, depressed dissolved oxygen levels in select areas, and increased nutrient levels. Water quality sampling and modeling show that Jamaica Bay is a eutrophic system, but, in spite of this, dissolved oxygen and fecal coliform levels suggest water quality of the bay is improving, although high levels of nitrogen and chlorophyll-*a* continue to persist and prove problematic in the estuary (New York City Department of Environmental Protection 2007).

The primary sediments found within the eastern and northern portions of the bay are characterized as muddy fine sands while the southern and western portions of the bay are characterized as fine to medium sands (U.S. Fish and Wildlife Service 1997). As discussed in more detail in the following sections, Jamaica Bay contains large quantities of chemicals, including heavy metals, pesticides, polychlorinated biphenyl (PCB), dichlorodiphenyl-trichloroethane (DDT), and 2,3,7,8,-tetrachlordibenzo-*p*-dioxin (2,3,7,8-TCDD) (U.S. Army Corps of Engineers 2016b). Concentrations of many of these contaminants exceed New York State regulatory thresholds throughout the bay (Steinberg *et al.* 2004; New York State Department of Environmental Conservation 2014a). Additionally, portions of Jamaica Bay, including some of the northern basins and eastern Jamaica Bay, were on the New York State (NYS) 2016 section 303(d) impaired waterbodies list due to pathogens and low dissolved oxygen (New York State Department of Environmental Conservation 2016). However, these areas are proposed for delisting in the draft NYS 2018 section 303(d) list (New York State Department of Environmental Conservation 2018).

The surrounding shoreline of Jamaica Bay is characterized as urban, containing residential, commercial, industrial, and associated infrastructure. Other features located along the Jamaica Bay shoreline include the John F. Kennedy (JFK) International Airport, the former Pennsylvania Avenue and Fountain Avenue landfills, and wastewater treatment facilities. Many of the creeks have been modified, channelized, filled with sediment, or diverted. Some remnant creeks are present along the shoreline.

Offshore Borrow Area

Figure 2. Location of the East Rockaway Borrow Area.

The offshore dredging/borrow area is located approximately 2 mi south of Rockaway Peninsula and approximately 6 mi east of the Rockaway Inlet. The borrow area is approximately 2.6 mi long and 1.1 mi wide, with depths between 36 and 58 feet. The borrow area covers approximately 1,830 ac of marine subtidal habitat, including the water column and ocean bottom habitats.

Coney Island

Coney Island is attached to Long Island and is approximately 4 mi long and 1 mi wide. This area is comprised of extensive residential and commercial developments and associated infrastructure, NYC-owned/managed beaches, and a wastewater treatment plant.

B. ECOLOGICAL SIGNIFICANCE OF THE STUDY AREA

As described below, the Study Area provides habitats of regional and ecological significance to a suite of migratory birds, threatened and endangered species, and species of special concern, despite the negative influences of the surrounding urbanization. Jamaica Bay, the Rockaway Peninsula, and offshore waters provide habitat to various fish and wildlife species and have received special designations from multiple agencies and organizations.

The purpose of this section is to establish and identify significant fish and wildlife resources in the Study Area with a focus on the FWCA analysis areas. This information provides the basis for the more detailed discussion of the ecological communities and significant habitats upon which the impacts of the Corps' Recommended Plan and the fish and wildlife enhancement opportunities are subsequently evaluated.

1. Significant Habitat and Habitat Complex

The Jamaica Bay and Breezy Point Complex (Complex) encompasses the entire Jamaica Bay estuarine lagoon, part of the Rockaway Inlet, the western part of the Rockaway barrier beach, Plumb Beach, and most of the tidal creeks and undeveloped uplands adjacent to the Bay (U.S. Fish and Wildlife Service 1997). This Complex is of regional importance due to the location and rich food resources found within the complex. The Complex contains: beach and dune habitat for nesting bird and rare plant species; foraging areas for waterfowl, shorebirds, and colonial nesting waterbirds; important breeding and juvenile nursery habitat for finfish and shellfish; nesting habitats for gulls, terns, waterfowl, and herons; upland breeding habitat for grassland bird nesting and foraging areas; and butterfly concentration areas (U.S. Fish and Wildlife Service 1997).

2. Gateway National Recreation Area (GNRA)

The GNRA is comprised of 27,000 ac located in NY and New Jersey. Within NY, the park is broken into three distinct districts: Refuge District, Breezy Point District, and North Shore District, which are described below:

a) <u>Refuge District</u>

The Jamaica Bay Wildlife Refuge (Refuge) is a 9,155-ac refuge located on a marsh island in the middle of Jamaica Bay. The Refuge provides diverse habitat to many species of birds, reptiles, and amphibians, and marine and aquatic species. The Refuge is identified as a critical stopover area on the Eastern Flyway migration route with more than 325 bird species having been observed at the Refuge. Within the Refuge, the following habitats are present: saltmarsh, freshwater, brackish ponds, upland woods, fields, beach, open water, and bay islands.

b) <u>Breezy Point District</u>

The Breezy Point District includes the following units: Breezy Point Tip, West Beach, Fort Tilden, and Jacob Riis, which are located along the Atlantic Coast of Rockaway Peninsula. The

Breezy Point Tip is comprised of more than 200 ac of sand dunes, salt and brackish marshes, and grasslands. The site hosts a number of breeding species including the federally-listed piping plover (*Charadrius melodus*; threatened) and roseate tern (*Sterna dougallii dougallii*; endangered), as well as NYS-listed species such as least tern (*Sterna antillarum*; threatened), common tern (*Sterna hirundo*; threatened), black skimmer (*Rynchops niger*), and American oystercatcher (*Haematopus palliatus*). West Beach provides some limited grassland habitat to nesting killdeer (*Charadrius vociferous*) and eastern cottontail rabbit *(Sylvilagus floridanus*). Fort Tilden provides habitat for nesting species of piping plover and American oystercatcher.

c) North Shore District

The North Shore District includes the following units: Floyd Bennett Field, Canarsie Pier, Dead Horse Bay, Plum Beach, and Bergen Beach. Previously a municipal airport, Floyd Bennett Field provides 140 ac of grassland habitat for grasshopper sparrow (*Ammodramus savannarum*), eastern meadowlark (*Sturnella magna*), American kestrel (*Falco sparverius*), and northern harrier (*Circus cyaneus*). Canarsie Pier is surrounded by valuable saltmarsh habitat. Plumb Beach provides important foraging habitat to shorebirds and spawning habitat for horseshoe crab (*Limulus polyphemus*). The habitat at Plumb Beach includes tidal mudflats, low saltmarsh areas, a tidal lagoon, and a fragile dune system.

3. Audubon Important Bird Areas (IBA)

The IBA program identifies, monitors, and protects habitats critical to the success of bird populations (More information about Audubon IBA can be found at http://ny.audubon.org/conservation/what-important-bird-area). The Jamaica Bay complex is a designated IBA and, therefore, critical for wintering, resident, and breeding bird populations found there. The habitats present within the complex include the marine and tidal wetland portions of the bay itself, as well as the barrier beach/dune system and some adjoining upland shrub and grassland. Sensitive species or species of special concern that have been observed in the complex include: black-bellied plover (*Pluvialis squatarola*), red knot (*Calidris canutus rufa*; federally threatened), piping plover, laughing gull (*Leucophaeus atricilla*), roseate terns, common tern, Forster's tern (*Sterna forsteri*), least tern, black skimmer, brant (*Branta bernicula*), greater scaup (*Aythya marila*), and peregrine falcon (*Falco peregrinus; NYS endangered*) (Burger and Liner 2005).

4. New York State Department of State Significant Coastal Fish and Wildlife Habitats

Jamaica Bay is designated as a New York State Department of State (NYSDOS) Significant Coastal Fish and Wildlife Habitat. The designated area includes the entire bay, salt marsh, fringing tidal marsh, tidal flats, dredge spoil islands, and adjacent upland areas, which include open field, shrub thicket, developing woodlands, and beachgrass dune (New York State Department of State 1992). The designated habitat is of great significance as one of the largest coastal wetland ecosystems in New York. The area provides nesting and foraging habitat for a number of NYS threatened and endangered species, and NYS-designated species of special concern including: piping plover, common tern, northern harrier, diamondback terrapin (*Maclemys t. terrapin*), upland sandpiper (*Bartramia longicauda*), barn owl (*Tyto alba*), short-eared owl (*Asio flammeus*), and grasshopper sparrow. The area also serves as a regionally-important recreational fishing and birdwatching site, hosting a wintering waterfowl concentration of statewide importance, including the only population of breeding laughing gulls in New York.

5. NYSDEC Critical Environmental Area

The NYSDEC designates Critical Environmental Areas (CEA) due to their exceptional or unique character with respect to one or more of the following (More information about NYSDEC CEA can be found at http://www.dec.ny.gov/permits/6184.html):

- a benefit or threat to human health;
- a natural setting (*e.g*., fish and wildlife habitat, forest and vegetation, open space, and areas of important aesthetic or scenic quality);
- agricultural, social, cultural, historic, archaeological, recreational, or educational values; or
- an inherent ecological, geological, or hydrological sensitivity to change that may be adversely affected by any change.

Jamaica Bay, including the tributaries, tidal wetlands, and regulated adjacent areas, is a NYSDEC-designated CEA, and was designated as such in order to protect the ecosystem and the large number of wildlife present within the site.

C. HABITAT AND ECOSYSTEM CLASSIFICATIONS

As described above, the Study Area includes portions of Jamaica Bay, the Rockaway Peninsula, and offshore areas of the Atlantic Ocean adjacent to the Rockaway Peninsula. Within these areas, three major ecological systems (Estuarine, Marine, and Terrestrial), each with their respective subsystems and communities, can be identified using the classification system in Edinger *et al.* (2014). Below is a discussion of these three systems, and the subsystems and communities that are found within the Study Area, with a focus on those communities that occur within the FWCA analysis area of the project.

1. Estuarine System

The Estuarine System is defined by Edinger *et al.* (2014), as "deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed but have open, partly obstructed, or sporadic access to open ocean or tidal fresh waters, and in which ocean water is at least occasionally diluted by freshwater runoff." The Estuarine System is further subdivided into the following subsystems: estuarine subtidal, estuarine intertidal, and estuarine cultural, which can be further divided into community types. Below is a description of the estuarine subsystems found within the Study Area and the communities (as defined by Edinger *et al*. 2014) likely to be found within the FWCA analysis area:

a) Estuarine Subtidal

The Estuarine Subtidal subsystem is comprised of the area below the lowest tide. The substrate in this subsystem is continuously submerged by tidal water. This subsystem is found within the Study Area within Jamaica Bay. Estuarine subtidal communities that are likely to occur within the Analysis Area include:

Saltwater Tidal Creek: This is an aquatic community that is continuously tidally flooded with saline water that averages less than 2 m deep at low tide.

b) Estuarine Intertidal

The Estuarine Intertidal subsystem encompasses the area between the highest tide level and the lowest tide level and is periodically exposed and flooded by semidiurnal tides. Regularity of exposure at low tide and flooding at high tide varies throughout the intertidal. Within the Study Area, the estuarine intertidal subsystem is found within Jamaica Bay. Estuarine Intertidal communities occur within the FWCA analysis area primarily along the north shore of the Rockaway Peninsula and in the basins in eastern Jamaica Bay. The communities that are likely to be found in the FWCA analysis area include:

High Salt Marsh: A community dominated by a single graminoid species that occurs in sheltered areas from mean high tide up to the limit of spring tides. This community is flooded by spring tides and flood tides. Small remnant areas of high marsh are present on the north shore of the Rockaway Peninsula and within Motts Basin.

Low Salt Marsh: A coastal marsh community that forms in sheltered areas between mean high tide and mean sea level. The low marsh is regularly flooded by semidiurnal tides and is largely comprised of a stand of smooth cordgrass (*Spartina alterniflora*).

Salt Shrub: This shrubland community is often found on the upper edge of high marsh. It is an ecotone community between saltmarsh and upland vegetation.

Salt Panne: A poorly-drained shallow depression within high or low marsh.

Brackish Interdunal Swales: This is a brackish marsh community that occurs in interdunal swales and is infrequently flooded by extreme high tides.

c) Estuarine Cultural

This subsystem is comprised of communities that are created or maintained by human activities and/or modified by human activities to an extent that the physical substrate or biological community is substantially different from what would occur there naturally without human influence. Within the Study Area, Estuarine Cultural Communities are found within Jamaica Bay. Within the FWCA analysis area, these communities are found along the north shore of the Rockaway Peninsula and within the basins of eastern Jamaica Bay. Estuarine Cultural communities likely to be found within the FWCA analysis area include:

Estuarine Riprap/Artificial Shore: This is a constructed wetland community of the estuarine shore in which the substrate consists of broken rocks, wooden bulkheads, or concrete.

Estuarine Common Reed Marsh: This is a tidal marsh community that is dominated by common reed (*Phragmites australis*).

2. Marine System

The Marine System is described by Edinger *et al.* (2014) as "open ocean overlying the continental shelf, the associated coastline that is exposed to wind and waves, and shallow coastal bays that are saline because they lack significant freshwater inflow. The limits extend from mean high water seaward, beyond the limits of rooted vascular vegetation." The Marine System is further subdivided into the following subsystems: Marine Subtidal, Marine Intertidal, and Marine Cultural, all which are further divided into community types. Within the Study Area the Marine System occurs at the interface of the southern shoreline of the Rockaway Peninsula and the Atlantic Ocean and out to the offshore waters of the borrow area. Below is a description of the Marine subsystems and communities that can be found within the FWCA analysis area:

a) <u>Marine Subtidal</u>

The Marine Subtidal subsystem is the area below the lowest tide that is permanently flooded with tidal water. Within the Study Area, this subsystem occurs south of the Rockaway Peninsula and out to the offshore borrow area. The Marine Subtidal communities within the FWCA analysis area include:

Marine Deepwater Community: This community includes the waters of the open ocean, encompassing both the water column and all underlying benthic substrate (*e.g.*, rock bottom, unconsolidated bottom), from below the lowest tide level and beyond the seaward extent of rooted vascular vegetation.

b) <u>Marine Intertidal</u>

Edinger *et al.* (2014) describes the Marine Intertidal subsystem as "the area between the highest tide level and the lowest tide level; the substrate is periodically flooded and exposed by semidiurnal tides." Within the Analysis Area, this subsystem and its communities occur along the south shore of the Rockaway Peninsula. The following Marine Intertidal community is found within the FWCA analysis area:

Marine Intertidal Gravel/Sand Beach: This is a community that is composed of well-drained sand or gravel substrate that is washed by high-energy waves.

c) Marine Cultural

This subsystem is made up of communities that are created or maintained by human activities, or are modified by human activities to an extent that the physical or biological attributes of these communities are substantially different from what would naturally occur (Edinger *et al.* 2014). The marine cultural communities likely to occur within the FWCA analysis area include:

> *Marine Dredge Excavation Pit/Channel:* This community consists of the benthic community and the adjacent aquatic community that is created when ocean sediments are dredged.

3. Terrestrial System

The Terrestrial System as defined by Edinger *et al*. (2014) includes all areas that are not aquatic, wetland, or subterranean communities. The terrestrial system consists of upland habitats that are well drained and that do not support hydrophytic vegetation. The Terrestrial System is further subdivided into a number of subsystems. The terrestrial subsystems that occur within the Study Area are Open Uplands and Terrestrial Cultural, both of which can be further divided into community types. Below is a description of the Terrestrial communities that can be found within the FWCA analysis area on the Rockaway Peninsula between the boundaries of the Estuarine and Marine Systems:

a) Open Uplands

The open uplands subsystem is comprised of those communities that are dominated by shrubs, herbs, or mosses and lichens, and that have less than 25 percent tree canopy cover. They fall into three main categories: grasslands, meadows, and shrublands. Within the FWCA analysis area, the open upland subsystem is found on the southern side of the Rockaway Peninsula. The open upland communities that are likely to be found within the FWCA analysis area include:

> *Maritime Beach:* This community occurs above mean high tide on unstable cobble, sand, or gravel ocean shores. It is sparsely-vegetated and it is subject to modification by storm waves and wind erosion.

> *Maritime Dunes:* This community is comprised of active and stabilized dunes that support grasses and low shrubs.

> *Maritime Shrubland:* This is a shrubland community that is exposed to offshore winds and salt spray and that occurs on dry seaside bluffs and headlands.

> *Maritime Grassland:* This is a grassland community that grows near the ocean, within the influence of offshore winds and salt spray on the glaciated Atlantic coastal plain.

b) Terrestrial Cultural

This subsystem is made up of communities that are created or maintained by human activities, or are modified by human activities to an extent that the physical or biological attributes of these communities are substantially different from what would naturally occur (Edinger *et al.* 2014). Terrestrial cultural communities are found throughout the FWCA analysis area. Terrestrial cultural communities that are likely to be found within the FWCA analysis area include (but are not limited) to the following: mowed lawn, mowed lawn with trees, mowed roadside, unpaved road, paved road, landfill, urban vacant lot, and urban structure exterior.

V. FISH AND WILDLIFE RESOURCE CONCERNS AND PLANNING OBJECTIVES

The purpose of coordination between the Corps and the Service under the FWCA is to ensure equal consideration of fish and wildlife resources in the planning of water resource development projects. The Service's emphasis for the reformulation study is to mitigate the potential adverse impacts during construction activities, and operation and maintenance of the study.

The term "fish and wildlife resources" as used herein includes birds, fish, mammals, and all other classes of native animals and all types of aquatic and land vegetation upon which fish and wildlife are dependent. Marine and aquatic habitats, marshes, bay bottoms, and maritime beaches are of primary importance to the Service because these habitats are limited in availability, rich in species, and support some of the rarest species in New York.

A. FISH AND WILDLIFE RESOURCE CONCERNS

The Service has several fish and wildlife resource concerns, as identified in this section. Recommendations to address these concerns are found in Section XII, *"Service Planning and Mitigation Recommendations."*

1. Habitat Loss, Alteration, and Degradation

The Study Area is located in one of the most developed areas of the country and, as a result, many natural habitats have been lost and degraded over time. The terrestrial and aquatic habitats in the Study Area have been significantly altered to accommodate extensive residential and industrial development (U.S. Army Corps of Engineers and Port Authority of New York and New Jersey 2016; O'Neil *et al.* 2016). Diminishment of the natural vegetative communities has fragmented habitat and limited food, cover, and nesting for fish and wildlife in the Study Area.

Jamaica Bay, including the north shore of the Rockaway Peninsula, once supported more saltmarsh habitat than exists today but thousands of acres were lost due to filling. Sea-level rise continues to contribute to marsh loss in Jamaica Bay. In addition to the loss of saltmarsh habitat, the bayside shoreline of the Rockaway Peninsula is heavily armored with bulkhead, revetments, and riprap leaving very little natural shoreline for fish and wildlife resources. The armoring of shorelines is an ongoing threat as communities attempt to increase protection from erosion, storms, and sea-level rise.

The Rockaway Peninsula once experienced natural morphological changes, such as the westward growth of the peninsula and the westward migration of East Rockaway Inlet (U.S. Army Corps of Engineers 2016a). However, the Rockaway Peninsula has been stabilized with a number of bulkheads, groins and jetties over the past century. The extensive roads, infrastructure, and development found there also stabilize the Rockaway Peninsula and preclude natural processes, such as overwash and rollover, from occurring. Loss of natural processes due to shoreline stabilization and development inhibits the formation of early successional habitats and will continue to prevent any natural migration of the Rockaway Peninsula as sea-level rises.

2. Invasive Species

Invasive plants can be problematic as they can have negative impacts on native species and ecosystems. Invasive plant species may lower plant diversity by outcompeting native species (Hejda *et al.* 2009; Charles and Dukes 2007). The presence of invasive species may also lower wildlife diversity and species composition can be different in areas of high densities of invasive plants than in areas with native plants (Benoit and Askins 1999; Herrera and Dudley 2003; and Burghardt *et al.* 2009). Invasive plants may have other ecosystem effects, such as alterations of energy, nutrient, and hydrological cycles; changes to disturbance regimes; alterations to physical habitat; and impacts on climate and atmospheric composition (Charles and Dukes 2007).

A number of invasive plant species have been identified in Jamaica Bay and the Rockaway Peninsula. The following sixteen invasive species were identified and listed as “plants of concern” within the Jamaica Bay Wildlife Refuge: Tree-of-Heaven (*Ailanthus altissima*), garlic mustard (*Alliaria petiolata*), porcelain berry (*Ampelopsis brevipendunculata*), mugwort (*Artemisia vulgaris*), Oriental bittersweet (*Celastrus orbiculatus*), spotted knapweed (*Centaurea biebersteinii* [*maculosa*]), cypress spurge (*Chamaesyce* [*Euphorbia*] *cyparissias*), crown vetch (*Coronilla varia*), Russian and autumn olives (*Elaegnus umbellate* and *E. angustifolia*), Japanese honeysuckle (*Lonicera japonica*), purple loosestrife (*Lythrum salicaria*), common reed, Japanese knotweed (*Polygonum cuspidatum* [*Fallopia japonica*]), buckthorn (*Rhamnus frangula*), and multiflora rose (*Rosa multiflora*) (Stalter *et al.* 2009).

Common reed may be of particular concern within the Study Area. Common reed is a perennial wetland grass that is aggressive and outcompetes native plants and displaces native wildlife, as it provides little food or shelter for most saltmarsh-dependent species. Common reed may have other impacts including raising surface elevation of the marsh and altering hydrology and nutrient flows (U.S. Fish and Wildlife Service 2007a). Site visits revealed that common reed is prevalent along the north shore of the Rockaway Peninsula.

3. Wildlife and Habitat Management Related to the Federal Aviation Administration (FAA) Memorandum of Agreement (MOA)

Wildlife management is a significant issue, particularly near JFK International Airport. Aircraft colliding with wildlife, particularly birds, can pose a risk to air travel on and around airports. Restoring and managing habitat within the vicinity of airports can have impacts on overall bird populations in the area, which may contribute to the likelihood of bird strikes. As a result, the FAA has developed a MOA with the Service to guide restoration and management efforts such that they do not create conditions that would result in dangers to air travel. Additionally, the U.S. Department of Agriculture's (USDA) Wildlife Services undertakes gull and geese population control measures within the Jamaica Bay Wildlife Refuge near JFK International Airport and gull and coyote control near LaGuardia Airport.

4. Environmental Contaminants

Contaminants that have been identified in Jamaica Bay include, but are not limited to: metals, polycyclic aromatic hydrocarbons (PAH), pesticides, chlorinated dioxins and furans, PCBs, solvents, and wastewater-related pharmaceuticals and healthcare products, derived from point and non-point sources. The presence of legacy contaminants in Jamaica Bay sediments poses a significant challenge in performing habitat restoration (U.S. Army Corps of Engineers and Port Authority of New York and New Jersey 2016; U.S. Army Corps of Engineers 2016b). Concentrations of many of these contaminants exceed NYS regulatory thresholds throughout the bay (Steinberg *et al.* 2004; New York State Department of Environmental Conservation 2014a). Additionally, chemicals from wastewater treatment plants discharges, combined sewer overflows, non-point source discharges, and chemical and oil spills are also known to be in the sediments (U. S. Army Corps of Engineers 2016b). A study by Benotti and Brownawell (2007) identified fifteen environmental contaminants in Jamaica Bay at least once, including 12 that were identified in most or all of the 24 sites that were surveyed. These compounds included pharmaceutical compounds and major human metabolites including: caffeine, cotinine, nicotine, paraxanthine, acetaminophen, carbamazepine, cimetidine, codeine, diltiazem, ketoprofen, metformin, ranitidine and salbutamol. Laboratory and field studies have shown that various classes of pharmaceuticals can have negative effects, such as reduced health and reproduction, on fish and other aquatic organisms (Corcoran *et al*. 2010; Gaw *et al.* 2014; Overturf *et al*. 2015; Fabbri and Franzellitti 2016). There is growing concern especially about pharmaceuticals in aquatic environments and their impacts on aquatic organisms, marine ecosystems, and human health (Corcoran *et al*. 2010; Gaw *et al*. 2014; Overturf *et al*. 2015; Fabbri and Franzellitti 2016).

The reformulation study is located within the boundaries Army Corps of Engineer's Hudson and Raritan Estuary (HRE) Restoration Study. A number of studies listed in the passage below which is excerpted from the Service's HRE Final FWCA Report (U.S. Fish and Wildlife Service 2018c) have specifically evaluated the biological effects of environmental contamination within the HRE and may, therefore, be applicable to this Reformulation Study.

> *The Corps mapped predicted concentrations of PCBs and 2,3,7,8-TCDD in the top 10 cm of sediment throughout the HRE (U.S. Army Corps of Engineers, Port Authority of New York and New Jersey 2016). Approximately 62 percent of the HRE had sediment concentrations exceeding a remediation goal for 2,3,7,8-TCDD of 3.17 parts per trillion (ppt), a value calculated by the Service (Kubiak et al. 2007), using an effects concentration for successful oyster reproduction and oyster lipid content reported by Wintermyer and Cooper (2003), in conjunction with measured organic carbon contents of sediment in the HRE (Contaminant Assessment and Reduction Project [CARP], 1999-2000). The Corps (2009) also mapped predicted concentrations of total PCBs in sediment and compared those concentrations to the ER-L and ER-M values reported by Long et al. (1995). Approximately 90 percent of the HRE had expected sediment PCB*

> *concentrations exceeding the ER-M, while 99 percent had sediment PCB concentrations exceeding the ER-L. These evaluations reveal the difficulties in finding potential restoration sites without environmental contaminant issues within in the HRE. However, the difficulty may actually be even greater, given that a similar exercise has not been conducted for mercury.*

Dredging sediments can resuspend contaminants, making them more bioavailable (Knott *et al.* 2009). Adverse effects can begin at the base of the food chain, accounting for toxicity to phytoplankton and autotrophic bacteria (Nayer *et al.* 2004). Dredging can also result in sediment resuspension, which can enhance the growth of water column bacteria and protozoa through release of nutrients. This establishes a pathway for organic contaminants to be accumulated by microorganisms and higher trophic animals such as filter feeding organisms (Latimer *et al.* 1999; Zarull *et al.* 1999). The degree of contaminant bioavailability is determined by *'the reactivity of each contaminant with the biological interface, the presence of other chemicals that may antagonize or stimulate uptake, and external factors such as temperature that affect the rate of biological or chemical reactions'* (Luoma 1983, as quoted in Eggleton and Thomas 2004).

Contaminants may also limit oyster restoration efforts that are proposed for natural and nature based features (NNBF) in the Recommended Plan. Wintermeyer and Cooper (2003) studied the effects of dioxin and dioxin-like compounds on egg development and fertilization of the eastern oyster (*Crassostrea virginica*) in Newark Bay and the Arthur Kill, New Jersey. They found that bioavailable contaminants in the water impaired gonadal development, egg viability, and larval production in oysters.

5. Supply of Genetic Stock of Native Plantings

Contracting for native plant material under the current paradigm (*e.g.*, at the time of construction award) delays the initiation of procurement and production of plants and results in compromised material selection, variety, and source. In restoring natural systems, plant materials must be carefully sourced to avoid the negative genetic consequences of introducing maladapted genotypes into local plant populations. Founder effects, genetic swamping, and outbreeding depression are all well-established, negative consequences of translocating maladapted non-local genetic plant materials into restoration sites (Hufford and Mazer 2003).

Numerous coastal resiliency projects are proposed in the Tri-state area over the next decade for construction by the Corps, the Federal Emergency Management Agency, the Housing and Urban Development, the New York State Governor's Office of Storm Recovery, and other federal, state, and municipal agencies. The cumulative effect of these projects will likely further exacerbate the current shortage of locally-sourced and genetically-diverse plants for the Study Area.

The needs for acquiring appropriate plant material over the next ten years cannot be met without the Corps' involvement in assembling a regional team to collect, store, and produce sufficient quantities of genetically-diverse plant material – similar to what the Bureau of Land Management (BLM) is undertaking with numerous stakeholders, seed collectors, farmers, and commercial growers. The problem of native plant procurement for these post-hurricane Sandy projects has recently been further identified by the Rockefeller Foundation in the just-released study entitled, *"Challenges in Supplying Native Plants for Resilience (for the NYC Region)"* (Taedoki B.V. and The Rockefeller Foundation 2016).

B. PLANNING OBJECTIVES

The purpose of consultation under the FWCA is to ensure equal consideration of fish and wildlife resources in the planning of water resource development projects. The Service's emphasis in this regard is to identify means and measures to mitigate the potential adverse impacts of the proposed project and to make positive contributions to fish and wildlife resource problems and opportunities.

From the Service's perspective, a desired output of the proposed project is to ensure the healthy marine, estuarine, and terrestrial ecological communities. Specifically, the Service recommends that conservation of fish and wildlife resources be accomplished by:

1. Ensuring that the proposed project evaluate alternatives that ensure natural areas are protected and conserved and that biological diversity is maintained;
2. Identifying a project alternative that is most beneficial to fish and wildlife resources;
3. Obtaining basic biological data for the marine, estuarine, and terrestrial habitats to aid in the development of appropriate conservation measures;
4. Implementing mitigation measures to avoid and minimize potential direct and indirect project related impacts;
5. Incorporating habitat enhancement opportunities to benefit fish and wildlife resources in the Study Area;
6. Incorporating education and outreach activities in the project to inform the public about the uniqueness and fragility of the coastal ecosystem;
7. Developing and implementing monitoring and maintenance plans for habitats created or impacted by the project; and
8. Ensuring that the implementation of the reformulation plan does not conflict with other federal, state, and local projects within the project's Study Area.

VI. EVALUATION METHODOLOGY

Descriptions of natural resources are based on studies for similar projects, relevant grey and peer-reviewed literature, local, state, and federal fish and wildlife reports and plans, and personal communications with knowledgeable biologists, planners, coastal geologists, and engineers.

In this report, the Service provides a discussion of federal trust resources (*i.e.*, migratory birds, wetlands, endangered species, and anadromous fish), as well as other significant fish and wildlife resources, for the study area. As discussed in more detail in the following section, this report provides descriptions of fish and wildlife resources that use the three major ecological systems (marine, estuarine, and terrestrial) of the proposed Study Area.

VII. DESCRIPTION OF FISH AND WILDLIFE RESOURCES

A. PLANTS

1. Plant Communities

Below are descriptions of the plant communities, as described by Edinger *et al.* (2014), which are common within the FWCA analysis area:

a) Estuarine Communities

Salt Shrub – The common shrubs of the salt shrub community include the following: groundsel-tree (*Baccharis halimifolia*), saltmarsh-elder (*Iva frutescens*), and pasture rose (*Rosa Carolina*). The common herbaceous species are: salt-meadow grass (*Spartina patens*), black-grass (*Juncus gerardii*), and switchgrass (*Panicum virgatum*) (Edinger *et al.* 2014).

High Salt Marsh – Salt-meadow grass (*Spartina patens*) or a dwarf form of cordgrass (*S. alterniflora*) dominate large areas of this community. Spikegrass (*Distichlis spicata*), black-grass, and glassworts (*Salicornia* spp.) may also dominate large areas of this community. Common species of the upper slope of the high marsh include: black-grass, switchgrass, sea-lavender (*Limonium carolinianum*), seaside gerardia (*Agalinis marinta*), and slender saltmarsh aster (*Aster tenuifolius*) (Edinger *et al.* 2014).

Low Salt Marsh – Low marsh is comprised largely of a monospecific stand of cordgrass. Some species of marine algae can form dense mats on the surface sediments between the cordgrass stems, including knotted wrack (*Ascophyllum nodosum*) and rockweed (*Fucus vesiculosus*), sea lettuce (*Ulva* spp.), and hollow green weeds (*Enteromorpha* spp.). Other plants that may be present in the low marsh in low numbers include: glasswort (*Salicornia europaea*), saltmarsh sand-spur (*Spergularia marina*), and lesser sea blite (*Suaeda maritima*) (Edinger *et al.* 2014).

Brackish Interdunal Swales – This community is dominated by grasses, sedges, and rushes including salt-meadow grass, dwarf spikerush (*Eleocharis parvula*), three-square (*Schoenoplectus pungens*), flatsedge (*Cyperus polystachyos*), and jointed rush (*Juncus articulatus*). Other characteristic plants include: salt-meadow grass (*Leptochloa fusca* spp. *fascicularis*), seaside bulrush (*Bobloschoenus maritimus* spp. *paludosus*), toad-rush (*Juncus ambiguus*), sedge-rush (*Juncus scirpoides*), mock bishop's-weed (*Ptilimnium capillaceum*), golden dock (*Rumex maritimus*), eastern annual saltmarsh aster (*Symphyotrichum subulatum* var. *subulatum*), red pigweed (*Chenopodium rubrum*), saltmarsh fleabane (*Pluchea odorata*), rose-mallow (*Hibiscus moscheutos*), bushy knotweed (*Polygonum ramosissimum*), and saltmarsh-elder. Seabeach amaranth (*Amaranthus pumilus*) may also occur. Common reed can become invasive in this community (Edinger *et al.* 2014).

b) Terrestrial Communities

Maritime Beach – The characteristic species of the maritime beach include: American beach grass (*Ammophila breviligulata*), sea-rocket (*Cakile edentula* spp. *edentula*), seaside atriplex (*Atriplex patula*), seabeach atriplex (*A. arenaria*), seabeach sandwort (*Honkenya peploides*), salsola (*Salsola kali*), seaside spurge (*Chamaesyce polygonifolia*), and seabeach knotweed (*Polygonum glaucum*) (Edinger *et al.* 2014).

Maritime Dunes – As described earlier, the maritime dunes community is comprised of both active and stabilized dunes. The characteristic species of the active dunes include: American beach grass, dusty-miller (*Artemisia stelleriana*), beach pea (*Lathyrus japonicas*), sedge (*Carex silicea*), seaside goldenrod (*Solidago sempervirens*), and sand-rose (*Rosa rugosa*) (Edinger *et al.* 2014). The common species of stabilized dunes include: beach heather (*Hudsonia tomentosa*), bearberry (*Arctostaphylos uva-ursi*), beachgrass, cyperus (*Cyperus polystachyos* var. *macrostachyus*), seaside goldenrod, beach pinweed (*Lechea maritima*), jointweed (*Polygonella articulata*), sand-rose, bayberry (*Myrica pensylvanica*), beach-plum (*Prunus maritima*), poison ivy (*Toxicodendron radicans*), lichens (*Cladina submitis* and *Cetraria arenaria*), seabeach amaranth, and, in small numbers, stunted pitch pines (*Pinus rigida*) or post oaks (*Quercus stellata*) (Edinger *et al.* 2014).

Maritime Shrubland – Common shrubs and sapling trees of maritime shrubland include: shadbush (*Amelanchier canadensis*), bayberry, black cherry (*Prunus serotina*), arrowwood (*Viburnum dentatum*), and shining sumac (*Rhus copallinum*). Other shrubs and stunted trees that may be present include beach-plum, sand-rose, wild rose (*R. virginiana*), eastern red cedar (*Juniperus virginiana*), American holly (*Ilex opaca*), black oak (*Quercus velutina*), and sassafras (*Sassafras albidum*). Small amounts of the following that may also be found in this community include: highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), red maple (*Acer rubrum*), and black chockeberry (*Aronia melanocarpa*) – these are often found in moister low areas (Edinger *et al*. 2014)

Characteristic vines include: poison ivy, Virginia creeper (*Parthenocissus quiquefolius*), greenbrier (*Smilax rotundofiloia*), oriental bittersweet, and Japanese honeysuckle. Herbaceous plants are very sparse in this community, but may include: flat-topped goldenrod (*Euthamia graminifolia*), wild indigo (*Baptisia tinctoria*), white-topped aster (*Aster paternus*), and little bluestem (*Schizachyrium scoparium*) (Edinger *et al.* 2014).

Maritime Grassland – The dominant grasses of the maritime grassland include: little bluestem, common hairgrass (*Deschampsia flexuosa*), and poverty-grass (*Danthonia spicata*). Other characteristic species include: Pennsylvania sedge (*Carex pensylvanica*), rush (*Juncus greenei*), Indian grass (*Sorghastrum nutans*), Atlantic golden aster (*Pityopsis falcate*), bushy rockrose (*Helianthemum dumosum*), hoary frostweed (*H. propinquum*), flat-topped goldenrod, white-topped aster, pussy’s toes (*Antennaria plantaginifolia*), bitter milkwort (*Polygama polygama*), bayberry, shining sumac, and northern dewberry (*Rubus flagellaris*) (Edinger *et al.* 2014).

2. Rare Plants and Plants of Ecological Significance

Surveys conducted as part of an Environmental Impact Statement for the Arverne Urban Renewal Area Project (Wall and Associates, Inc. *et al.* 2003) identified five rare and/or ecologically significant plant species along the south shore of the eastern Rockaway Peninsula. The three rare plants that were located were the federally-listed seabeach amaranth (threatened), the NYS-listed seabeach knotweed (threatened), and the NYS-listed dune sandspur (*Cenchrus tribuloides*; rare). Surveyors also identified two ecologically-significant plants: milkweed (*Aesclepias syriaca*) and wild pepper grass (*Lepidium virginicum*). Milkweed is a host plant to the monarch butterfly (*Danaus plexippus*), which is being reviewed for federal listing status, and wild pepper grass is a host species for the checkered white (*Pontia protodice*), which is a species of special concern in New York.

Other rare plants that occur within Jamaica Bay and Breezy Point include: Houghton's umbrella-sedge (*Cyperus houghtonii*), blunt spikerush (*Elecharis obtuse* var. *ovata*), field-dodder (*Cuscuta pentagona*), smartweed-dodder (*Cuscuta polygonorum*), Schweinitz's flatsedge (*Cyperus schweinitzii*), Roland's sea-blite (*Suaeda rolandii*), willow oak (*Quercus phellos*), and retrorse flatsedge (*Cyperus retrorsus*) (U.S. Fish and Wildlife Service 1997).

B. WILDLIFE

1. AVIAN SPECIES

Migratory birds are a federal trust resource. Many species of migratory birds have experienced population declines in recent decades, largely due to direct and indirect destruction and fragmentation of their habitats (Dunne 1989).

The FWCA requires the Secretary of the Interior, through the Service, to identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA. *Birds of Conservation Concern 2008* (U.S. Fish and Wildlife Service 2008) is the most recent effort to carry out this mandate. The overall goal of that report is to accurately identify the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent our highest conservation priorities. A resource assessment by the Service's IPaC (Information, Planning, and Conservation System) identified a total of 33 Birds of Conservation Concern that may occur seasonally or year-round within the Study Area (U.S. Fish and Wildlife Service 2018a). All the species below have been observed in the Study Area (Veit *et al.* 2002; eBIRD 2018); however, some of these species are rare occurrences in the area. These are listed in Table 1, below.

Table 1. Birds of Conservation Concern in the Study Area (U.S. Fish and Wildlife Service 2018a).

Species	Scientific Name	Species	Scientific Name
American Oystercatcher	*Haematopus palliates*	Nelson's Sparrow	*Ammodramus nelson*
Black Skimmer	*Rynchops niger*	Prairie Warbler	*Dendroica discolor*
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Prothonotary Warbler	*Protonotaria citrea*

Bobolink	*Dolichonyx oryzivorus*	Purple Sandpiper	*Calidris maritima*
Buff-breasted Sandpiper	*Calidris subruficollis*	Red-headed Woodpecker	*Melanerpes erythrocephalus*
Canada Warbler	*Cardellina Canadensis*	Red-throated Loon	*Gavia stellate*
Cerulean Warbler	*Dendroica cerulean*	Ruddy Turnstone	*Arenaria interpres morinella*
Clapper Rail	*Rallus crepitans*	Rusty Blackbird	*Euphagus carolinus*
Dunlin	*Calidris alpina arcticola*	Saltmarsh Sparrow	*Ammodramus caudacutus*
Evening Grosbeak	*Coccothraustes vespertinus*	Seaside Sparrow	*Ammodramus maritimus*
Golden-winged Warbler	*Vermivora chrysoptera*	Semipalmated Sandpiper	*Calidris pusilla*
Gull-billed Tern	*Gelochelidon nilotica*	Short-billed Dowitcher	*Limnodromus griseus*
Hudsonian Godwit	*Limosa haemastica*	Snowy Owl	*Bubo scandiacus*
Kentucky Warbler	*Oporornis formosus*	Whimbrel	*Numenius phaeopus*
Least Tern	*Sterna antillarum*	Willet	*Tringa semipalmata*
Lesser Yellowlegs	*Tringa flavipes*	Wood Thrush	*Hylocichla mustelina*
Long-eared Owl	*Asio otus*		

Jamaica Bay encompasses a large portion of the Study Area and supports numerous bird species. The NPS conducted bird surveys in Jamaica Bay from 1994 to 2014. Over the course of the NPS surveys, 325 species of birds were identified as using the Jamaica Bay Wildlife Refuge (National Park Service 2014). Many of these species are migratory species or rare occurrences, however, over 60 species are confirmed breeders (National Park Service 2014). Notable breeders within Jamaica Bay include wading bird colonies and obligate saltmarsh-breeding birds, such as saltmarsh sparrow (*Ammospiza caudacuta*) and clapper rail (*Rallus crepitans*). The habitats of the Rockaway Peninsula also support a number of breeding and migratory birds. In April 2000 and April 2001, the Jamaica Bay Ecosystem Research and Restoration Team (Veit *et al.* 2002) performed bird surveys at nine sites across Jamaica Bay, including three bayside locations on the Rockaway Peninsula: Dubos Point, Bayswater Point State Park, and Brant Point. During these surveys, they observed 142 species of birds across the three sites (full list in Appendix B). Of the nine sites surveyed throughout the bay, Dubos Point was one of three with the highest migrant shorebird diversity and Bayswater Point State Park was one of two with the highest in neotropical migrant landbird diversity.

Suites of birds that are found in the Study Area that are of particular conservation concern are discussed in more detail below.

a) <u>Shorebirds and Seabirds</u>

The Study Area provides essential nesting and foraging habitats for significant breeding colonies of shorebirds and seabirds, including the piping plover, roseate tern, least tern, common tern, black skimmer, and American oystercatcher. Roseate terns have historically nested within the Study Area, but have not been observed nesting recently, although some have been observed foraging in the area. It should also be noted that the black skimmer colony that nests within the Study Area is one of only three nesting skimmer colonies in New York.

Within the Study Area, the piping plover nests in the maritime beach and dune communities on the Rockaway Peninsula and forages on invertebrates primarily along the ocean and bay shorelines. The least tern also nests on the maritime beaches, but forages for fish in ocean and bay open waters. The common tern and black skimmer breed on maritime beach/dune habitats and forage for fish in ocean and bay open waters. The American oystercatcher breeds and forages in the maritime beach and dune habitats of the Rockaway Peninsula, as well as in the estuarine habitats of Jamaica Bay.

Numerous migratory shorebirds can also be found during migratory periods in the estuarine communities of Jamaica Bay and the marine and maritime beaches of the Rockaway Peninsula. Most notably, NY's largest concentrations of migratory red knots are found in the marsh islands of Jamaica Bay. Significant flocks of semipalmated sandpiper (*Calidris pusilla*) and sanderling (*C. alba*) have also been documented (New York City Audubon, unpublished data). The red knot and other migratory shorebirds, such as sanderling and semipalmated sandpipers, also utilize the marine and maritime beaches within the Study Area during spring and fall migrations (eBird 2018).

Many species of shorebirds in the U.S. are suffering from declines in populations. The "*Atlantic Flyway Shorebird Business Strategy"* (Winn *et al.* 2013) identifies the following as some of the main threats to shorebirds: hunting, predation, human disturbance, and habitat loss and change. The following species are recognized by the "*Atlantic Flyway Shorebird Business Strategy"* as species of greatest conservation concern: American oystercatcher, semipalmated sandpiper, red knot, whimbrel (*Numenius phaeopus*), Wilson's plover (*Charadrius wilsonia*), marbled godwit (*Limosa fedoa*), piping plover, purple sandpiper (*Calidris maritima*), red-necked phalarope (*Phalaropus lobatus*), ruddy turnstone (*Arenaria interpres*), sanderling, snowy plover (*Charadrius nivosus*), American golden-plover (*Pluvialis dominica*), greater yellowlegs (*Tringa melanoleuca*), and lesser yellowlegs (*Tringa flavipes*). Except for the snowy and Wilson's plovers, all of these species have been recorded in the Study Area (eBird 2018).

b) Saltmarsh Birds

Many bird species rely on saltmarsh habitat for foraging and/or nesting. Certain species, such as saltmarsh sparrows and clapper rails, are obligate saltmarsh nesting species, meaning that they nest exclusively in saltmarsh habitat and are particularly vulnerable to marsh loss or degradation. Historic and current losses of saltmarsh habitat have led to a number of saltmarsh bird species being recognized as species of conservation concern (New York State Department of Environmental Conservation 2015; U.S. Fish and Wildlife Service 2008; and International Union for Conservation of Nature 2016). Sea-level rise continues to pose a threat to saltmarsh birds as it reduces available saltmarsh habitat and may lead to an increased frequency of nest flooding – a major cause of nest loss for marsh-nesting species (Gjerdrum *et al.* 2008; Shriver *et al.* 2007; Bayard and Elphick 2011).

The marsh islands and fringing marshes of Jamaica Bay provide nesting habitat for a number of marsh-nesting birds. The Jamaica Bay marsh islands provide habitat to a number of breeding colonies of wading birds each summer (Winston 2017). Obligate saltmarsh-nesting birds, including saltmarsh sparrow, seaside sparrow (*Ammodramus maritimus*), and clapper rail, nest on the marsh islands and in the fringing marshes along the bay (Kocek 2014; New York State Department of Environmental Protection 2005). These three species were also located in habitats on the Rockaway Peninsula (Veit *et al.* 2002). Other marsh-dependent species that were located include, but are not limited to: American black duck (*Anas rubripes*), American bittern (*Botaurus lentiginosus*), great blue heron (*Ardea Herodias*), green heron (*Butorides virescens*), yellow-crowned night-heron (*Nyctanassa violacea*), black-crowned night-heron (*Nycticorax nycticorax*), great egret (*Ardea alba*), snowy egret (*Egretta thula*), and marsh wren (*Cistothorus palustris*) (Veit *et al.* 2002).

c) Waterfowl

Wintering waterfowl are found in both marine waters off the Rockaway Peninsula, as well as the estuarine waters in Jamaica Bay. Significant concentrations of wintering waterfowl can be found in Jamaica Bay. Large numbers of greater scaup, American black duck, brant, Canada goose (*Branta canadensis*), bufflehead (*Bucephala albeola*), canvasback (A*ythya valisneria*), mallard (*Anas platyrhynchos*), ruddy duck (*Oxyura jamaicensis*), red-breasted merganser (*Mergus serrator*), snow goose (*Chen caerulescens*), and American wigeon (*Anas americana*) have been documented since the late 1970s (New York State Department of State 1992; U.S. Fish and Wildlife Service 1997; Waldman 2008). Other waterfowl species documented within the bay include: horned grebe (*Podiceps auritus*), green-winged teal (*Anas crecca*), gadwall (*A. strepera*), northern shoveler (*A. clypeata*), and common goldeneye (*Bucephala clangula*) (U.S. Fish and Wildlife Service 1997). Jamaica Bay is recognized as a focal area by the Atlantic Coast Joint Venture (ACJV) *Waterfowl Implementation Plan* (Atlantic Coast Joint Venture 2005). The sheltered open water, fringing marshes, and mudflats provide habitat for wintering sea, bay, and dabbling ducks (Atlantic Coast Joint Venture 2005).

The waterfowl of the marine waters off the Rockaway Peninsula have not been as well described, however, the Atlantic Coast Wintering Sea Duck Survey (2008-2011) incorporated an aerial survey transect off of the coast of southwestern Long Island. White-winged scoter (*Melanitta fusca*), long-tailed duck (*Clangula hyemalis*), surf scoter (*M. perspicillata*), and black scoter (*M. americana*) were detected on this transect and others along the south shore of Long Island (Silverman *et al.* 2013). Because they were hard to distinguish down to species during the aerial surveys, bufflehead, goldeneye, and merganser species were reported as one consolidated group, which was also detected on the southwestern Long Island transect (Silverman *et al.* 2013, as cited in Michel *et al.* 2013).

Waterfowl are of conservation concern as mid-winter survey data from 1970-2003 indicated that various waterfowl species have suffered population declines (Atlantic Coast Joint Venture 2005). This includes species, such as the American black duck and the long-tailed duck, which are found in the Study Area. The status of many sea duck populations is largely unknown and, due to this concern, there are research and conservation initiatives for these species. Long-tailed duck, American common eider, black scoter, surf scoter, and white-winged scoter are designated as high priority species by the Sea Duck Joint Venture Management Board Management Board (SDJV); all of which have been located in the Study Area (Silverman *et al*. 2013; eBird 2018). Recent and ongoing efforts are being made to better understand these populations and the threats they may face (Sea Duck Joint Venture Management Board 2014). The main threats to waterfowl are: habitat loss, fragmentation and degradation; contaminants; disease; invasive species; predation and harvest; human population and disturbance; and global climate change (Atlantic Coast Joint Venture 2005).

d) Neotropical Migratory Landbirds

Neotropical migrants are those bird species that breed in the U.S. and Canada, and migrate south to overwinter in the neotropics. Neotropical migratory landbirds (*e.g*., migratory songbirds) make up a large proportion of neotropical migrants, as well as a large proportion of the avian community in the northeastern United States (Askins *et al.* 1990; Keller and Yahner 2006). Many neotropical migrants, including species of migratory songbirds, have suffered population declines in recent decades (Robbins *et al*. 1989; Askins *et al.* 1990; Sauer *et al.* 2014). Neotropical landbird migrants suffer mortality during all phases of their annual lifecycle; however, the greatest mortality for some species may occur during migratory periods (Holmes 2007). Numerous species of migratory neotropical migratory landbird species fulfill many of their life stages (*i.e.*, breeding and migration) within the Study Area.

The following neotropical bird species are recognized by the Service as species of concern (U.S. Fish and Wildlife Service 2008) and may be found within the Study Area: bobolink (*Dolichonyx oryzivorus*), Canada warbler (*Wilsonia canadensis*), cerulean warbler (*Dendroica cerulea*), golden-winged warbler (*Vermivora chrysoptera*), Kentucky warbler (*Oporornis formosus*), prairie warbler (*Dendroica discolor*), prothonotary warbler (*Protonotaria citrea*), and wood thrush (*Hylocichla mustelina*).

Additionally, a number of neotropical migratory landbird species are confirmed breeders within the Study Area including (but not limited to): American robin (*Turdus migratorius*), barn swallow (*Hirundo rustica*), cedar waxwing (Bombycilla cedrorum), common yellowthroat (*Geothlypis trichas*), gray catbird (*Dumetella carolinensis*), house wren (*Troglodytes aedon*), marsh wren, red-winged blackbird (*Agelaius phoeniceus*), song sparrow (*Melospiza melodia*), tree swallow (*Tachycineta bicolor*), yellow warbler (*Dendroica petechia*), and willow flycatcher (*Empidonax traillii*) (National Park Service 2014; U.S. Fish and Wildlife Service 2018b).

2. Amphibians and Reptiles

Reptiles and amphibians that occur within the Study Area include: Fowler's toad (*Bufo woodhousii fowleri*), spring peeper (*Pseudacris crucifer*), gray treefrog (*Hyla versicolor*), green frog (*Rana clamitans*), spotted salamander (*Ambystoma maculatum*), redback salamander (*Plethodon cinereus*), northern brown snake (*Storeria d. dekayi*), smooth green snake (*Opheodrys vernalis*), eastern hognose snake (*Heterodon platirhinos*), eastern milk snake (*Lampropeltis triangulum triangulum*), northern black racer (*Coluber c. constrictor*), snapping turtle (*Chelydra serpentina*), eastern painted turtle (*Chrysemys p. picta*), and eastern box turtle (*Terrapene c. carolina*) (U.S. Fish and Wildlife Service 1997).

Diamondback Terrapins

Diamondback terrapins inhabit coastal marshes, tidal creeks, estuaries, bays, and coves where they forage and breed. Breeding and nesting typically occurs in May, June, and July. Nest locations are commonly found on uplands adjacent to estuarine habitats and include dunes, grasslands, shrublands, beaches, and sand/gravel trails (Feinberg and Burke 2004). Terrapin populations are declining across their range – Atlantic and Gulf Coasts of the United States. Major threats to terrapins include: road mortality, predators, mortality due to fishing gear, harvesting, and habitat destruction. Within Jamaica Bay, terrapins have been documented nesting at the GNRA – specifically, Rulers Bar Hassock and Little Egg Island (Feinberg and Burke 2003), JFK Airport, and Idlewild Park (Pehek *et al.* 2018). There have also been anecdotal reports of nesting adults and hatchling diamondback terrapins on the north side of the Rockaway Peninsula (Burke 2018).

3. Mammals

Resident mammals of the Jamaica Bay islands and shoreline include: opossum (*Didelphis virginiana*), eastern cottontail rabbit, eastern chipmunk (*Tamias striatus* – introduced), gray squirrel (*Sciurus carolinensis*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), muskrat (*Ondatra zibethicus*), and house mouse (*Mus musculus*). Migratory bats found at the Jamaica Bay Wildlife Refuge include: little brown bat (*Myotis lucifugus*), silver-haired bat (*Lasionycteris noctivagans*), red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*) (U.S. Fish and Wildlife Service 1997). Introduced nuisance mammal species include: Norway rat (*Rattus norvegicus*), feral cat (*Felis catus*), and feral dog (*Canis familiaris*) (U.S. Fish and Wildlife Service 1997).

Marine mammals that may occur within the vicinity of the Study Area include: harbor seal (*Phoca vitulina*), humpback whale (*Megaptera novaeangliae*), bottlenose dolphin (*Tursiops truncates*), and the federally-listed sperm whale (*Physeter microcephalus*; endangered) (U.S. Fish and Wildlife Service 1997). Other marine mammals that have been observed more widely in the New York Bight include: blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), North Atlantic right whale (*Eubalaena glacialis*), common dolphin (*Delphinus delphis*), Cuvier's beaked whale (*Ziphius cavirostris*), minke whale (*Balaenoptera acutorostrata*), pilot whale (*Globicephala melas*), and Risso's dolphin (*Grampus griseus*) (Tetra Tech and Smultea Sciences 2018).

C. FISH

1. Essential Fish Habitat (EFH)

The EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) authorize the NOAA Fisheries to evaluate development projects proposed or licensed by federal agencies, including the Corps. If coastal development projects have the potential to adversely affect marine, estuarine, or anadromous species or their habitat, NOAA

Fisheries makes recommendations on how to avoid, minimize, or compensate these impacts (National Oceanic and Atmospheric Administration website, https://www.greateratlantic.fisheries.noaa.gov/habitat/efh/efhassessment.html).

The MSFCMA also establishes measures to protect Essential Fish Habitat (EFH). The NOAA Fisheries must coordinate with other federal agencies to conserve and enhance EFH, and federal agencies must consult with the NOAA Fisheries on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. In turn, the NOAA Fisheries must provide recommendations to federal and state agencies on such activities to conserve EFH. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from actions or proposed actions authorized, funded, or undertaken by that agency.

The EFH areas are depicted on the NOAA Fisheries' website: https://www.greateratlantic.fisheries.noaa.gov/habitat/efh/efhassessment.html). Several species designated as EFH species by the NOAA Fisheries are found in the Study Area. After reviewing the draft FWCA report, the NOAA Fisheries provided the following information about EFH species: "*The project area has been designated as EFH for a number of federally managed species, including Atlantic butterfish (Peprilus triacanthus), Atlantic mackerel (Scomber scombrus), Atlantic sea herring (Clupea harengus), black sea bass (Centropristis striata), bluefish (Pomatumus saltatrix), clearnose skate (Raja eglanteria), cobia (Rachycentron canadum), king mackerel (Scomberomorus cavalla), little skate (Leucoraja erinacea), long-finned inshore squid (Loligo pealei), monkfish (Lophius americanus), red hake (Urophycis chuss), scup (Stenotomus chrysops), Spanish mackerel (Scomberomorous maculates), summer flounder (Paralichthys dentatus), whiting (Merluccius bilinearis), windowpane flounder (Scophthalmus aquosus), winter flounder (Pseudopleuronectes americanus), winter skate (Leucoraja ocellata), and others.*

The project area is also EFH for several highly migratory species, including blue shark (Prionace glauca), dusky shark (Carcharinus obscurus), sanbar shark (Carcharinus plumbeus), and sand tiger shark (Odontaspis taurus). Sand tiger and dusky sharks have also been designated as Species of Concern by the NOAA. Species of Concern are those about which we have concerns regarding their status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act (ESA)." Note that the NOAA Fisheries defines the project area as the Atlantic coast of NYC between East Rockaway Inlet and Rockaway Inlet, areas within Jamaica Bay, and the offshore borrow area.

2. FINFISH

Jamaica Bay provides important spawning, foraging, and nursery habitat for many finfish species. Species documented in the bay include: winter flounder, summer flounder, windowpane flounder, weakfish (*Cynoscion regalis*), bluefish, scup, blueback herring (*Alosa aestivalis*), Atlantic cod (*Gadus morhua*), black sea bass, northern kingfish (*Menticirrhus saxatilis*), tautog (*Tautoga onitis*), Atlantic silversides, mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), Atlantic menhaden (*Brevoortia tyrannus*), bay anchovy, northern pipefish, American shad (*Alosa sapidissima*), Atlantic sturgeon (*Acipenser* *oxyrhynchus*), sea robin (*Prionotus carolinus*), striped bass (*Morone saxatilis*), banded killifish (*Fundulus diaphanus*), cunner (*Tautogolabrus adspersus*), inland silversides (*Menidia berylinna*), striped sea robin (*Prionotus evolans*), white mullet (*Mugil curema*), and white perch (*Morone americana*) (National Park Service 2007; U.S. Fish and Wildlife Service 1997; New York State Department of State 1992). American eel (*Anguilla rostrata*), once common in Jamaica Bay, have experienced range-wide declines (Haro *et al.* 2000 *in* Waldman 2008). A summary table of species found within Jamaica Bay can be found in Appendix C.

Many common species found in the nearshore and offshore habitats are the same as the species found in Jamaica Bay and a summary of nearshore and offshore species is provided in Appendix D. Many of the species present are EFH-designated species. As discussed above, EFHs are those aquatic habitats where fish spawn, breed, feed or grow to maturity and include wetlands, coral reefs, sea grasses, and rivers. The EFH provisions of the MSFCMA authorize the NOAA Fisheries to evaluate development projects proposed or licensed by federal agencies, including the Corps. If coastal development projects have the potential to adversely affect marine, estuarine, or anadromous species or their habitat, the NOAA Fisheries makes recommendations on how to avoid, minimize, or compensate these impacts (NOAA website: https://www.greateratlantic.fisheries.noaa.gov/habitat/efh/efhassessment.html).

In addition to Jamaica Bay and the nearshore and offshore waters, the inlets in the Study Area are also important to numerous species of fish. In their response to the Draft FWCA report, the NOAA Fisheries identified a number of fish that transit the inlets in the Study Area to move between nearshore and offshore waters and estuarine waters. These species include, but are not limited to, commercially or recreationally important species such as winter flounder, as well as anadromous fishes, such as river herring (alewife [*Alosa pseudoharengus*] and blue back herring [*Alosa aestivalis*]). Winter flounder (as well as other species) may use the inlets to access estuarine habitats in which they spawn. Anadromous species use the inlets as migratory pathways to nursery and forage habitat within the estuary beyond the inlet. Alewife and blueback herring spend most of their adult life at sea, but return to freshwater areas to spawn in the spring.

D. INVERTEBRATES

1. Marine Invertebrates

This section only contains a brief description of these ecological resources. The Service recommends that the Corps coordinate with the NOAA Fisheries for a more in-depth discussion of marine invertebrate resources in the Study Area and potential impacts resulting from implementation of the proposed action. The offshore marine habitat supports shellfish and crustaceans, such as mud clam (*Mulinia lateralis*), razor clam (*Ensis directus*), surf clam (*Spisula solidissima*), blue mussel (*Mytilus edulis*), soft shell clam (*Mya arenaria*), blue crab (*Callinectes sapidus*), and American lobster (*Homarus americanus*) (U.S. Fish and Wildlife Service 1997). Other marine subtidal benthic macrofauna that may be found in the Study Area include: tellin clam (*Tellinidae* spp.), sand dollar (*Echinarachnius parma*), amphipod species (*e.g.*, *Protohaustarius deichmaae, Unicola irrorata*), and polychaete species (*e.g., Sthenelais limicola, Lumbrineris fragilis, Spiophanes bombyx*), all of which are found in habitats described as a medium, coarse-grain sand community (Steimle and Stone 1973).

Surf clam populations were previously known to occur from the shoreline to approximately 2 mi. offshore (New York State Department of Environmental Conservation 2002). Overall, the NYS waters of the Atlantic Ocean were noted as a major surf clam fishery. In 2001, 444,053 bushels of surf clams, with a value of $4.5 million were harvested (New York State Department of Environmental Conservation 2002). Historically, surf clam surveys conducted along the Rockaway Beach Peninsula have been shown to produce a harvest valued at approximately $100,000 per 100 ac or more (New York State Department of Environmental Conservation 1994).

The bay supports shellfish populations of hard clams (*Mercenaria mercenaria*), soft clams (*Mya arenaria*), mussels, and rock crabs (*Cancer irroratus*) (New York State Department of State 1992). At one time, Jamaica Bay supported a large fishery for oyster (*Crassostrea virginica*), hard clam, softshell clam, and blue crab (Waldman 2008). However, due to threats of disease, the fisheries were closed in 1921 (Waldman 2008). A list of the aquatic species is provided in Appendix E.

Oysters were once an abundant fishery producing upwards of 700,000 bushels of oysters per year at its peak (Grambo and Vega 1984, *in* Waldman 2008; Franz 1982, *in* Zarnoch and Schreibman 2012). However, overfishing, habitat loss from dredging and filling, and pollution led to a collapse of the fishery (Zarnoch and Schreibman 2012).

Recent efforts by Zarnoch and Schreibman (2012) and the NYCDEP, in conjunction with the Suffolk Cornell Cooperative Extension (SCEE), have carried out studies to determine whether oysters could be able to survive under the current conditions of the Bay. Zarnoch and Schreibman (2012) concluded that juvenile oysters transplanted into Jamaica Bay are likely to survive and grow. In 2010, an oyster bed pilot study using spat-on-shell and spat-covered reef balls was undertaken within Jamaica Bay by the NYCDEP, the SCEE and the NYSDEC. A follow-up assessment in 2016 determined that the oysters were alive and appeared to be healthy (New York City Department of Environmental Protection 2016).

Horseshoe Crabs

Horseshoe crabs can be found in the waters of the Study Area. Their eggs provide an important food source for migrating shorebirds. Horseshoe crabs are also important to medical research and pharmaceutical companies and are harvested by commercial fishermen to be used as bait in eel and conch fisheries. Coast-wide management of horseshoe crabs is essential to maintain healthy populations. The status of horseshoe crab populations along the Atlantic coast is poorly understood, but horseshoe crabs continue to be harvested while their populations decline. A decline in the horseshoe crab population could severely affect migrating shorebird populations that depend on the eggs for survival. The survival of this species is linked to the survival of the red knot, as horseshoe crab eggs are an important food source for this species.

Horseshoe crabs are known to spawn within Jamaica Bay. Documented spawning sites include: Plumb Beach, Dead Horse Bay, Big Egg Island, Spring Creek, Bayswater Point State Park, Brant Point, and Dubos Point (Sclafani *et al.* 2014; Botton *et al.* 2006).

2. Insects, Moths, and Butterflies

The Bay is located along the migration route of the monarch butterfly (Brower 2004, *in* Waldman 2008) and provides habitat for a number of insects, skippers, and butterflies (including several regionally- and state-rare species), including the checkered white, which has been observed on the Rockaway Peninsula (Wall and Associates, Inc. *et al.* 2003). A summary table of the insects, moths, and butterflies is provided in Appendix F.

E. THREATENED AND ENDANGERED SPECIES AND SPECIES UNDER REVIEW

Pursuant to section 7 of the ESA, the Corps is required to make a determination as to whether the proposed project "may affect" listed species and seek the concurrence from both the Service and the NOAA Fisheries. The Service's IPaC system (https://ecos.fws.gov/ipac/) contains information on listed species and should be used in the Corps' determination process along with consultation with the Service. In correspondence dated September 27, 2018, the Corps requested formal consultation for piping plover and seabeach amaranth populations found in the proposed project area. The Corps also determined that the proposed project would not be likely to adversely affect the red knot.

Should the project also necessitate consultation with the NOAA Fisheries, in accordance with the ESA, the appropriate contact is provided below:

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Section 7 Coordinator
NOAA Fisheries
Greater Atlantic Regional Fisheries Office
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1. FEDERALLY-LISTED THREATENED AND ENDANGERED SPECIES

Below is a brief discussion of the federally-listed threatened and endangered species that are likely to occur in the Study Area. Their status has been previously noted in this report, but more detailed information is provided below. They will all be addressed in the Service's Biological Opinion for the current Project.

a) <u>Piping Plover</u>

The piping plover was listed as threatened and endangered pursuant to the ESA on January 10, 1986. Protection of the species under the ESA reflects the species precarious status rangewide.

Three separate breeding populations, each with its own recovery plan and recovery criteria, were affirmed in the 2009 Five-Year Review (U.S. Fish and Wildlife Service 2009). Piping plovers that breed on the Atlantic Coast of the U.S. and Canada are listed as threatened under the ESA. Piping plovers that breed in the Great Lakes watershed are listed as endangered, while the population breeding on Northern Great Plains of the U.S. and Canada is listed as threatened (U.S. Fish and Wildlife Service 1985, 2009). All piping plovers are listed as threatened on their shared migration and wintering range, which extends along the U.S. Atlantic and Gulf Coasts from North Carolina to Texas, and into Mexico, the Bahamas, and West Indies (Elliott-Smith and Haig 2004; Elliott-Smith *et al.* 2009). Threats to Atlantic Coast piping plovers in the breeding portion of their range identified in the 1996 Recovery Plan include: habitat loss and degradation, disturbance by humans and pets, increased predation, and oil spills (U.S. Fish and Wildlife Service 1996a).

The Atlantic Coast piping plover breeds on sandy, coastal beaches from Newfoundland to North Carolina. On Long Island, including the Study Area, piping plovers are found on ocean and bay beaches from the time they arrive to breed in March and April until their departure to wintering grounds in September. Piping plovers nest above the high tide line on coastal beaches, sandflats at the ends of sandspits and barrier islands, gently-sloping fore dunes, blowout areas behind primary dunes, sparsely-vegetated dunes, and washover areas cut into or between dunes. Feeding areas include: intertidal portions of ocean beaches, washover areas, mudflats, sandflats, wracklines, and shorelines of coastal ponds, lagoons, or saltmarshes (U.S. Fish and Wildlife Service 1996a).

The ocean beaches within the Study Area support nesting piping plovers and are monitored and managed each nesting season. The New York City Department of Parks and Recreation (NYCDPR) monitor and manage the beaches in Far Rockaway and Arverne; the NPS manages and monitors the GNRA parcels (Jacob Riis, Fort Tilden, and Breezy Point); and the Breezy Point Cooperative manages cooperatively with the Service (private beach community from B201-B222 Streets).

b) Red Knot

The red knot is a medium-sized migratory shorebird. The rufa red knot subspecies was listed as threatened under the ESA on January 12, 2015. The rufa red knot was listed as a threatened species due to loss of both breeding and nonbreeding habitat; likely effects related to disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies (mismatches) in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions.

Red knots breed in the Canadian arctic and winter mainly in Tierra del Fuego, northern Brazil, or Florida, and migrate through NY (as well as other places along the Atlantic Coast), to and from breeding sites in the spring and fall (U.S. Fish and Wildlife Service 2014). In North America, red knots are found along sandy, gravel or cobble beaches, tidal mudflats, saltmarshes, shallow coastal impoundments, and lagoons and peat banks. Red knots use sandy beaches during both the spring and fall migration (U.S. Fish and Wildlife Service 2014).

Within the Study Area, red knots utilize low-energy bay and ocean intertidal areas (*e.g.*, tidal flats and tidal marshes) as stopover/foraging habitat during spring and fall migrations.

c) Roseate Tern

The roseate tern is a medium-sized, gull-like tern. The northeastern and Caribbean breeding populations of the roseate tern were designated, respectively, as endangered and threatened, on November 2, 1987. The northeastern population includes birds that breed (or formerly bred) along the Atlantic coast of the U.S. from North Carolina to Maine. The primary reasons for listing the northeastern population of the roseate tern as endangered were the concentration of the population into a small number of breeding sites and, to a lesser extent, a decline in total numbers (U.S. Fish and Wildlife Service 1998a).

Roseate terns are an exclusively marine bird, usually breeding on small islands and occasionally on sand dunes of barrier beaches (U.S. Fish and Wildlife Service 2011). During the breeding season, birds typically forage over shallow coastal waters around the breeding colony. Roseate terns have historically nested in the Study Area on the beaches of the Rockaway Peninsula; however, they have not been documented nesting in the area in over five years.

d) Seabeach Amaranth

Seabeach amaranth is an annual plant that grows on sandy ocean beaches. On April 7, 1993, it was added to the List of Endangered and Threatened Wildlife and Plants as a threatened species. The listing was based upon the elimination of seabeach amaranth from two-thirds of its historic range, and continuing threats to the 55 populations that remained at the time (U.S. Fish and Wildlife Service 1993). Threats to seabeach amaranth include: trampling from off-road vehicles (ORV) and/or pedestrians; loss of habitat from development; beach stabilization practices that promote dense beachgrass growth, burial of seed banks, and competition with perennial plants as beach habitat is stabilized (U.S. Fish and Wildlife Service 1996b).

Seabeach amaranth grows within the Study Area within the maritime beach and dune communities of the Rockaway Peninsula. Within the Study Area, seabeach amaranth is monitored and managed by the NPS, the NYCDPR, and the Breezy Point Cooperative, in cooperation with the Service, on their respective properties.

e) Sea Turtles

The Service and the NOAA Fisheries share jurisdiction for sea turtles. The NOAA Fisheries has responsibility for federally-listed sea turtles in the marine environment and the Service has responsibility while they are on land. There are four threatened or endangered sea turtle species that may occur within the Study Area: loggerhead sea turtle (*Caretta caretta*; threatened), Kemp's ridley sea turtle (*Lepidochelys kempii*; endangered), green sea turtle (*Chelonia mydas*; threatened), and leatherback sea turtle (*Dermochelys coriacea*; endangered). Sea turtles typically occur along the Long Island coast from May to mid-November, with the highest concentrations present from June through October. In the Study Area, these species are usually limited to the marine environment and are typically the sole responsibility of the NOAA Fisheries. However, there is a recent documented case of a nesting Kemp's Ridley sea turtle on the Rockaway Peninsula. The following have been identified as threats to sea turtles in the marine environment: bycatch in commercial and recreational fisheries, capture during channel dredging, vessel collisions, marine pollution, and impingement on power plant intakes, among others (National Oceanic and Atmospheric Administration 2017). Threats to nesting sea turtles, eggs, and hatchlings include, but are not limited to: beach erosion, beach armoring, beach nourishment, artificial lighting, predators, invasive plants, beach driving, beach cleaning, human presence, inundation by tides, and poaching (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1991; National Marine Fisheries Service, U.S. Fish and Wildlife Service, and SEMARNAT 2011).

f) Sturgeon

The federally-listed Atlantic sturgeon (endangered, threatened) may occur in the Study Area and is under the jurisdiction of the NOAA Fisheries. Sturgeon are an anadromous species found in rivers, estuaries, and coastal waters along the Atlantic Coast, and could occur in the Rockaway Inlets and Jamaica Bay. Atlantic sturgeons that are spawned in rivers of the U.S. or are captive progeny of Atlantic sturgeon that spawned in the U.S. are listed under the ESA as five Distinct Population Segments (DPS). As of February 6, 2012, the NY Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered. The Gulf of Maine DPS is listed as threatened.

g) Atlantic Large Whales

After reviewing the draft FWCA report, the NOAA Fisheries provided the following additional information as it pertains to endangered marine mammals: "*Federally endangered North Atlantic right and fin whales occur year-round off the New York coast in the Atlantic Ocean. Right whales are most likely to occur in the offshore borrow areas between November and April and fin whales are most likely to occur between October and January. Right whales feed on copepods and could be foraging in the Study Area if suitable forage in present; right whales are also likely to occur in the Study Area while migrating along the Atlantic coast. Fin whale sightings off the eastern United States are centered along the 100m isobaths, but fin whales are well spread out over shallower and deeper water, including submarine canyons along the shelf break (Kenney and Winn 1987; Hain et al. 1992). Fin whales feed on small schooling fish, squid, and crustaceans, including krill. Sperm and sei whales* [*Balaenoptera borealis*] *are limited to the offshore area beyond the continental shelf.*"

2. Species under Review for Federal Listing

The Service is evaluating the little brown bat, the tri-colored bat (*Perimyotis subflavus*; NYSDEC species of concern), the monarch butterfly, and the yellow-banded bumblebee (*Bombus terricola*) to determine if listing under the ESA is warranted. These four species may be present in the Study Area. Species being evaluated for listing do not receive any substantive or procedural protection under the ESA, and the Service has not yet determined if listing of any of these three species is warranted. However, the Corps should be aware that these species are being evaluated for possible listing and may wish to include them in field surveys and/or impact assessments, particularly for projects with long-term planning horizons and/or long operational lives. Despite the current status of these species regarding listing decisions, each of these species is in decline range-wide for the East Coast.

F. SPECIES OF GREATEST CONSERVATION NEED

Since 2001, the Service has awarded State Wildlife Grants (SWG) for "the development and implementation of programs for the benefit of wildlife and their habitat, including species that are not hunted or fished…" To participate in the SWG program, as directed by Congress, the fish and wildlife resource agencies of each state, commonwealth, territory, and the District of Columbia developed a Comprehensive Wildlife Conservation Plan (later referred to as a State Wildlife Action Plan or SWAP) for review and approval by the Service. All the SWAPs were submitted to the Service and approved by early 2006. These plans identify and describe species of greatest conservation need and include many species that have experienced significant population declines.

The Service recognizes that the State of New York has identified species of greatest conservation need as part of their SWAP. Many of those identified species overlap with species that are discussed in this report. We seek recommendations from the NYSDEC on the particular species of greatest conservation need that they prefer addressed in the Final FWCA Report.

G. WETLANDS

Saltwater and freshwater marshes can be found throughout Jamaica Bay, along the south shore of Rockaway Peninsula, and scattered along the Jamaica Bay shoreline. The majority of the wetlands present in the Study Area are categorized as estuarine and marine deepwater, and estuarine and marine wetland. There are some limited freshwater marshes located on the barrier island and mainland.

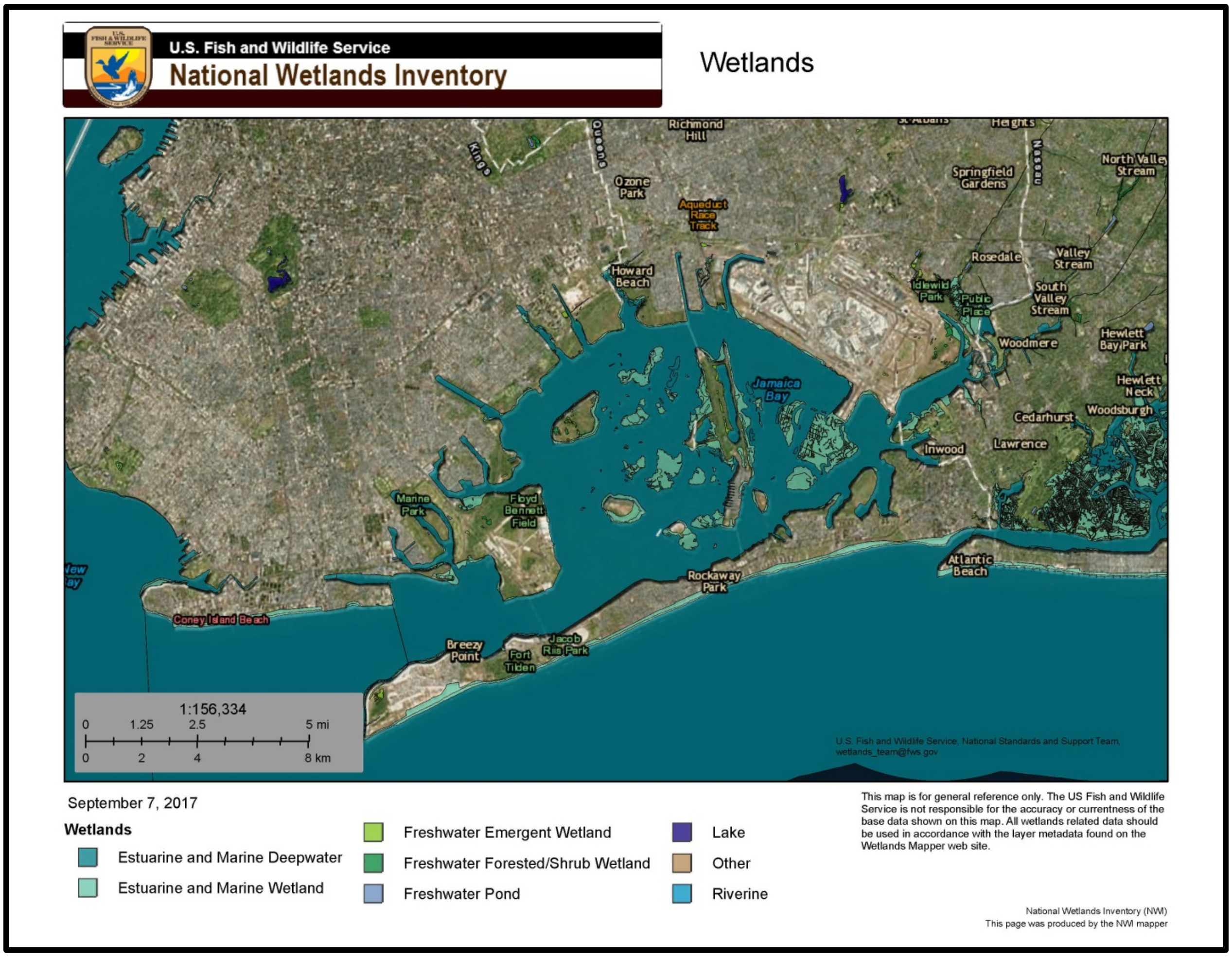

Figure 3. National Wetlands Inventory Map of the Study Area. (https://www.fws.gov/wetlands/data/mapper.html).

1. Saltwater Marshes

Saltwater marshes are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within federal trusteeship (*i.e.*, migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Marshes are among the most productive communities known, providing important ecological services including wildlife habitat, shoreline erosion control, and water column filtration (Waldman 2008). They perform a variety of important functions that benefit both fish and wildlife resources such as spawning and nesting habitat for fish and wildlife. Saltmarshes also provide storm protection for human infrastructure.

The loss of wetlands in Jamaica Bay is significant. Since the European colonization, it is estimated that approximately 12,000 ac of 16,000 ac of saltmarsh has been lost (New York City Department of Environmental Protection 2007; U.S. Fish and Wildlife Service 1997; Waldman 2008). Rates of saltmarsh loss have been estimated based on the analysis of aerial photographs. Between 1924 and 1974, the rate of loss was approximately 0.4 percent annually. Since 1974, the rate has increased to 1.4 percent annually (Hartig *et al*. 2002, *in* Waldman 2008).

There are various factors that may have contributed to this decline, including: sediment deprivation, channel deepening, eutrophication, stabilization of the Rockaway Inlet, growth of the Rockaway peninsula, and sea-level rise. Water quality issues, particularly increased nitrogen levels and eutrophication, make saltmarshes more vulnerable to sea-level rise by weakening root systems and through loss of organic biomass (due to increased microbial decomposition) resulting in marsh elevation loss (Turner *et al.* 2009; New York State Department of Environmental Conservation 2014b).

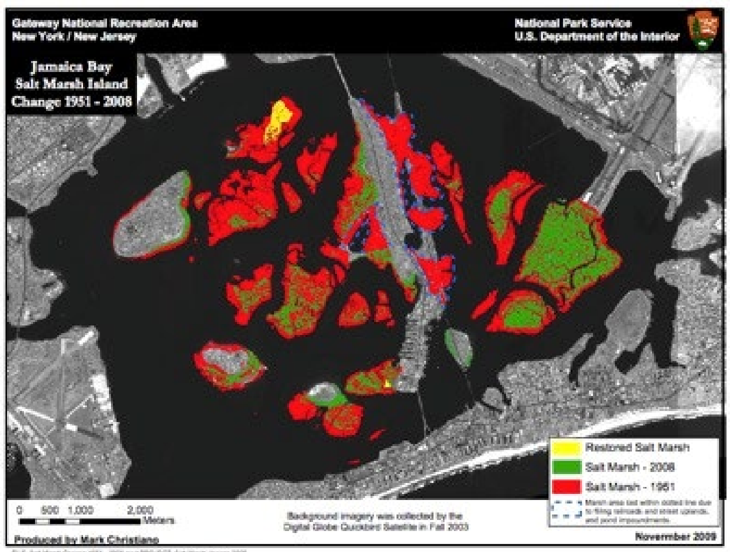

Figure 4. Historic Wetland Losses in Jamaica Bay from 1951 – 2008. (Yellow: Restored saltmarsh; Green: Saltmarsh 2008; Red: Saltmarsh 1951).

2. Freshwater Wetlands

Like tidal marshes, freshwater wetlands provide habitat for a variety of fish and wildlife resources while also providing ecological services for people. Historically, the Study Area contained more freshwater wetland habitat. However, due to conversion of wetlands to agricultural, industrial, or residential uses, many wetlands were lost. Only one percent of those freshwater wetlands that existed in the NYC pre-colonial era remain (New York City 2009). Within the Study Area, freshwater wetlands are restricted to the western point of Rockaway Peninsula, and Canarsie Pol, Rulers Bar Hassock in the Jamaica Bay Wildlife Refuge, as well as east and west of Hendrix Creek, and along the southeast corner of JFK airport.

VIII. FUTURE WITHOUT PROJECT CONDITIONS

This report assumes that several ongoing and future projects are likely to occur within the Study Area even if this project is not implemented. These projects include maintenance dredging of the Rockaway Inlet Federal Navigation Channel and East Rockaway Inlet Navigation Channel. In the absence of the Recommended Plan, it is also likely that state and local governments would seek permits from the Corps' Regulatory Branch to undertake smaller-scale beach nourishment projects or that the Corps will explore alternative studies, such as the NY and NJ Harbor Area and Tributaries Feasibility Study to develop coastal storm risk reduction measures. Various beach management activities, such as beach scraping, are being carried out within the Study Area and will likely continue to occur.

In the without-project condition, erosional events and future storms are likely to occur. Natural features, such as dunes and beaches, would likely be shaped by these events and natural processes would occur to the extent possible along the developed shoreline. Erosion and storms may directly threaten human structures such as the reconstructed boardwalk and other infrastructure along the oceanfront, bay shorelines, and upland interior. If the elevation of the beach and dunes is lowered due to storms and erosion, their capability to provide storm protection may be reduced, which may expose the coastal communities to extensive property damage and loss. However, sand accretion due to storms may also occur.

Natural processes and human activities would continue to greatly influence the ecological communities on Rockaway peninsula, Jamaica Bay, and the offshore marine habitats. The maritime beach and dunes along the beaches, which are heavily developed, could continue to erode or accrete due to natural processes. In spite of the extensive development on the Rockaway Peninsula, shorebird habitat is present and significant erosional loss of these beaches would adversely affect local shorebird populations by reducing their nesting areas.

As discussed above, there is relatively less opportunity for natural processes to create and maintain habitat features, such as lower lying beaches, variable dune fields, and ephemeral pools. Relatively larger-scale habitat-forming natural processes are only likely to occur in the undeveloped, western area of the Rockaway peninsula. Further, in the without-project condition, the maritime beach in these areas that do not have the ability to migrate or roll over, will likely result in the loss of shorebird habitat. The marine intertidal system would naturally fluctuate in response to patterns and rates of shoreline accretion and erosion in the without project condition.

The future of the proposed offshore dredging area in the without-project scenario would likely be the continued existence of a benthic-pelagic sandy bottom community in its present condition. The offshore borrow would not be characterized by unnatural depressions created by dredging and existing populations of marine invertebrates and benthic/pelagic finfish species would not be disturbed or destroyed by mechanical dredging operations over the next 50 years.

There are a number of projects and studies being carried out that will affect Jamaica Bay. The Corps has carried out a number of projects related to restoration efforts and storm damage protection. A number of state and local efforts have been undertaken to improve habitats along the shoreline of the bay and to restore water quality. If this general trend in habitat restoration and water quality improvement continue then the general condition of the bay will improve. It is likely that in light of the urbanized nature of the Study Area, local, state, and federal efforts will continue to be studied in order to protect the study area from future storm damage.

IX. OTHER ENVIRONMENTAL CONDITIONS: CLIMATE CHANGE AND SEA-LEVEL RISE

The term "climate change" refers to a change in the mean or variability of one or more measures of climate (*e.g.*, temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (Intergovernmental Panel on Climate Change 2007). Extensive analyses of global average surface air temperature, the most widely-used measure of change, clearly indicate that warming of the global climate system has occurred over the past several decades (Intergovernmental Panel on Climate Change 2013). One very likely outcome of climate change is an accelerated rise in sea level. Measurements of global mean sea level indicate sea level has risen at an average rate of 1.7 millimeters (mm) per year from 1901 to 2010; at a faster rate of 3.2 mm per year from 1993 to 2010; and will exceed that rate during the 21st Century (International Panel on Climate Change 2013). Sea-level rise will likely have implications for restoration activities planned or underway in the HRE Feasibility Study Area. Sea-level rise will affect the types of natural communities found in the HRE Feasibility Study Area. Additional tidal flow from modest sea-level rise may have both beneficial and adverse impacts on restoration that are difficult to predict without additional information (*e.g.*, precise elevations of restoration sites, site-specific sedimentation/erosion rates, and predicted future current velocities) (U.S. Fish and Wildlife Service 2007b). Recently, sea-level rise in a 1,000 kilometers (km) reach of the Atlantic Coast from Cape Hatteras, North Carolina, to Cape Cod, Massachusetts (which includes the HRE Feasibility Study Area), experienced three to four times higher sea-level rates than the global average (Sallenger *et al.* 2012). Many models of climate change project a shift to more intense individual storms and fewer weak storms in the North Atlantic Basin. Long-term effects of climate change may impact coastal communities such as the communities on Rockaway Peninsula and contribute to continued loss of saltmarsh in Jamaica Bay.

Climate change is expected to have impacts on oceans and estuaries beyond sea-level rise. The Intergovernmental Panel on Climate Change identified changes in water temperature and acidification of ocean water as other wide-reaching concerns resulting from climate change (Wong *et al*. 2014). Changes in water temperature may impact the distribution, abundance, and production of aquatic life (Wong *et al.* 2014; Scavia *et al*. 2002). As a result of warmer temperatures, some species may be pushed pole-ward, some may suffer from living in sub-optimal temperatures, while others may be lost entirely (Wong *et al.* 2014; Scavia *et al.* 2002). Acidification due to the absorption of increased atmospheric carbon dioxide could have impacts on the ocean's "calcifiers," such as shellfish, which may not be able to survive at higher acidity levels (Wong *et al.* 2014). The effects of climate change will likely result in more localized impacts, as well. A concern for estuaries is the exacerbation of existing human pressures, such as eutrophication. For example, changes in climate may result in alterations of freshwater inputs, water temperature, sea level, and ocean exchange, which can make estuaries more vulnerable to eutrophication (Scavia *et al.* 2002). Other climate-related impacts to estuaries may include: changes in water residence time, nutrient delivery, dilution, vertical stratification, phytoplankton growth rates, and sediment deposition/erosion balances as a result of changes in freshwater inflow, air temperatures, and precipitation patterns (Wong *et al*. 2014; Scavia *et al*. 2002).

X. DESCRIPTION OF THE RECOMMENDED PLAN

The Recommended Plan is comprised of an Atlantic shorefront component and three separate HFFRRF projects on Jamaica Bay: 1) Mid-Rockaway, 2) Cedarhurst Lawrence, and 3) Motts Basin North.

The Atlantic shorefront component consists of beach restoration with renourishment, groin extension, construction of new groins, and a composite seawall. The Jamaica Bay component consists of three separate high frequency flooding risk reduction features HFFRRFs along the bay shoreline. The HFFRRFs are small-scale coastal storm risk management (CSRM) features to reduce risks for communities vulnerable to high frequency events and to provide CSRM in the short-term prior to construction of a comprehensive solution developed as part of upcoming NY NJ Harbor and Tributaries feasibility study.

A. ATLANTIC SHOREFRONT

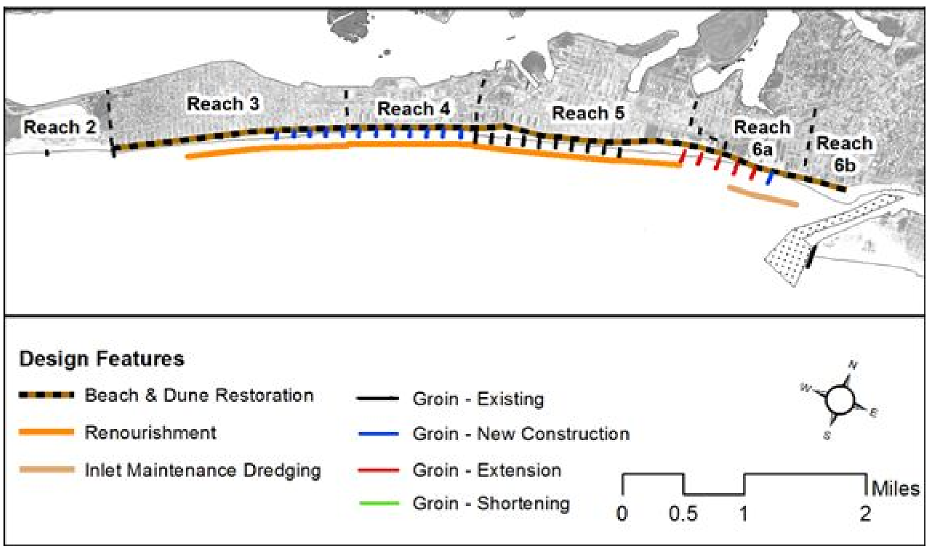

Figure 5. Atlantic Shorefront Project Elements.

The Atlantic shorefront project elements (including tapers) span from Beach 9th Street to Beach 169th Street. The recommended plan in this area combines beach restoration and erosion control and two tapered beach sections at both the east and west end of the project. In summary, the recommended plan on the Atlantic Ocean shorefront consists of the following features:

- A reinforced dune (composite seawall) with a structure crest elevation of +17 ft NAVD88 and dune elevation of +18 ft NAVD88, and a design berm width of 60 ft extending approximately 35,000 linear ft from Beach 9th Street to Beach 149th Street. The bottom of dune reinforcement extends up to 15 ft below the dune crest.
- A beach berm elevation of +8 ft NAVD88 and a depth of closure of -25 ft NAVD88.
- A total beachfill quantity of approximately 1.6 million cy for the initial placement, including tolerance, overfill, and advanced nourishment with a 4-year

renourishment cycle of approximately 1,021,000 cy, resulting in an advance berm width of 60 ft;

- Obtaining sand from a borrow area located approximately 2 mi south of the Rockaway Peninsula and about 6 mi east of the Rockaway Inlet. It is about 2.6 mi long, and 1.1 mi wide, with depths of 36 to 58 ft and contains approximately 17 million cy of suitable beachfill material, which exceeds the required initial fill and all periodic renourishment fill operations.
- Extension of five existing groins; and new construction of 13 new groins.

1. Composite Seawall and Berm Description

The structure crest elevation is +17 ft NAVD88, the dune elevation is +18 ft NAVD88, and the design berm width is 60 feet. The composite seawall will be constructed of armor stone and sheet pile walls. The composite seawall may be adapted in the future to rising sea levels by adding a layer of armor stone and extending the concrete cap up to the elevation of the armor stone.

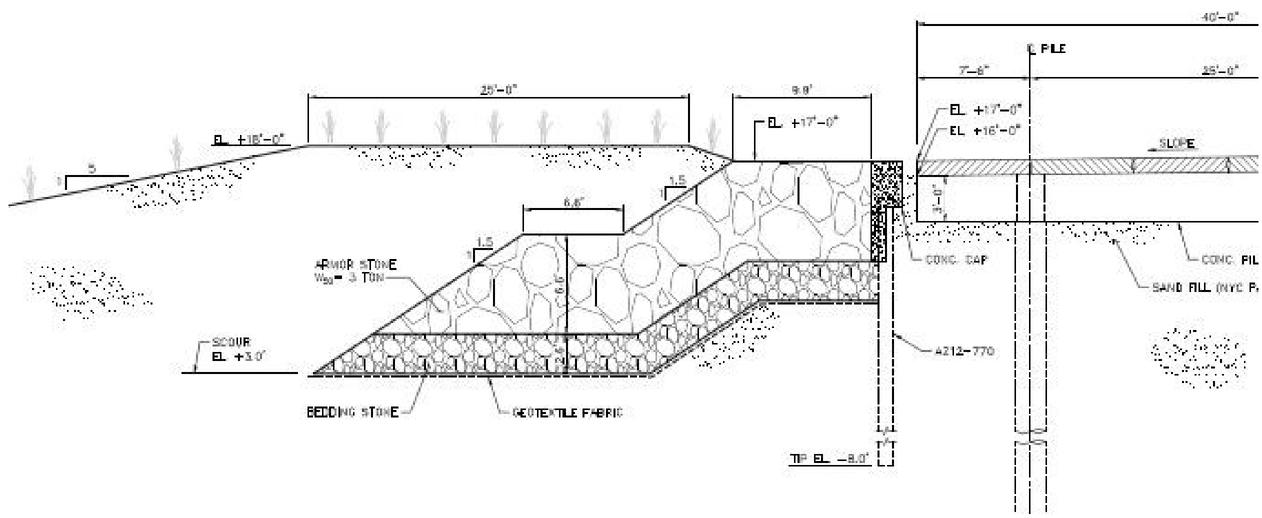

Figure 6. Composite Seawall Beach 19th Street to Beach 126th Street.

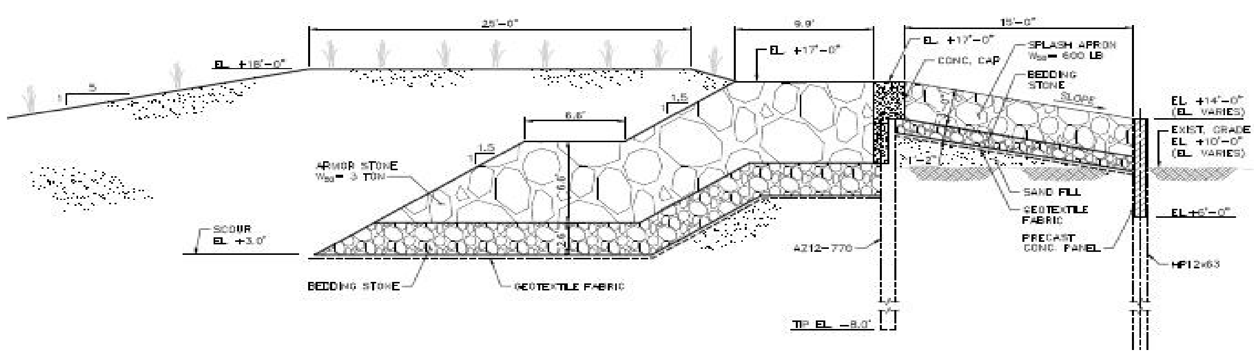

Figure 7. Composite Seawall Beach 126th Street to Beach 149th Street.

2. Beachfill Description

The recommended plan includes dune and beachfill, as well as beachfill tapers on either side. The dune and beachfill (including tapers) extends from the eastern end of the barrier island at Beach 9^{th} Street west to Beach 169^{th} Street. The dune will have a top elevation of +18 ft above NAVD88, a top width of 25 ft, and landward and seaward slopes of 1V:5H that will extend along the entire footprint (1V:3H on landward slope fronting the boardwalk). The berm will have a minimum width of 60 ft at an elevation of +8 ft NAVD88. The width of the design berm is controlled by the alignment of the baseline. The baseline is aligned with the natural shoreline and the distance from the baseline to the design shoreline is always 243 feet. The alignment of the dune follows the unnatural alignment of the boardwalk and, as a result, the distance between the toe of the dune and the seaward crest of the berm varies. Initial beachfill and renourishment quantities are provided in Table 2 below:

Table 2. Initial Construction Beachfill Quantities.

Sub-reach	Beachfill	Renourishment per
West Taper	306,000	
Sub-reach 3	356,000	444,000
Sub-reach 4	294,000	133,000
Sub-reach 5	321,000	444,000
Sub-reach 6a	250,000	0
Sub-reach 6b	20,000	0
East Taper	49,000	0
Total	**1,596,000**	**1,021,000**

Note: Renourishment would occur on a four-year cycle.

3. New Groins and Groin Extension Description

Three types of groin measures are considered in the alternative analysis: new groin construction, groin extension, and groin shortening. The Project involves construction of twelve new groins in Reaches 3 and 4 (between 92^{nd} Street – 121^{st} Street) and an additional groin in reach 6a (34^{th} Street). The five groin extensions are located in Reach 6a (between 37^{th} Street – 49^{th} Street). The spacing between groins is based on the existing spacing in Reach 5 (720 ft) and Reach 6a (780 ft). The required lengths of the new groins are based on the GENESIS-T model simulations. The extension of the groin lengths vary and range from 75 ft to 200 feet. Groin widths will be 13 feet. A summary of groin dimensions can be found in Table 3 below:

Table 3. Summary of Groin Lengths.

Alternative	Reach	Number	Street	HSS (ft)	ISS (ft)	OS (ft)	Total (ft)	Notes:
Alt 3	6a	1	34th St	90	108	328	526	new 526'
Alt 3	6a	2	37th St	90	108	328	526	extension 175'
Alt 3	6a	3	40th St	90	108	328	526	extension 200'
Alt 3	6a	4	43rd St	90	108	228	426	extension 75'
Alt 3	6a	5	46th St	90	108	228	426	extension 150'
Alt 3	6a	6	49th St	90	108	228	426	extension 200'
Alt 3	4	1	92nd St	90	108	128	326	new 326
Alt 3	4	2	95th St	90	108	128	326	new 326
Alt 3	4	3	98th St	90	108	128	326	new 326
Alt 3	4	4	101st St	90	108	128	326	new 326
Alt 3	4	5	104th St	90	108	128	326	new 326

Alt 3	4	6	106th St	90	108	128	326	new 326
Alt 3	4	7	108th St	90	108	128	326	new 326
Alt 3	3	8	110th St	90	108	153	351	new 351
Alt 3	3	9	113th St	90	108	178	376	new 376
Alt 3	3	10	115th St	90	108	178	376	new 376
Alt 3	3	11	118th St	90	108	178	376	new 376
Alt 3	3	12	121st St	90	108	128	326	new 326

* HSS = horizontal shore section extending along the design berm; ISS = an intermediate sloping section extending from the berm to the design shoreline; OS = outer sloping section that extends from the shoreline to offshore; HD = head section is part of the OS and is typically constructed at a flatter slope than the trunk of the groin and may require larger stone due to the exposure to breaking waves.

4. Beachfill Tapers

The east beachfill taper is approximately 3,000 ft in shorefront length from Beach 19th Street east to Beach 9th Street. It will consist of 1,000 ft of dune and beach taper, including reinforced dune feature, and approximately 2,000 ft of dune and beachfill without reinforced dune feature. In addition to the tapering of berm width, the dune elevation also tapers from an elevation of +18 ft NAVD88 at 19th Street down to approximately +12 ft NAVD88 at Beach 9th Street, which will be tied into the existing grade.

The west beachfill taper is approximately 5,000 ft in shorefront length from Beach 149th Street west to Beach 169th Street fronting Riis Park. The beachfill taper will be beachfill only with a berm width tapered from the design width at 149th Street to the existing width and height at 169th Street. In addition to the beachfill taper, a tapered groin system comprised of three (3) rock groins is included for this section.

B. JAMAICA BAY HIGH FREQUENCY FLOODING RISK REDUCTION FEATURES

1. Cedarhurst-Lawrence

The project is located in Nassau County and crosses the border between the Village of Cedarhurst and the town of Hempstead. The project site is on a channel that is located west of the Lawrence High School. The project begins on the east side of the channel and consists of approximately 1000 ft of deep bulkhead that follows the existing bulkhead line around the southern and western shores of the channel. The project will also modify three existing outfalls in the area where the bulkhead will be raised. Each outfall will be modified to add a valve chamber that will include a sluice gate and flap valve to prevent high tides or storm surge from flooding through the drainage system. The outlet pipes will be replaced if the design phase indicates it is necessary. Drainage along the landward side of the bulkhead will be provided by a small ditch or drainage collection pipe, with inlets that will be connected to the existing or additional drainage outlets. When the drainage outlets are blocked by a storm tide, the ditch or pipes will direct runoff towards a pump station.

2. Motts Basin North

This project consists of construction of 540 ft of medium floodwall beginning just north of the corner Alameda Avenue and Waterfront Boulevard and running parallel to Waterfront Boulevard on its south side. The line of protection then shifts to a section of medium floodwall above an existing outfall, continuing east for 47 ft before transitioning back into a low floodwall for an additional 105 feet. Project design elevations vary have preliminarily been established based on the expected wave exposure and are +8.0 feet.

The existing outlet will be modified to add a valve chamber that will include a sluice gate and flap valve to prevent high tides or storm surge from flooding through the drainage system. The outlet pipes will be replaced if the design phase indicates it is necessary. Drainage along the landward side of the bulkhead will be provided by a small ditch. Inlets will connect to the existing and one proposed additional drainage outlets.

3. Mid-Rockaway

a) Edgemere Area

This project alignment follows the coastal edge of Edgemere where a series of HFFRR-Features are interlinked to form the perimeter line of risk reduction. The alignment consists of approximately 480 ft of medium floodwall, 660 ft of high floodwall, 1,510 ft of low berm, 2,060 ft of medium berm, 80 ft of high berm, 2,260 ft of hybrid berm, and 250 ft of bulkhead. One road ramp is included to maintain access to the waterfront. Three existing outlets will be modified to prevent high tides or storm surge to result in flow reversal and cause flooding through the drainage system. Twelve new outfalls (5 ft x 3 ft) are included within the project and three new pump stations are included within the design. This area also includes two areas where the NNBFs are implemented, one on the east and one on the west side of the peninsula.

NNBF Descriptions:

Edgemere 1: On the west side of the Edgemere neighborhood, the proposed NNBF design with the establishment of the rock sill, will protect some of the existing eroding wetlands habitats, both subtidal and intertidal, and will provide for some areas where high marsh – scrub/shrub habitat can be established. The rock sills are also intended to provide and habitat for attached fauna such as ribbed mussels and oysters.

Edgemere 2: On the east side of the Edgemere neighborhood, a large area of wetland habitat is proposed to be restored and created between the constructed berm on the land and the newly constructed rock sill, just off of the existing coastline. The proposed NNBF includes the removal of the *Phragmites* where appropriate, and restoration of the intertidal habitats including planting of smooth cordgrass and high marsh at appropriate elevations, as well as ribbed mussel and oyster reef restoration, which will aid in attenuating wave action.

b) Arverne Area

This alignment consists of the construction of approximately 3,170 ft of low floodwall, 480 ft of medium floodwall, 440 ft of high floodwall, 2,630 ft of low berm, 580 ft of hybrid berm, 890 ft of bulkhead, and 990 ft of revetment, as well as three areas where NNBFs (discussed below separately). Three road ramps and one vehicular gate are included to maintain access to the waterfront. Eight existing outlets will be modified to add a valve chambers that will include a sluice gate and flap valve to prevent high tides or storm surge to result in flow reversal and cause flooding through the drainage system. Eight new outfalls (5 ft x 3 ft) are included within the project. In addition, three new pump stations are included within the design.

NNBF Descriptions:

Arverne 1: The north-west corner of the Arverne peninsula (Brant Point). This NNBF will include installation of rock sills off the existing, eroding shoreline to protect the toe of the slope and dampen incoming waves so the existing shoreline could be regraded and potentially extended seaward. This NNBF will also include the removal of the *Phragmites* and creation/restoration of the intertidal wetland habitat and high marsh. Some existing uplands features are to be regraded to high marsh. A portion of the existing upland maritime forest between the berm feature and the wetlands are to remain undisturbed and expanded where practical.

Arverne 2: At the north-east corner of the peninsula where there is currently a narrow beach (Dubos Point), in between Beach 69th Street and just east of Beach 65th Street, a NNBF is proposed that includes the construction of rock sills to create an intertidal flat and replanting with smooth cordgrass (low marsh). Further upslope and to the east intertidal marsh can be regraded to provide high marsh habitat adjacent to the existing upland habitats providing a buffer in anticipation of rising sea level. Additional materials or techniques for oyster and ribbed mussel restoration may be included in the final design.

Arverne 3: To the east of Marina 59, the proposed NNBF includes restoration of an intertidal flat, protected by rock sills, and regrading of the higher elevations areas to accommodate the establishment of intertidal marsh similar to the adjacent natural marsh areas.

c) Hammels Area

This project alignment consists of approximately 2,550 ft of low floodwall and a total of six road ramps that provide risk reduction to the Hammels area. Three new outfalls (5 ft x 3 ft) are included within the project. The three existing outlets will be modified to add a valve chamber that will include a sluice gate and flap valve to prevent high tides or storm surge to result in flow reversal and cause flooding through the drainage system. In addition, two new pump stations are included within the design.

XI. DESCRIPTION OF PROJECT IMPACTS ON FISH AND WILDLIFE RESOURCES

The proposed action has the potential to directly and indirectly impact fish and wildlife resources within the Study Area and the condition of Jamaica Bay and Rockaway Peninsula resulting from the proposed project.

As described above, the Corps has identified an alternative that includes a composite seawall and dune with beach renourishment, and the construction and extension of groins on the Atlantic shoreline, and construction of bulkheads, floodwalls, revetments, and rock sills on the bay shoreline.

A. IMPACTS

1. Habitat Loss and Modification

The Recommended Plan will result in habitat modifications that will likely adversely impact fish and wildlife species. As noted above, the Recommended Plan includes: the placement of beachfill; construction of a composite seawall; the construction of new groins and the modification of existing groins; the construction of bulkheads, floodwalls, and berms (with associated outfalls); and the construction of rock sills with associated wetlands.

a) Beachfill/Berm

Increasing beach width through beachfill and berm creation may have some positive impacts, such as creating habitat area for beach-nesting birds and seabeach amaranth. Potentially beneficial impacts of beach nourishment have been observed at other Corps sites existing on Long Island (wider beaches provide more shorebird breeding areas/growing areas for coastal plants); however, these are not well studied and remain anecdotal as to their long-term contribution to resource conservation.

Habitat modifications, even when intended to be beneficial can sometimes have negative consequences through loss or reduction of forage resources, habitat alteration, habitat succession, or habitat fragmentation . For example, though black skimmers and terns frequently nest on dredge spoil islands, they abandoned Meadow Island on Long Island after the deposition of dredge spoil altered the vegetation on the island (Burger and Gochfeld 1990a). While this is a bay island site that differs from the beaches in the Study Area, it still serves as an example of habitat modification leading to negative impacts.

Depending on the species under evaluation, beach nourishment activities may also have relatively shorter-term impacts resulting from increased turbidity in the nearshore zone and burial of benthic invertebrates. These impacts will be discussed later in the report.

b) <u>Composite Seawall</u>

The construction of a composite seawall in the Study Area may negatively impact the wildlife and plants within the maritime beach and dune communities by permanently altering the ocean beach, and affecting microhabitats within the dune systems on the island. It is also not known whether a revetment capped with sand would provide suitable nesting habitat, or support natural vegetation densities. Additionally, the landward edge of the composite seawall would be exposed on the top, thereby eliminating sandy dune habitat that currently exists, and preventing use of this area by beach-nesting birds. There is also the potential for storm events or sea-level rise to expose the composite seawall completely, potentially leading to negative impacts on beach habitat and fish and wildlife resources due to erosion in front of the structure and at its flanks. Beach renourishment will occur in the Study Area every four years throughout the 50-year life of the project and may help to prevent the exposure of the seawall and resulting impacts, but it is unknown if this is cycle would adequately address exposure should it occur. Additionally, the project description does not discuss proposed renourishment in the area of the 5000-ft western taper between Beach 149th Street and Beach 169th Street. Furthermore, the exposure of the composite seawall is a concern beyond the life of the project due to its permanent nature.

As noted above, one of the potential concerns regarding seawalls is the potential loss or narrowing of beach habitat. Dugan *et al.* (2011) describe this loss as occurring through three processes: placement loss, passive erosion, and active erosion. Placement loss is described as the resulting loss of beach width due to the footprint of the armoring structure (Dugan *et al.* 2011). Passive erosion occurs as sea-level rises and the seawall acts as a fixed structure, which does not allow for landward migration and causes the beach fronting the wall to drown (Dugan *et al.* 2011; Tait and Griggs 1990). Lastly, active erosion occurs as waves reflect off the surface of the wall and cause erosion in front or flanking the wall (Dugan *et al.* 2011; Tait and Griggs 1990).

Tait and Griggs (1990) reviewed a number of studies regarding the impacts of seawalls on Pacific, Gulf, and Atlantic coast beaches. Based on their review they found that beach response to seawalls occurred both in front of and adjacent to seawalls and was highly variable across sites. The following beach responses were seen in the field and summarized by Tait and Griggs (1990):

> “Scour Trough – a linear trough or depression fronting a seawall.
>
> Deflated Profile – the lowering or erosion of the beach face.
>
> Beach Cusps – crescentic or semi-circular embayments on the beach face.
>
> Rip Current Trough – a trough or embayment crossing through the surf zone.
>
> End Scour – erosion of the unprotected beach adjacent to the end of a seawall.

Upcoast Sand Accretion – the impoundment of sand on the upcoast or updrift end of a structure."

Tait and Griggs (1990) found that any of the above-described responses may occur at a seawall, but recognized that beach response may also be indistinguishable from adjacent beaches lacking seawalls. While responses might vary among sites, Tait and Griggs (1990) concluded that long-term shoreline retreat is the most important factor affecting the impact of a seawall and that in areas that experience long-term retreat, the beaches fronting seawalls would eventually be lost.

Hall and Pilkey (1991) evaluated beaches with seawalls in New Jersey. They found that dry beach width was narrowest at beaches with seawalls, and widest at beaches that lacked structures. Even when compared to adjacent beaches, that are likely to be affected by similar wave and storm conditions, they found that sections of beach with seawalls and groins were narrower than immediately adjacent beaches that were unstructured. The density of hard structures also seemed to influence dry beach width as beaches with greater densities of stabilizing structures had narrower beaches. Similarly, Dugan *et al.* (2008) found that some beach zones on California beaches were narrower where there were seawalls. They found that certain upper intertidal beach zones were narrower or completely lacking in front of seawalls than at unarmored beaches. Mid-intertidal zones were also found to be narrower at armored vs. unarmored beaches.

The narrowing or loss of beach within the Study Area is a concern as these beaches provide nesting habitat for a variety of beach-nesting bird species and migratory shorebirds, including the piping plover and red knot. Use of these beaches as breeding or migratory areas would be eliminated should these beaches become too narrow or be lost completely. Dugan *et al.* (2008) noted impacts of seawalls on southern California beaches on shorebirds, seabirds, and their prey resources. They found that abundance, biomass, and individual size of beach macroinvertebrates were less on armored than unarmored beach segments. Birds were also more abundant and diverse on the unarmored sections of beach. Shorebirds, which were primarily using the beach for foraging, and gulls and seabirds, which were using the beach mostly for roosting, were both more abundant and diverse in unarmored sections. The negative response of the roosting birds suggests that prey base alone does not drive the use of these beaches by the birds, and that seawalls may have broader ecological impacts on birds.

Loss or severe narrowing of beaches in the Study Area would also impact other rare or federally-listed species including seabeach knotweed and seabeach amaranth – both of which occur in maritime beach and dune communities.

c) <u>Artificial Dunes and Dune Plantings</u>

The construction and planting of artificial dunes may impact beach dwelling animals and plants. The construction of the dune is proposed for areas that are currently used for nesting by beach-nesting birds. Modifying the habitat has potential to impact the nesting birds as it is not known if they will use the constructed dune in the same way as existing habitat. Piping plovers will nest on dunes, but the dunes they choose are generally low and gently sloping (Maslo *et al.* 2011). Dunes greater than 2.0 m in height and with slope greater than 20 percent are considered undesirable for piping plovers and even lower and gentler profiles are recommended as targets for restoration projects (target values: 1.1 m dune height and 14 percent dune slope) (Maslo *et al.* 2011). Least terns are also not generally described as nesting on dunes. Atlantic Coast least terns are known to nest on flat, open beaches; beach berms; dredge spoil islands; dredge knobs; and large flats (Gochfeld 1983; Burger and Gochfeld 1990b). They are described as nesting on the beach berm at the base of the outer dune (Gochfeld 1983) and, within a colony, prefer to nest in the center of the beach rather than towards the dune or the ocean (Burger and Gochfeld 1990b). While nesting sites are generally flat, least terns showed some preference for nesting on small mounds and ridges within those sites, and nest elevations were higher than random points, however, the ridges were described as being only 10-20 centimeters (cm) higher than surrounding areas, and elevation differences were slight (Burger and Gochfeld 1990b).

Dune construction may also influence vegetation growth in and around the nesting areas. As the dunes would not be frequently overwashed, vegetation may become thick over time. Thick vegetation may preclude nesting as beach-nesting birds often prefer nesting locations that are bare or lightly-vegetated (Maslo *et al.* 2011; Cohen *et al.* 2008; Burger and Gochfeld 1990b; Kotliar and Burger 1986; Gochfeld 1983; Thompson and Slack 1982). The beach-nesting bird species present within the Study Area typically prefer to nest in areas with less than 30 percent vegetation cover. Studies have shown that least terns prefer 5-10 percent cover and colonies often do not use sites with greater than 20 percent cover (Gochfeld 1983), black skimmers generally use areas with up to 10 percent vegetation cover and do not use areas with greater than 30 percent cover (Burger and Gochfeld 1990a), and common terns nest on beaches with 10-25 percent vegetation cover (Birds of North America 2018). Maslo *et al.* (2011) found that the majority of the piping plovers in their study nested in vegetation cover that was less than 20 percent. They recommended 13 percent vegetation cover as a restoration target, and suggested that anything greater than 33.5 percent cover was unsuitable for nesting plovers.

It is believed that beach-nesting birds avoid nesting in or near thick vegetation as doing so may make birds and nests more vulnerable to predators as birds may not detect them as well (Burger 1987; Prindiville-Gaines and Ryan 1988). Studies of piping plover have shown that nests closer to vegetation or in areas of greater vegetation cover have less success than those further from vegetation or in less densely vegetated areas (Espie *et al.* 1996; Prindiville-Gaines and Ryan 1988). A study of Kentish plovers (*Charadrius alexandrinus*) also demonstrated experimentally that plovers were able to detect predators at greater distances and suffered less mortality at the nests with no or little vegetative cover (Amat and Masero 2004).

Construction of a dune may also impact seabeach amaranth. The "*Seabeach Amaranth Recovery Plan"* (U.S. Fish and Wildlife Service 1996b) states that *"any stabilization of shoreline is detrimental for a pioneer, upper beach annual whose niche or 'life strategy' is the colonization of unstable, unvegetated, or new land, and which is unable to compete with perennial grasses."* On North Carolina's barrier islands, the zone where seabeach amaranth is absent corresponds almost exactly with the presence of an artificial barrier dune built and maintained by various federal agencies from the 1930s to 1950s (U.S. Fish and Wildlife Service 1996b).

d) Construction and Modification of Groins

Construction of the groins involves the direct removal of sandy habitat in the intertidal and nearshore areas. Intertidal and nearshore habitat will be permanently altered from sandy habitat to rocky subtidal/intertidal habitat by the construction of the groins. While these structures may function as habitat after the completion of the project, the habitat structure and biotic community will be altered from the before-project condition. Additionally, the construction of the project may change habitat formation patterns along the beach, as well as areas downdrift of the project (U.S. Fish and Wildlife Service 2000). The construction of the groins will permanently alter the feeding, sheltering, and breeding areas for fish and wildlife. The permanence of these features will reduce the effective areas available to species that utilize sandy habitat for feeding sheltering and breeding. For example, surf clams burrow in medium to course sand and gravel substrates, habitat that would no longer exist in areas where groins are proposed (U.S. Fish and Wildlife Service 1983).

The Service believes that construction of large hard structures on the beach will change habitat formation patterns. The shoreline would not exist in a continuous line after construction of the groins. Instead, it will consist of several "cells" created by the groins and result in the fragmentation of the shoreline. Erosion from increased wave energy could create vertical scarps or concave formation along the shoreline. These formations, combined with the structures themselves, may disrupt foraging by shorebirds, such as black skimmers, who skim along the surface of the shallow water to capture food. Foraging piping plover broods, which also move along the shoreline searching for prey in the intertidal zone and wrackline, will have to move up the beach and around the groins, consuming valuable energy needed for survival (U.S. Fish and Wildlife Service 2000).

Impacts to beach habitat and fish and wildlife resources may occur beyond the immediate area of the groin field as groins can have impacts on downdrift beaches. Structures such as groins that act as littoral drift barriers may cause erosion on downdrift beaches (Bruun 1995). Erosion and narrowing of beaches downdrift could reduce available habitat for breeding or foraging shorebirds and seabirds, and can reduce habitat for plants such as seabeach amaranth.

e) HFFRRFs: Shoreline Armoring

Bulkheads and other alongshore structures (*e.g.*, revetments, seawalls) can have a number of negative impacts on coastal habitats. These hard shore-parallel structures reflect wave energy and can cause erosion, sometimes resulting in loss of intertidal habitat and creation of deeper waters (Prosser *et al.* 2017; Dugan *et al.* 2011). This can be detrimental as shallow nearshore habitats often serve as foraging, refuge, and nursery areas for fish and aquatic invertebrates (Dugan *et al.* 2011; Ruiz *et al.* 1993; Beck *et al.* 2001) and studies have shown that diversity, abundance, and community structure of aquatic organisms can be adversely impacted by these structures (Bilkovic and Roggero 2008; Seitz *et al.* 2006; Kornis *et al.* 2017). Bulkheads and other shore-parallel structures, such as floodwalls, can also reduce terrestrial-aquatic connectivity. Exchange of sediment, nutrients, and organic material between terrestrial and aquatic habitats can be disrupted by these structures (Dugan *et al.* 2011; Bilkovic and Roggero 2008).

Different types of hardened shorelines may have different value to fish and wildlife resources. For example, Bilkovic and Roggero (2008) found that fish community integrity was lower at shorelines with bulkheads than at natural or riprap revetment shorelines. Similarly, Seitz *et al.* (2006) found that the abundance and diversity of bivalves and infauna (polychaetes, amphipods, etc.) was lower adjacent to bulkheads than adjacent to natural marsh or riprap. Rock sills associated with hybrid living shorelines, supported more fish and aquatic invertebrates than bulkheads or traditional rock revetments (Gittman *et al.* 2016; Bilkovic and Mitchell 2013).

Much of the shoreline in the Study Area has already been hardened; however, if the project introduces hardened structures to areas that have little existing structure or converts one shoreline type to another (*e.g*., converting a concrete rubble shoreline to a bulkhead), this may cause impacts to fish and aquatic organisms. Furthermore, construction of bulkheads, berms, and revetments are proposed in areas that have fringing saltmarsh. The Service is concerned that these structures may result in the loss of saltmarsh due to direct conversion of habitat or as the result of construction activities related to the shoreline protection structures. The construction of shoreline structures may also have other less direct impacts, such as increased runoff into Jamaica Bay. New storm water outfalls that would divert water into Jamaica Bay are proposed in association with the floodwalls and berms. These outfalls could be a conduit for pollutants and may impact water quality.

f) <u>HFFRRFs: Natural and Nature Based Features</u>

The use of nature-based features such as rock sill or marsh toe revetments in association with marshes may provide benefits to fish and wildlife resources over using traditional shoreline hardening approaches. Balouskus and Targett (2016) found that densities of some fish species were greater along a hybrid shoreline (comprised of a saltmarsh and riprap sill), than along shoreline with only a traditional riprap structure. Similarly, Gittman *et al.* (2016) found higher abundances of fishes at marsh sill sites than at sites with bulkheads, and found that marshes with sills may act as nursery habitat for fish. These nature-based approaches may provide more diverse habitat than traditional shoreline stabilization structures as they allow for colonization of a greater diversity of organisms, by allowing for the colonization of both infauna and epifauna. Both marsh sills and traditional riprap revetments provide structure for epifauna; however, traditional riprap revetments preclude the colonization of infauna due to loss of the intertidal zone. Marsh sills are often placed slightly offshore and preserve some amount of intertidal habitat, thereby allowing recruitment of both infauna and epifauna (Bilkovic and Mitchell 2013).

In some studies, marshes with sills have also performed as well as, or better than, natural marshes in providing habitat for marine organisms. Gittman *et al.* (2016) found that, at three years post-construction, the abundance and diversity of fishes and crustaceans was higher at marshes with sills than at natural fringing marshes without sills. Currin *et al*. (2007) also found that fish and invertebrates used marsh with stone sills in similar numbers to natural marshes. However, these results are not consistent across all studies. Balouskus and Target (2016) saw greater fish densities at riprap sills than at a traditional riprap revetment shoreline; however, fish densities were still lower than at natural marshes. Subramanian *et al.* (2008) also noted that sills can have detrimental impacts on wildlife as fish and crabs may get caught behind sills when tides recede and they are unable to escape.

The construction of marsh sills also involves trade-offs as they result in the conversion of existing habitat into an intertidal-sill; existing habitats that may be lost to conversion include relict fringe marshes, unvegetated tidal flats, and shallow subtidal bottom (Bilkovic *et al.* 2016; Bilovich and Mitchell 2013). The conversion of habitat to rock sills may also lead to subsequent changes in benthic communities. In one study, the construction of marsh sills was shown to benefit epifauna, but resulted in a reduction of the abundance, biomass, and diversity of infauna (Bilkovic and Mitchell 2013). Changes in community structure measured after the construction of sills showed increases in density and biomass of large bivalves, but decreases in density and biomass of polychaetes (Davenport *et al.* 2017).

Sediment characteristics (*e.g*., grain size, relative amounts of organic matter) and sediment accretion rates have also been shown to vary among marsh sill sites and differ from natural marshes. Marshes with sills had greater organic matter content, and higher sediment accretion rates than natural marshes (Currin *et al.* 2008). Greater accretion rates in marshes with sills may result in the conversion of low marsh to high marsh, and may reduce the fishery habitat value of that marsh (Currin *et al.* 2007). Sediment characteristics at marsh sills, however, were not consistent across studies. Other studies have found that marshes with sills had coarser sediment and lower organic matter than natural marshes (Bilkovic and Mitchell 2013). Low soil organic matter content may limit infauna colonization (Bilkovic *et al.* 2016; Sacco *et al.* 1994).

The design of a sill can influence its relative impact on habitats and fish and wildlife. Sill height, placement relative to the shore, sill porosity, and presence or absence of gaps/openings can influence the health of the saltmarsh behind the sill, tidal flushing, and the ability of aquatic organisms to access the marsh. Marsh sills placed too close to the marsh, that are designed too high, that don't incorporate any gaps or openings, and/or that have rock that is packed too tightly may limit tidal exchange, cause marsh to die off behind the sill, and restrict access of aquatic organisms (Bilkovic *et al.* 2016; Subramanian *et al.* 2008; Duhring 2008; Bosch *et al.* 2006). The proper design of gaps or openings is also important as they can cause marsh erosion or accretion in the gap if they are not designed correctly (Bosch *et al.* 2006; Hardaway *et al.* 2007; O'Donnell 2017).

The current shoreline and fringing marshes along the bay shoreline of the Rockaway Peninsula are known to support saltmarsh birds and horseshoe crabs. Should the installation of rock sills negatively impact the saltmarsh or prevent access to the shoreline these species may be negatively impacted.

g) <u>Borrow Area Dredging</u>

This section addresses the impacts to the marine subtidal habitats in the offshore dredging area. A description of the potential physical and biological changes and their associated impacts is given in Minerals Management Service (MMS) (2001). Some notable potential biological effects to fish and invertebrates include, but are not limited to: (1) removal or loss of infauna and epifauna at the borrow site for one to five years to a community with comparable pre-disturbance abundance and diversity and biomass but different species composition and structure; (2) altered energy transfer on the food chain and altered composition of fish prey base; (3) loss of spawning habitat; (4) loss of overwintering habitat; and (5) changes in community structure (species present, diversity, abundance, and biomass in surrounding areas) (Minerals Management Service 2001).

The primary adverse impact on the environment due to dredging operations at a borrow area involves the direct disturbance and destruction of benthic resources and their habitats from the dredge, which results in a loss of benthic organisms from the immediate area. Dredging may lower the productivity of a borrow area, and thus, the usefulness of the site for the production of fish and shellfish may decrease until a typical community is re-established in the borrow area (Woodward-Clyde Consultants 1975).

In addition to direct loss of benthic organisms to dredging, dredging can result in a number of different alterations to the seabed, which may affect its suitability as habitat for benthic organisms. Deep borrow pits are a possible result of seabed alteration from dredging. Small deep pits may become poor habitat due to reduced water circulation and high sedimentation rates can lead to anoxic conditions lethal to species using the pits. These adverse impacts have been found to be minimal in areas with strong currents where oxygen can be quickly replenished (Turbeville and Marsh 1982). Some borrow pits have also been shown to attract numerous fish and serve as resting places for sea turtles. Dredging can also lead to changes in sediment composition by exposing underlying sediments that are different from the existing sediments. Changes in sediment may impact the assemblage of benthic species, the ability of benthic organisms to burrow or feed, and/or the rate of recovery at a borrow site (Byrnes *et al.* 2004).

Recovery times for benthic communities at dredge sites vary. Many studies concluded that the benthic community within the borrow area of a dredge operation is fully recovered within one-year, while other studies found that recovery took more than one year and that species composition was still changing because sediment composition had not returned to pre-dredging conditions (Greene 2002; U.S. Army Corps of Engineers 2016c). Other studies suggest that recovery time may take one to five years to return to original levels of biomass and abundance (Greene 2002). Greene (2002) provided the following summary of factors that influence recovery time and degree of diversity of benthic organisms:

> "1) Duration and timing of dredging; 2) the type of dredging equipment used to extract the sediment; 3) sediment composition of the mine site; 4) amount of sand removed from the site; 5) the fauna present in the mine pit and surrounding area prior to dredging and their ability to adapt to change; 6) characteristics of the new sediment interface; 7) life history characteristics of fauna that recolonize; 8) water quality at the site; 9) hydro-dynamics of the mine pit and surrounding area; and 10) degree of sedimentation that occurs following dredging."

The impacts of dredging on benthic organisms may have further impacts on organisms that forage on benthic resources. For example, seabirds also use these open ocean habitats and can experience loss of foraging resources due to dredging, which can result in shifts in foraging patterns (U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, *pers. comm*. 2004). The Bureau of Ocean Energy Management (BOEM; formerly MMS) which oversees exploration of offshore areas for mining, and oil and gas reserves, has recognized the potential impacts of their programs to seabirds and has undertaken, in certain areas of the country, surveys to understand seabird distribution and abundance in their project areas.

2. Disturbance and Mortality

Disturbance to fish and wildlife resources will likely occur during construction and as a result of the Project's modification of habitats. The following is a discussion of the likely impacts resulting from the implementation of this project.

a) Shorebirds and Seabirds

The timing of beach nourishment activities, construction of the composite seawall, and construction of groins will be a major factor regarding short- and long-term impacts for breeding and migrating shorebird and seabird species. The direct effects of these construction activities include disruption of breeding, foraging, and roosting activities. Beach construction activities are usually very intensive environmentally disruptive operations, which involve the mobilization and use of heavy equipment and vehicles on the ocean beaches. The operation of dredging equipment immediately adjacent to a shoreline that is used as a courtship, nesting, and brood-rearing area has the potential to disturb shorebirds to the point where they may not successfully nest and fledge young. Dredging equipment that is operated immediately adjacent to shorebird breeding habitat may preclude shorebirds from using the habitat entirely, forcing them to seek appropriate habitat elsewhere. Operation of machinery used to move dredge pipeline and to grade the nourished beach can greatly disturb shorebirds and their nests, and can endanger the lives of chicks (U.S. Fish and Wildlife Service 1995). However, even low levels of human activity have been shown to result in disturbance and displacement of shorebirds at migration staging and roosting areas (Pfister *et al.* 1992). Migratory shorebirds are particularly vulnerable to disturbance at roosting sites at high tides where the habitat available for roosting is diminished (U.S. Fish and Wildlife Service 1998b).

Long-term indirect impacts as a result of the project are also likely, as recreational activities on beaches within the Study Area may increase as a result of the proposed project and the resulting wider beaches. Recreational activities that may potentially adversely affect these species include: an increase in beach patrons and associated activities (sunbathing, sports, playing loud music, etc.), unleashed pets, fireworks, kite-flying, and increase in garbage and refuse concomitant with increased recreational activities. Unleashed pets, such as dogs and cats, can prey on shorebirds. Kite-flying may disturb these species as it is believed that the ground-nesting shorebirds perceive kites as avian predators.

Consequently, human activities may adversely affect productivity of shorebirds (Ruhlen *et al.* 2002) and influence foraging activity of some shorebird species (Burger and Gochfeld 1991). Wide beaches with little human disturbance at the time these species initiate nesting (March to May) often experience heavy recreational pressure later in the nesting season (June through August), potentially creating sufficient disturbance to cause abandonment of nests, interfere with foraging, cause broods to be separated from adults, or attract predators.

b) Saltmarsh Birds and Neotropical Migrants

Nesting birds, including saltmarsh nesting birds and neotropical migrant songbirds, typically occupy the Study Area between April and September. Migrants are typically present from March through late May and early September through mid-October. Resident species are present year-round. Conducting construction activities during important biological windows can lead to disruption of breeding, feeding, and resting/staging behavior. As a result, construction will likely temporarily disrupt resident birds and breeding migrants. Prolonged absences of adults from their nests can jeopardize eggs or young. Depending on weather conditions, eggs may overheat or cool and fail to hatch. Young nestlings rely on their parents to provide warmth or shade, and may die from hypothermia or heat stress if adults are forced away from the nest for an extended period of time. Eggs and juveniles are subject to greater predation risk while they are unattended. Some species could be displaced if construction activities are planned during breeding or migration periods. Other species that overwinter in wetlands may be disturbed and displaced should construction occur during the winter season.

c) Diamondback Terrapins

Habitat for diamondback terrapins along the bay shoreline of the Rockaway Peninsula is limited, however, there are anecdotal reports of nesting terrapins. If they are present along the shoreline in the areas proposed for HFFRRFs, nesting turtles, their nests, and/or overwintering turtles could be killed or otherwise disturbed by construction activities associated with these features.

d) Fish and Aquatic Invertebrates

In-water work associated with dredging, groin construction, and the construction of HFFRRFs and NNBFs will cause disturbance and potentially direct mortality to fish and aquatic invertebrates. Offshore dredging directly effects fish by displacing mobile fish populations from the dredging operation site (Woodhead 1992) and results in direct mortality of immotile organisms. Similarly, the construction of groins, rocks sills, or other in-water structures would result in the burying of existing benthic organisms, and use of the shoreline area by fish and other mobile aquatic organisms would be temporarily disrupted by construction activities. Direct burial of most benthic organisms would generally be lethal, although some burrowing clams and crustaceans may be able to migrate upwards (U.S. Army Corps of Engineers 1992). Motile organisms, such as fish, appear to be the least affected by construction activities as they are able to move to avoid disturbances (Hurme and Pullen 1988).

Spawning horseshoe crabs could also be disturbed or disrupted by construction activities. Construction activities or vessels that create a wake could also disrupt horseshoe crab eggs.

e) Federally-Listed Species

Impacts to federally-listed species under the jurisdiction of the Service will be addressed in detail in the Biological Opinion for this project. Provided below is a brief discussion of impacts to listed species.

The proposed project has the potential to exert both direct and indirect adverse effects on the piping plover, red knots, and seabeach amaranth. Dredging and beach disposal activities during the plover breeding season have the potential to exert direct adverse effects on the piping plover as a result of disruption of courtship, nesting, and feeding activities, and alteration of their habitat. Likewise, if these activities occur during red knot migratory periods they may disrupt foraging and roosting activities of this species. Seabeach amaranth may also be directly impacted by beach nourishment through burial of adult plants and seeds, or crushing of adult plants construction vehicles.

Disturbance to federally-listed species may also come from indirect effects of the project. Increased beach width due to the project can lead to an increase in human recreation on beaches. This may have negative impacts on piping plovers that use the beaches to nest and rear chicks and red knots using the beaches to forage and roost. Increased numbers of people on the beach can disrupt breeding or foraging activities of these species. Other recreation-related activities that may potentially disturb piping plovers and red knots include: off-road vehicle (ORV) use, unleashing of pets, fireworks, kite-flying, and removal of wrack near plover nesting and feeding areas. Increased recreation could also lead trampling of seabeach amaranth plants and seeds.

3. Turbidity and Suspended Sediment

The project contains a number of activities that can result in sediment suspension and turbidity. Beach nourishment, in-water activities (such as construction of groins, bulkheads, and rock sills), and borrow area dredging may lead to suspended sediment and turbidity which may impact fish and other aquatic organisms.

Localized turbidity plumes can have lethal and sublethal effects on benthos and fish. Suspended sediments can have direct impacts on fish, including hematological compensation for reduced gas exchange across gill surfaces; abrasion of epithelial tissue; packing of the gut with large quantities of ingested solids, which may have little nutritive value; disruption of gill tissues (abrasion, clogging, increased activity of mucosa); and increased activity with a reduction of stored metabolic reserves (Profiles Research and Consulting Groups, Inc. 1980). Some of these impacts, such as the coating of gills, can cause mortality (O'Connor *et al.* 1976). Impacts may vary across species.

Other direct impacts of sediments include the smothering of immobile benthic organisms, fish eggs, and non-motile fish larvae or adults (Stern and Stickle 1978). Sediment burial can delay hatching time or lower hatching success of the eggs of some species (Schubel and Wang 1973; Auld and Schubel 1978; Nelson and Wheeler 1997; Berry *et al.* 2011). The impacts of suspended sediment and sediment burial on benthic invertebrates includes mortality, decreased body condition, and changes in growth or development (Wilber and Clarke 2001; Greene 2002; Colden and Lipcius 2015). However, the impacts of sediment on fish and benthic invertebrates is varied across species and life stages, and some species such as bivalves can be somewhat silt-tolerant (Wilber and Clarke 2001; Sherk *et al.* 1974).

In addition to direct effects, turbidity and suspended sediments may also impact fish and benthos in indirect ways. For example, suspended sediment can mask pheromones used by migratory fishes to reach their spawning grounds and impede their migration (Newcombe and MacDonald 1991). Suspended sediments may also impact aquatic organisms by creating anoxic water conditions (O'Connor *et al.* 1976) and/or decreasing light penetration (Stern and Stickle 1978). Studies have shown that turbidity and resulting shading and light scattering can have negative impacts on the ability of fish to detect prey and may hinder foraging efforts (Breitburg 1988; Benfield and Minello 1996). However, the influence of turbidity and light on foraging ability may vary among different sizes and types of fish; some groups of fish such as planktivores and fish larvae may benefit from turbid conditions (Utne-Palm 2002; Wilber and Clarke 2001).

4. Burial of Marine Intertidal and Marine Beach Invertebrate Species

The Corps estimates that 804,000 cy of sediment will be required for initial construction and approximately 1,021,000 cy of sediment for renourishment events. Placement of sand will lead to the burial and subsequent mortality of marine invertebrates. Beach resources affected by the placement of sand include flora and fauna found on the upland (vascular plants, terrestrial arthropods, and avifauna, etc.) and microphytobenthos (benthic micro-algae) and marine zoobenthos (Speybroeck *et al.* 2006). Speybroeck *et al.* (2006) states that the speed and degree of ecological recovery is largely dependent on four factors: the quality and quantity of the sediment; the nourishment technique and strategy applied; the place and size of nourishment; and the physical environment prior to nourishment. Model simulations conducted by Vanden Eede *et al.* (2014) found that species richness is not affected by beach nourishment because ecological niches remain available; however, because of steeper slopes, the niches are smaller. The model indicated that sediment grain size is important to the recolonization of macrobenthos, as well as nourishment specific and ecosystem dependent factors such as nourishment period, method and technique, erosion susceptibility, and the recolonizing capabilities of the species as discussed in Speybroeck *et al.* (2006).

Speybroeck *et al.* (2006) recognizes that the majority of studies have focused on macrobenthic infauna (*e.g.*, Reilly and Bellis 1978; Parr *et al.* 1978; Gorzelany and Nelson 1987; Peterson *et al.* 2000; Peterson and Manning 2001; Lindquist and Manning 2001), were not standardized and that these studies are primarily short-term studies, and that little is known about the cumulative effects of repeated renourishments. Few studies have focused on the impacts to primary producers (Cahoon *et al.* 2012). Studies report that recovery of benthic infauna can occur within a matter of months or may take several years to recover. This variation is likely due to variations in the factors listed above.

Recovery time of benthic invertebrates appears to show variability. Some studies have observed that when nourishment ceases, the recovery of the community is rapid and complete recovery may occur within one or two seasons (Reilly and Bellis 1978; Parr *et al.* 1978). No significant long-term negative effects of beach nourishment on nearshore benthic fauna were found during monitoring of a beach replenishment project on a central Florida east coast sand beach community (Gorzelany and Nelson 1987), but long-term adverse impacts to benthic fauna at North Topsail Beach, North Carolina, resulted following beach nourishment (Peterson and Manning (2001). However, Lindquist and Manning (2001) reported that periodic nourishment of beaches appeared to prevent the full recovery of benthic species. The ability of macrofauna to recover is due to: (a) their short life cycles, (b) their fast reproductive potential, and (c) the recruitment of plankton larvae and motile macrofauna from nearby unaffected areas (Naqvi and Pullen 1982).

The time of year that nourishment occurs may impact recovery times of invertebrates. When nourishment is completed between early August and early October, the community may recover within two months prior to the winter decline. Recovery time following nourishment in mid to late October is expected to occur within the range of two to six months. If nourishment occurs between the months of late October and January, the compounding effects of nourishment and seasonal population decline will result in a minimum of six months recovery time for the community (Burlas *et al.* 2001). In 2003, the time period for benthic recolonization was approximately 12 to 18 months for the Fire Island Community project area (Land Use Ecological Services, Inc. 2005). Terwilliger Consulting Inc. (2009) states that beachfill should be of the thinnest depth possible to facilitate the repopulation of the fill areas based on Defeo *et al. (*2009) who recommend repeated application of layers no thicker than 30 centimeters.

Impacts of beach nourishment on benthic invertebrates may have impacts on organisms that feed on them. For example, at Bogue Banks, North Carolina, a cold-season renourishment project that deposited sediment coarser than the existing sediment caused a decline in biomass of a number of benthic invertebrate species (Peterson *et al.* 2006). As a result of the decreased prey availability and, possibly, also as a result of the coarser sediment, the number of foraging shorebirds at the beach was also greatly reduced (Peterson *et al.* 2006). This suggests the importance of matching sediment characteristics to the original sediments, as well as the potential impacts of decreased benthic resources on shorebirds. As previously discussed, timing of placement also influences the length of recovery time of benthic invertebrates. Should the timing of a project prevent the recovery of benthic invertebrates prior to critical shorebird migration or nesting seasons, it may be reasonable to conclude that this too may impact shorebirds for at least one season after nourishment occurs.

B. CUMULATIVE IMPACTS

There are a number of other federal and local projects within or adjacent to the Study Area (see Appendix A) that have recently occurred, are ongoing, or that are proposed for the future that have had or will likely have impacts on habitats and fish and wildlife resources. Taken together, these projects will likely have cumulative impacts on fish and wildlife resources within and beyond the Study Area. The Service did not undertake a cumulative impacts analysis for the Recommended Plan, however, the abundance of projects within or adjacent to the Study Area that impact fish and wildlife resources underscores the importance of implementing mitigation measures for the current project. We request that the Corps provide an assessment of the effectiveness of implemented mitigation measures to date for completed and/or ongoing projects within or adjacent to the Study Area as part of the cumulative impacts analysis in their final report. If this information has already been developed, we request that the Corps share it with us so that we can review it and include it in our final FWCA report.

The following upcoming or ongoing federal projects occur within or immediately adjacent to the Analysis Area of the current project:

- Atlantic Coast of NYC-Rockaway Inlet to Norton Point, Shore Protection Project
- Rockaway Inlet Federal Navigation Channel Project
- East Rockaway Inlet Federal Navigation Channel Project
- Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach, NY, Storm Damage Reduction Project
- NY NJ Harbor and Tributaries Coastal Storm Risk Management Feasibility Study.
- Hudson River Estuary Restoration Feasibility Study

More information about these and other projects within or adjacent to the Study Area can be found in Appendix A.

XII. SERVICE PLANNING AND MITIGATION RECOMMENDATIONS

The Service provides the following planning and mitigation recommendations to facilitate the Corps in developing avoidance and minimization measures to avoid or limit project related impacts to trust resources.

The planning recommendations given below are provided as measures related to the formulation and design of the proposed project. As the project advances, through the Corps' planning process, the Service considers the consultation under the FWCA as an opportunity to integrate fish and wildlife conservation into the planning process.

The Service's Mitigation Policy (Policy) (U.S. Fish and Wildlife Service 1981) was developed to guide our preparation of recommendations on mitigating the adverse impacts of land and water developments on fish, wildlife, their habitats, and uses thereof. It helps both the Service and the federal action agency, in this case, the Corps, by assuring consistent and effective recommendations, by outlining policy for the levels of habitat mitigation needed, and the various methods for accomplishing mitigation for habitat losses associated with such projects. It allows federal action agencies to anticipate Service recommendations and to assist in the preparation of mitigation measures early, thus avoiding delays and assuring equal consideration of fish and wildlife resources with other project features and purposes.

The term "mitigation" is defined in the Service's Policy (U.S. Fish and Wildlife Service 1981) as: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating impacts over time; and (e) compensating for impacts by replacing or providing substitute resources or habitats.

The Service has jurisdiction over a broad range of fish and wildlife resources. Service authorities are codified under multiple statutes that address management and conservation of natural resources from many perspectives, including, but not limited to, the effects of land, water, and energy development on fish, wildlife, plants, and their habitats. The types of resources for which the Service is authorized to recommend mitigation also include those that contribute broadly to ecological functions that sustain species. Section 404 of the Clean Water Act (CWA; 33 CFR 320.4) codifies the significance of wetlands and other waters of the U.S. as important public resources for their habitat value, among other functions.

Mitigation planning often presents practicable opportunities to implement mitigation measures in a manner that outweighs impacts to affected resources. When resource enhancement is also consistent with the mission, authorities, and/or responsibilities of action proponents, the Service will encourage proponents to develop measures that result in no net loss toward achieving conservation objectives for the resources affected by their actions.

Objectives identified by the Service in providing recommendations on this feasibility study are to protect and conserve fish and wildlife resources in the Study Area. This includes developing recommendations to make the project more environmentally compatible and to further conserve and enhance the diversity and abundance of fish and wildlife resources and their habitats.

The outcome of consultation under section 7 of the ESA or future consultations under the FWCA, could affect the recommendations herein. In addition, the Service provides conservation measures intended to facilitate the recovery of listed species, sensitive habitats, and other fish and wildlife resources.

A. CORPS PROPOSED MITIGATION MEASURES/BEST MANAGEMENT PRACTICES

In the revised General Re-evaluation Report/Environmental Impact Statement (GRR/EIS), the Corps describes conservation measures that they plan to implement or have already incorporated into the project for the benefit of fish of wildlife resources. These measures are summarized below:

- Best management practices (BMPs) (*e.g*., silt fencing) to control erosion and sedimentation during construction will be implemented.
- Time-of-year restrictions will be observed to avoid impacts to fish and wildlife resources, including a time-of-year restriction for piping plovers (no work April 1 through September 1).
- NNBFs have been incorporated into the Mid-Rockaway Edgemere Area and the Mid-Rockaway Arverne Area HFFRRF projects where possible to reduce shoreline hardening and to promote restoration of native habitats.

There will be 7.65 ac of wetlands restored and/or created as part of the NNBFs, which will serve as mitigation for the estimated 3.74 ac of federal and state regulated waters and wetlands under the CWA that will be impacted by the project. The Corps will also restore 1.35 ac of maritime forest habitat at the Mid-Rockaway Arverne Area HFFRRF to mitigate for the loss of 1.81 ac of maritime forest resulting from the project.

The Corps also states that it will continue to work with the Service to avoid, minimize, and mitigate impacts to wildlife, and will continue to work with the Service and the NOAA Fisheries to ensure that reasonable and prudent measures and standard BMPs are incorporated into project plans to minimize adverse impacts to federally-protected species. Likewise, they stated that it is also assumed that the latest protective BMPs and conservation measures will be incorporated into the project plans to minimize potential adverse impacts to protected state listed species.

B. PLANNING RECOMMENDATIONS

1. Habitat Loss, Degradation, and Fragmentation

As habitats in the Study Area have been lost and modified due to human development, we recommend that the Corps evaluate if there are any additional areas within the HFFRRF projects where shoreline hardening can be further reduced. We also recommend that the Corps create and enhance fish and wildlife habitat where appropriate throughout the Study Area, and incorporate adequate monitoring and maintenance of habitats to ensure that they remain useable by fish and wildlife resources for the life of the project (additional recommendations regarding monitoring and maintenance are included under *Mitigation Recommendations*). An adaptive management plan for mitigation measures should be developed to ensure implementation and success. Further coordination with the Service under a separate scope of work will be necessary to achieve this goal. As some aspects of the project are designed only to a feasibility level, the amount of habitat required for mitigation is not established at this time (*e.g.,* wetland losses are not fully known, as a formal wetland delineation has not been undertaken). Mitigation planning should address mitigation ratios for the different habitat types affected by this project. In general, we recommend at least 1:1 to avoid net loss of any given habitat; however, some habitats may require larger ratios. For example, wetland mitigation may necessitate higher ratios as restored or created wetlands might not provide the same functions as existing wetlands, or they may lose function for a period of time as they become established. A mitigation ratio greater than 1:1 may be needed to offset these losses. Overall, the Service will continue to work with the Corps as final designs are developed to provide more accurate measures of mitigation and to determine appropriate mitigation ratios.

In their response to the Draft FWCA report (full response in Appendix G), the Corps indicated that habitat mitigation is not associated with the proposed project, but in order to minimize erosion, maximize stability and longevity, and to attenuate wave energy, the plan was designed to minimize and, in some areas, preserve functional effectiveness of the bayside habitat. The Corps will also further evaluate ways to minimize project impacts during the pre-construction engineering and design (PED) phase. We acknowledge the Corps' response, however, we continue to recommend habitat mitigation measures to offset impacts to fish and wildlife resources.

2. Invasive Species

The Corps and its project stakeholders should commit to a long-term effort at managing habitat created or restored as a result of the Project to prevent the colonization or recolonization of invasive species. This effort should incorporate post-project monitoring and maintenance to ensure that the intended plants are successful and that invasive species such as common reed do not become problematic.

3. Wildlife Management

In the Draft FWCA report, we recommended, in accordance with the 2003 MOA entitled, "*Aircraft-Wildlife Strikes,"* and the subsequent 2007 circular entitled, *"Hazardous Wildlife Attractants on or Near Airports,"* the Corps should commence coordination with the Service and the FAA for activities in close proximity to JFK Airport so that the NNBFs can be sited and designed without creating hazardous conditions for aircraft.

The Corps provided the following response in their comments on the Draft FWCA report:

"*In accordance with the FAA Advisory Circular 150/5200-33B and the Memorandum of Agreement with FAA to address aircraft-wildlife strikes, when considering proposed flood risk management measures and mitigation areas, USACE must take into account whether the proposed action could increase wildlife hazards. The FAA recommends minimum separation criteria for land-use practices that attract hazardous wildlife to the vicinity of airports. These criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport's approach or departure airspace or air operations area (AOA).*

These separation criteria include:

- *Perimeter A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest AOA;*
- *Perimeter B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest AOA; and*
- *Perimeter C: Five-mile range to protect approach, departure, and circling airspace.*

As stated, the closest airport the study area that must comply with these standards is the John F. Kennedy International Airport, Queens County, New York. The natural features in the recommended alternative are within the limits of the 5-mile perimeter of the airport, and as designed are not expected to introduce hazardous wildlife attractants. In addition, the habitat acreage created is not large enough to provide nesting habitat for the potential species that cause hazards. The District will confirm these designs with the FAA and PANYNJ."

4. Environmental Contaminants

In the Draft FWCA report, we recommended pre-construction monitoring for sediment contaminants at the locations of the NNBFs, and urged that construction should not proceed without prior screening for contaminants. If concentrations of contaminants in sediment exceed acceptable thresholds, we noted that biological testing and/or remediation may be necessary.

In response to the Draft FWCA report (full response in Appendix G), the Corps indicated that a scope of work will be prepared during the PED phase to conduct specific testing for hazardous, toxic, and radioactive waste (HTRW) in the HFFRRF areas. If HTRW is located, the Corps will assess if the project can be realigned to avoid the contaminated site. In accordance with ER 1165-2-132, if the project alignment cannot be revised, the project's non-federal sponsor would be responsible for the removal of any contaminants to allow the construction of the alignment.

The non-federal sponsor will conduct, at 100 percent their expense, those remedial activities necessary to remove contaminated materials in accordance with ER 1165-2-132. The Corps will continue to coordinate with all parties, including the State of NY, City of NY, and the NPS.

5. Supply of Genetic Stock of Native Plantings

The Corps should use locally-sourced and genetically-diverse plants in any plantings associated with the Project. As there are a number of other proposed projects in the region that will also incorporate native plantings, some large in scale (*e.g*., HRE Restoration Feasibility Study), the Corps should develop a plan for the acquisition of locally sourced plants that accounts for a shortage of these plants in the NYC region. The Corps may consider undertaking a seed collection effort (as the BLM has begun) to begin fulfilling their planting needs for the HRE Feasibility Study Area (Bureau of Land Management 2015). This collection effort will comply with Title 18 Chapter 1 of the Administrative Code of the City of New York (Native biodiversity planting practices) which requires "…greater native biodiversity … in public landscapes." (many of the HRE restoration projects are located on NYC-owned public lands).

C. MITIGATION RECOMMENDATIONS

1. Habitat Loss and Modification

a) <u>Beachfill/Berm Creation</u>

- The Corps should ensure that the dredged sand for beach nourishment is compatible with the sand that is now on the beach with respect to grain size, clay content, and organic matter.
- Sand grain size distribution should be monitored at the beach nourishment site before the project and immediately after project completion.
- The beach fill area should be finished to the same slope as the surrounding beach and the area should be graded at a gentle uniform slope with no piles, ridges, or holes left in the final graded beach placement materials.
- If the project creates additional nesting habitat within the Study Area through the extension of the berm habitat, the Corps should ensure that these areas are properly monitored and managed, recognizing that existing monitoring programs may not have the staff or resources to take on additional monitoring or management responsibilities.

b) <u>Composite Seawall</u>

- As it is designed, the landward side of the composite seawall is exposed at the crest of the dune. Based on the current project description, it appears this would result in the loss of approximately 9 ac of sandy maritime dune habitat that may serve as has habitat for beach-nesting birds. In response to the Draft FWCA report (full response in Appendix G), the Corps indicated that, during the PED phase, they will evaluate potential options of covering the exposed portion of the composite seawall. The Service supports this, and continues to recommend that the Corps should mitigate for any loss of habitat if the final design not incorporate full burial of the composite seawall.

- The Service requests more information about how the Corps will monitor, prevent, and/or mitigate for any additional loss of sand at the crest of the dune and exposure of the composite seawall due to settling of sand through the composite sea wall or from wind or water erosion.
- We recommend developing a management plan for the composite seawall and dune to ensure that action is taken if the sand dune is eroded and the seawall becomes exposed. Should the seawall become exposed, a plan should be in place to re-bury the wall. Plans should be developed for both the breeding season (April 1 through September 1) and the non-breeding season, as different courses of action will be necessary. For any exposure that may occur during the non-breeding season, we recommend that the wall is buried prior to the next shorebird nesting season (April 1 through September 1). We recommend that the Corps work with the Service to develop a protocol for dealing with exposure that happens within the nesting season.
- If the project results in loss of nesting habitat through erosion or construction of the composite seawall, the area of habitat impacted should be determined and mitigated using an appropriate mitigation ratio determined through further consultation with the Service under the FWCA.

c) <u>Artificial Dunes and Dune Planting</u>

- We recommend that the Corps evaluate if the dune can be designed so that it is less than a 20 percent slope on the seaward side to better accommodate breeding piping plovers and other beach-nesting birds.
- The Corps has expressed that American beachgrass will be planted on 18-inch (in.) centers within a row and can be modified to 24 in. on center where piping plover nesting is present or has the potential for nesting (Mazey 2018). We request more information from the Corps about what percent cover this planting scheme would achieve and how it would be maintained.
- The Corps should maintain vegetation on the dune and the berm so that it continues to support nesting terns, skimmers, oystercatchers. An assessment of existing conditions relative to habitat suitability should be performed to assist in determining appropriate vegetation density for these species. Recommendations for vegetation densities for piping plover will be considered in the Biological Opinion. Any vegetation maintenance or maintenance in nesting areas should occur outside of the breeding season (April 1 through September 1).
- A vegetation management plan should be developed to achieve and maintain target densities once they are established.

d) <u>Construction and Modification of Groins</u>

- The construction of new groins and extension of existing groins at the eastern end of the Rockaway Peninsula should avoid adversely affecting sand accretion on downdrift beaches west of the new and extended groins.

- Monitoring should occur to determine the effects of new and extended groins on the beaches west of the groins.
- The Corps should develop remedial action plans should the new or extended groins be proven to negatively impact the beaches west of the groin fields.
- It is unclear from the project description whether the new groins would be buried. To reduce potential impediments to foraging shorebirds we recommend that the groins are buried to the greatest extent practicable.

e) HFFRRFs: Shoreline Armoring

- The Service requests that further consideration is given to the proposed construction of bulkhead along the shoreline of Thursby Basin Park on the western shore of Sommerville Basin. We recommend evaluating the feasibility of a structure further landward around the perimeter of the undeveloped lot, instead of hardening the shoreline at this location. In response to the Draft FWCA report, the Corps stated that, during the PED phase, the alignment of hard structures will be located to minimize impacts to sensitive to areas.
- The Service recommends that the Corps continue to evaluate and modify HFFRRF and NNBF project designs to minimize loss of, or impacts to, wetlands. If losses cannot be avoided, the Corps should mitigate in accordance with section 404 of the CWA and continue to coordinate with the Service to develop appropriate mitigation ratios.
- The Corps has provided estimated acres of wetland loss, restoration/creation, and enhancement. We request that Corps complete a formal wetland delineation and provide an updated summary of the acres of existing wetlands and the acres of wetland that will be lost, restored, created, and enhanced due to the project, with each category broken out separately (*i.e.,* restoration and creation would not be grouped).
- The Corps indicated that 1.81 ac of maritime forest would be impacted by the project and that they would offset this loss by restoring 1.35 ac of maritime forest. We recommend that the Corps mitigate this habitat with at least a 1:1 to ratio.
- We recommend that the Corps develop measures to filter storm water that will be diverted to the Bay via new outfalls such that floatables and other pollutants are removed or reduced.
- The Corps should work with local communities and the NYCDEP in establishing green infrastructure practices (*e.g*., rain gardens, bio-retention swales, etc.) to reduce stormwater runoff within the drainage basins impacted by the Project.

f) HFFRRFs: Natural and Nature Based Features

- Rock sills should be designed such that they allow for sufficient tidal exchange and access by fish and aquatic organisms. To do this, sills should be designed to incorporate openings or drop-downs, should range from 0 to +1 ft above mean high water, and should be placed channel-ward of the mean low water line – not directly on the marsh (Bosch *et al.* 2006). Additional recommendations regarding sill design, design of openings, and marsh establishment can be found in "*Shore Erosion Control Guidelines*" (Bosch *et al.* 2006).

- We recommend that the Corps follow all relevant guidance as described in the NYSDEC's "*Tidal Wetlands Guidance Document, Living Shoreline Techniques in the Marine District of New York State*" (New York State Department of Environmental Conservation 2017).
- Horseshoe crabs were documented at Brant Point and Dubos Point during surveys performed in 2000. As habitats may have changed since that time, the Corps should survey for spawning horseshoe crabs at all locations with suitable habitat within the HFFRRF project areas. Should horseshoe crabs be located, the Corps should give specific consideration to the design of the rock sill at or around horseshoe crab locations to ensure that horseshoe crabs are not impeded by the structure, and to enhance spawning habitat.
- The Corps should develop a monitoring plan to monitor the establishment and survival of marsh vegetation, use of the marsh by fish and other aquatic organisms, and tidal flushing. Development of an adaptive management plan to address any problems is also recommended.
- For establishment of low marsh we make the following recommendations: saltmarsh cordgrass can be propagated by bareroot seedlings, plugs, or seedlings in peat pots (Broome 1990). Direct seeding is generally less reliable and there have been incidences when low seed viability reduced successful establishment of this species. Bareroot seedlings or plugs are generally less expensive than potted seedlings. Most low saltmarsh planting plans involve planting plugs on 24-in. or 36-in. centers. We recommend that saltmarsh cordgrass plugs be planted on 18-in. centers along the newly created creek banks and areas subject to wave action. The closer spacing will reduce the time to establish dense cover and will reduce opportunities for erosion. If Canada geese or brant are abundant in the Study Area following planting, they may pose a risk to the successful establishment of dense stands of vegetation. Techniques to prevent over browsing of the freshly-planted marsh areas may need to be implemented.
- We recommend the following for the establishment of high marsh: Like saltmarsh cordgrass, saltmeadow hay, and spike grass can be propagated by bareroot seedlings and plugs. Seeding is not as effective for this species and would require the collection of mature seed and cold stratification of the seed over the winter and spring months. Fertilization may also be necessary, but the greater interval between tidal flushes allows the use of standard (as opposed to slow-release) fertilizers (Broome 1990). We recommend planting at 24-in. centers to quickly establish a dense cover of vegetation to reduce the opportunity for common reed to become established. Geese and brant may need to be discouraged from using the site until the vegetation becomes established.
- We recommend the following for the establishment of transition zones: Marsh elder and groundsel-tree are two species well adapted to transition zones between low marsh and adjacent uplands. These species are tolerant of saline conditions and infrequent tidal inundation. Peat pots or bareroot seedlings should be planted on 3-ft (90 cm) centers. To stabilize slopes, the Service recommends a conservation mix

containing annual rye (*Lolium* spp.) for quick cover and slope stabilization, and a native grass such as switchgrass that will increase habitat diversity and help prevent common reed colonization.

g) Borrow Area Dredging

- All offshore dredging activities should be coordinated with the NYSDEC – Region 2 in regard to the protection of resources under their jurisdiction.
- Exposing and impacting various sediment types during dredging should be avoided. Maintaining the same sediment type at the borrow area will increase the probability that the same pre-dredging benthic assemblage will re-establish after dredging.
- Producing deep, steep-sided pits with little to no water circulation that may lead to silt and organic matter accumulation and hypoxic or anoxic conditions, should be avoided. Broad, shallow pits with gently sloping sides are less likely to exhibit these effects.
- In recognition of the seabird monitoring activities being undertaken by BOEM (previously the MMS) on potential offshore sand reserves in other parts of the country, the Corps should adopt a similar sampling program for this federal trust resource. These surveys will be necessary to develop appropriate mitigation measures. Until these surveys are completed, the Service is unable to provide adequate mitigation measures to protect these species.
- The Service recommends that the Corps develop a pre- and post-monitoring program based on the guidance protocols developed by the MMS (see Minerals Management Service 2001) for finfish and benthic assemblages within the offshore dredging areas. The justification for their approach is the observation that while benthic species abundance has been shown to return to pre-dredging levels, in some cases from 1 to 2 years after dredging, species composition may be different and the ability of fishes to use such altered assemblages for prey is uncertain. Therefore, the purpose is centered more towards trophic transfer relationships under modified conditions, as opposed to changes in the resident fish community (Minerals Management Service 2001).
- The Corps should consult with the NYSDEC as to whether additional quantitative baseline surveys on the density and age distribution of surf clams should be collected to determine the surf clam resources within the offshore dredging area. This information can be used to determine areas, within the dredging zone, that should be excluded from dredging operations, and will also enable the Corps to better determine the value of surf clam resources that may be impacted by dredging.

2. Disturbance and Mortality

a) Shorebirds and Seabirds

- Activities associated with beach nourishment; berm, composite seawall, and dune construction; and groin rehabilitation should be accomplished outside of the breeding season for federally- and state-listed species (April 1 through September 1).

- To avoid or minimize recreational impacts, the protection of these species should be demonstrated prior to project implementation. This should occur by developing and completing plans for educating residents, landowners, or beach managers of the management requirements discussed below, and, prior to project commencement, by obtaining a written agreement from residents, landowners, or beach managers for full cooperation with the Corps and the Service, or mutually agreed-upon designated representatives (*e.g.*, the NYSDEC).
- Access to the project beaches should be provided to the Service, the Corps, or their mutually agreed upon designated representatives, to survey and monitor waterbird and shorebird use areas. Access should be given during daylight hours on any day(s) of any given year at the required frequency to accomplish the purposes stated above.
- Protection measures should be provided for that include the placement of symbolic fencing around breeding areas to avoid or minimize the impacts associated with recreational users.
- Fireworks should be prohibited on beaches used by shorebirds or colonial waterbirds as breeding, foraging, loafing, or roosting areas.
- The Corps should work with the landowners to implement leash laws and develop laws and regulations to control cats during the migratory bird use periods.
- Feeding of raccoons, gulls, or other wildlife should be prohibited to minimize mortality of migratory birds.
- Public access on dunes should be limited to wooden walkways over the dune in order to maintain beach grass beneath the walkway, and on the dunes.

b) Saltmarsh Birds and Neotropical Songbirds

- To the greatest extent practicable, the Corps should avoid construction activities, particularly any vegetation removal, within saltmarsh, salt shrub, maritime dune, maritime grassland, and maritime shrubland habitats from March 15 to July 31.

c) Diamondback Terrapins

- We recommend that the Corps survey for diamondback terrapins in all suitable habitat that will be impacted by the Project.
- Should terrapins be located, the Corps should coordinate with the Service and other relevant agencies to develop a plan to avoid impacts to and/or enhance habitat for this species.

d) Fish and Aquatic Invertebrates

- The Service recommends that the Corps consult with the NOAA Fisheries and the NYSDEC to determine if time-of-year construction windows are warranted for any aspect of the proposed project, including in-water work, to protect migrating, overwintering, and/or spawning fish species.

- We recommend that the Corps survey for spawning horseshoe crabs in all suitable habitat that will be impacted by the Project.
- In-water construction activities should not occur between May 1 and July 1 in any location that spawning horseshoe crabs are identified.

3. Turbidity and Suspended Sediment

- To minimize short-term increases in turbidity, work should begin from the landward side before "breaking out" into open water areas.
- Silt fence should be properly installed between disturbed areas and adjacent wetlands. At least 6 in. (15 cm) of the toe of the silt fence should be buried parallel to the ground surface on the upslope side of the fence. The silt fence should be inspected following installation and after significant storm events to ensure that it is functioning properly. Silt fence is preferable to hay or straw bales as the bales represent a potential undesirable seed source in maritime shrubland or grassland habitats.
- The use of soil erosion control measures, as approved by the local Soil Erosion Control District, should be installed prior to the grading of any projects. The use of jute matting or other biodegradable natural material is recommended for stabilizing all project construction areas. The matting should be maintained until the site has recovered sufficiently to avoid any soil movement within or off the proposed project site(s). The matting will also aid in improved stabilization of any planted materials.
- The Service recommends that the temporary access routes and staging areas for all construction activities be restricted from sensitive habitat areas, including wetlands and riparian zones. The use of low ground pressure vehicles for all work proposed in marshes and open waters, when necessary, should be implemented.

4. Burial of Invertebrates

- Recognizing the impacts of nourishment on beach invertebrates and shorebird foraging, and that renourishment is scheduled to occur every four years for the life of the project, we recommended in the Draft FWCA report, that the Corps mitigate by creating potential shorebird foraging habitat elsewhere within the Study Area. In their response to this recommendation in the Draft FWCA report, the Corps provided the following comment:

  " *It is acknowledged that beach nourishment results in short-term declines in abundance, biomass, and taxa richness. However, studies within the NY/NJ Bight have shown recovery of intertidal assemblages are complete within 2- 6.5 months of the conclusion of filling. Differences in the rate of recovery were most likely due to differences in when nourishment was complete. Recovery was the quickest when filling was completed before the low point in the seasonal cycle of infaunal abundance. It is important that the grain size of the fill material matched that of the beaches to be nourished.*"

The Service recognizes that recovery times after nourishment are variable, and that recovery may occur within 2 to 6.5 months of placement under certain conditions. However, a recovery time that lasts 2 to 6.5 months is long enough to encompass one or more migratory periods for shorebirds and/or an entire nesting season, thereby impacting foraging quality during these critical life stages. These impacts would occur during initial placement, as well as every four years when the beach is renourished, potentially impacting multiple migratory and/or breeding seasons. As such, the Service continues to recommend that the Corps mitigate the impacts on foraging habitat through the creation of foraging habitat elsewhere within the Study Area.

D. ENHANCEMENT OPPORTUNITIES

- We recommend continued coordination with the Service and other relevant partners to develop plans prior to project construction to create habitat to benefit species, such as horseshoe crabs, saltmarsh birds, and/or diamondback terrapins where appropriate within the HFFRRF locations.
- The Corps may consider working with local partners to restore additional habitat at Dubos Point. Upon a site visit, the Service noted the presence of invasive species within the park (*e.g.*, common reed). The area would benefit from efforts to control invasive species.
- The Corps may also consider enhancing spawning habitat for horseshoe crabs at Dubos Point outside of the project footprint.
- To provide better habitat for beach-nesting birds, the Corps may consider working with local partners to eradicate Asiatic sand sedge from the beaches within the Study Area. This exotic plant can outcompete native plant species and form thick patches, which can be degrade habitat for beach-nesting birds.
- A number of areas of saltmarsh habitat along the north shore of the Rockaway Peninsula were identified as potential restoration areas in the Corps' *Jamaica Bay Navigational Channels and Shoreline Environmental Surveys Final Report* (U.S Army Corps of Engineers 1997). Some of these areas are within or adjacent to the proposed HFFRRFs. In the Draft FWCA report, we suggested that the Corps may consider restoring saltmarsh and other coastal communities in these areas in order to provide added habitat for fish and wildlife. In response to this recommendation in the Draft FWCA report (full response in Appendix G), the Corps stated the purpose of the current Study is to provide coastal storm risk management measures to the Study Area, and that the Hudson Raritan Estuary Ecosystem Restoration Study will be focusing and recommending restoration opportunities within the Jamaica Bay Planning Region. The Service notes the purpose and limitations of the current Study, but maintains this as a recommendation.

E. THREATENED AND ENDANGERED SPECIES RECOMMENDATIONS

Section 7(a)(2) of the ESA, requires all federal agencies, in consultation with the Secretary of the Interior, to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any listed species. In consultation with the Service, the

Corps shall utilize its authority to further the purposes of the ESA in the conservation and recovery of listed species and the ecosystems on which they depend. Further, 50 CFR 402.02 states that the "effects of an action" to be considered during consultation include "direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action...."

The Service will continue to coordinate with the Corps in their section 7(a)(2) ESA consultation process for this project, and recommendations for endangered and threatened species under the jurisdiction of the Service will be described in the Biological Opinion.

XIII. SERVICE CONCLUSIONS

Section 2(b) of the FWCA requires that the final report of the Secretary of the Interior: 1) determine the magnitude of the impacts of the proposed projects on fish and wildlife resources; and 2) make specific recommendations as to measures that should be taken to conserve those resources. The Service has reviewed the current literature on the biological and physical processes influencing the marine, estuarine, and terrestrial communities of the Study Area. When the project is considered within the context of the existing and foreseeable coastal projects, this project has the potential to have significant adverse ecological impacts to fish and wildlife resources of national significance. However, the implementation of the conservation/mitigation measures proposed by the Corps and the Service, as described in this report, will assist the Corps in offsetting many of the potential adverse impacts presented in this report. As the Corps moves from feasibility level designs to final designs, they should continue to the coordinate with the Service as project designs are further developed so that the Service can provide revisions or supplements to this 2(b) report, as necessary.

XIV. REFERENCES

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APPENDIX A

Relevant Studies, Projects, and Reports Within and Adjacent to the Study Area

1. Federal Projects

Numerous federal shoreline projects have been funded, authorized, and carried out along the Rockaway shoreline and within Jamaica Bay. The names and descriptions of these projects are listed below.

Rockaway Beach Erosion Control and Hurricane Protection Project

The original Rockaway Beach project was authorized by the Flood Control Act of 1965 and later modified by the Water Resources Development Act (WRDA) of 1974 for a 10-year period. The original project included a 100-200 feet (ft) wide beach at an elevation of 10 feet above Mean Low Water (MLW) from Beach 149th Street to Beach 19th Street. From 1977 until 2004, the U.S. Army Corps of Engineers (Corps) designed, constructed, and maintained the project. A second major construction effort was authorized through section 934 of the WRDA of 1986, allowing continued federal participation in periodic beachfill nourishment. The U.S. Fish and Wildlife Service (Service) prepared a final FWCA 2b report for the Corps' new component of this project as authorized by the WRDA of 1986 (Public Law 99-662). The project consisted of a 6.2-mile (mi), 100-ft berm width at an elevation of +10 ft National Geodetic Vertical Datum (NGVD). Additionally, the project included the construction of six (6), 300-ft T-groins with sheet-pile/timber stems. The Service provided a number of recommendations in the 1993 and the 2000 FWCA reports.

U.S. Fish and Wildlife Service. 1993. Atlantic Coast of New York City – East Rockaway Inlet to Rockaway Inlet, Fish and Wildlife Coordination Act 2(b) Report. U.S. Fish and Wildlife Service, Long Island Field Office, Islip, NY.

U. S. Fish and Wildlife Service. 2000. Atlantic Coast of New York City - East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York Storm Damage Reduction Project, Fish and Wildlife Coordination Act Section 2 (b) Report . U.S. Fish and Wildlife Service, Long Island Field Office, Islip, NY.

East Rockaway Inlet Federal Navigation Channel Project

The East Rockaway Inlet Federal Navigation Project was authorized by the Rivers and Harbors Act (RHA) of 1930. The project provides for a 0.9 mi long, 250 ft wide, 12 ft deep MLW channel. During the 2017 fiscal year, approximately 270,000 cubic yards (cy) of sand were dredged and placed along Atlantic Ocean Rockaway Beach shoreline.

U.S. Fish and Wildlife Service. 2016. ESA/MBTA/FWCAR letter. U.S. Fish and Wildlife Service, Long Island Field Office, Shirley, NY.

Rockaway Inlet Federal Navigation Channel Project

The Rockaway Inlet Federal Navigation channel, located in Jamaica Bay, New York, was authorized by the RHA of 1910 and later modified by the RHAs of 1945 and 1950. The existing project provides for a 1.7 mi long, 1,000 ft wide, entrance channel that is 20 ft deep at MLW, and connects two interior channels with deep water in the Atlantic Ocean.

Atlantic Coast of New York City – Rockaway Inlet to Norton Point, Shore Protection Project

This storm damage protection project is located along 3 miles of Coney Island shoreline. The Project was authorized by the WRDA of 1986, as modified by section 1076 of the Intermodal Surface Transportation and Efficiency Act of 1991. Public Law (PL) 99-662 of the 1986 Act called for federal participation in beach restoration 250 ft beyond the historic shoreline at Coney Island. The project was further modified by the WRDA of 2000 (PL 106-541) to include the construction of T-groins in the area west of the West 37th Street terminal groin. The project included the construction of a 100 ft wide beach berm at an elevation of 13 ft above sea level, the construction of an 850 ft long terminal groin at West 37th Street, and periodic nourishment of the restored beaches on 10-year cycle for a period of 50 years.

The following information was excerpted from the Corps' fact sheet on this project (http://www.nan.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/487599/fact-sheet-rockaway-inlet-to-norton-point-coney-island/). *The Corps completed a Reevaluation Report & Environmental Assessment in January 2005, which recommended the construction of a series of T-groins to the west of the West 37th Street groin as a long-term solution to beach erosion and sand accumulation problems that have occurred in the Sea Gate area. A condition survey of the project area was completed in spring 2011. The plans & specifications for this section are nearing completion, and a new Project Partnership Agreement, necessary to initiate project construction, is currently being coordinated with the project sponsors, the State and City of New York. The Sea Gate portion of the project is considered to be an Authorized but Unconstructed project according to PL 113-2 (The Disaster Relief Appropriations Act of 2013). Because of this, the Sea Gate portions of the project will be funded at 100 percent federal cost. Project construction began in December 2014 and is scheduled and was completed June 2016.*

U.S. Fish and Wildlife Service. 2000. Final Fish and Wildlife Coordination Act 2(b) Report, Atlantic Coast of New York City – Rockaway Inlet to Norton Point (Coney Island Area), Shore Protection Project. U.S. Fish and Wildlife Service, Long Island Field Office, Islip, NY.

Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York, Storm Damage Reduction Project

This Storm Damage Reduction project extends 9 miles along the south shore of Long Island from Jones Inlet to East Rockaway Inlet. The project was authorized by a resolution by the Committee on Public Works and Transportation of the U.S. House of Representatives adopted

October 1, 1986. Project construction was authorized by the WRDA of 1996. The proposed action included the rehabilitation/repair of 17 groins; rehabilitation and extension of the eastern terminal groin in Point Lookout; construction of a new groin field at Point Lookout; construction of 57 timber/gravel dune walkovers, extensions of existing dune walkovers, and vehicle access ways; construction of 35,000 linear ft of dune and beachfill from an offshore borrow area for the initial fill placement; and the installation of 75,000 linear ft of sand fence and dune grass planting. The first phase of construction began in the fall of 2016.

U.S. Fish and Wildlife Service. 2015. Final Fish and Wildlife Coordination Act 2(b) Report, Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York, Storm Damage Reduction Project. U.S. Fish and Wildlife Service, Long Island Field Office, Shirley, NY.

U.S. Army Corps of Engineers. 2015. Atlantic Coast of Long Island: Jones Inlet to East Rockaway Inlet Long Beach Island, New York Hurricane and Storm Damage Reduction Hurricane Sandy Limited Reevaluation Report Environmental Assessment. U.S. Army Corps of Engineers, New York District, New York, NY.

Hudson Raritan Estuary Project, Ecosystem Restoration Feasibility Study

The purpose of the Corps' Hudson Raritan Estuary (HRE) Feasibility Study is to identify water resource issues, discuss existing environmental conditions, and highlight factors contributing to environmental degradation in the HRE. Through proposed restoration at 33 sites across the estuary, the HRE Feasibility Study also strives to contribute to ecosystem restoration, by building upon existing restoration and section 404 of the Clean Water Act (CWA; 33 U.S.C. 1344 *et seq*.) mitigation efforts. The HRE Feasibility Study was authorized by House of Representatives' Committee on Transportation and Infrastructure Resolution dated April 15, 1999, Docket Number 2596.

U.S. Fish and Wildlife Service. 2018. Final Fish and Wildlife Coordination Act 2(b) Report, Hudson-Raritan Estuary (HRE) Comprehensive Restoration Plan and HRE Ecosystem Restoration Feasibility Study. U.S. Fish and Wildlife Service (Long Island Field Office, Shirley, NY; New York Field Office, Cortland, NY; and New Jersey Field Office, Galloway, NJ).

Jamaica Bay, Marine Beach, and Plumb Beach Ecosystem Restoration Feasibility Study

This Study determined the feasibility of improvements for beach erosion control, hurricane protection and environmental improvements at seven sites within Jamaica Bay, including Brant Point, Spring Creek, Bayswater Park, Dubos Point, Hawtree Point, Fresh Creek, and Dead Horse Bay.

U.S. Army Corps of Engineers. 2013. Jamaica Bay, Marine Beach, and Plumb Beach Ecosystem Restoration Feasibility Study. U.S. Army Corps of Engineers, New York District, New York, NY.

Spring Creek Park (North) Ecosystem Restoration Project

This ecosystem restoration project comprises a 47 acre (ac) portion of Spring Creek Park located adjacent to the banks of Spring Creek and Ralph's Creek, tributaries to Jamaica Bay. The proposed project would restore 13 ac of intertidal saltmarsh, 22.1 ac of maritime upland habitat, and 2.4 ac of maritime upland. The project was authorized under the Continuing Authorities Program, section 1135(b) of the WRDA of 1986, as amended (33 U.S.C. 2309[a]) and further amended under the Water Resource Reform and Development Act (WRRDA) of 2014(f), further amended section 1135(d) of WRDA of 1986 (33 U.S.C. 2309a (d)). The Service provided an updated FWCA report in October of 2016.

U.S. Fish and Wildlife Service. 2004. Final Fish and Wildlife Coordination Act 2(b) Report, Spring Creek Restoration Project. U.S. Fish and Wildlife Service, Long Island Field Office, Islip, NY.

U.S. Fish and Wildlife Service. 2018. Final Fish and Wildlife Coordination Act 2(b) Report, Spring Creek Ecosystem Restoration Project Spring Creek Park Brooklyn and Queens, NY. U.S. Fish and Wildlife Service, Long Island Field Office, Islip, NY.

Gerritsen Creek - Marine Park Ecosystem Restoration Project

The Corps' Gerritsen Creek - Marine Park Ecosystem Restoration Project (see http://www.nan.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/487245/fact-sheet-gerritsen-creekmarine-park-ny/) improved the aquatic and coastal grassland habitats located in the northeastern section of Marine Park, Brooklyn, New York. The project restored 31 ac of saltmarsh and 23 ac of rare coastal grassland habitat.

West Pond Breach Repair

During Hurricane Sandy, the West Pond of the Jamaica Bay Wildlife Refuge was breached. Repairs include repairing the embankment at the breach and installing a water control structure and a groundwater well. The purpose of the proposed project was to provide for environmentally sensitive and resilient conditions along the West Pond Trail area that support a diversity of Jamaica Bay habitats and wildlife. The breach closure was completed in January of 2017.

U.S. Fish and Wildlife Service. 2016. ESA Concurrence letter for the Jamaica Bay Wildlife Refuge West Pond Trail Breach Repair. U.S. Fish and Wildlife Service, Long Island Field Office, Shirley, NY.

National Park Service. 2015. Jamaica Bay Wildlife Refuge West Pond Trail Breach Repair Environmental Assessment. National Park Service, Staten Island, NY.

Fort Tilden Shore Access and Resiliency Project

Hurricane Sandy caused physical changes to the Fort Tilden coastal area, displacing the established foredune system and affecting historic resources on and adjacent to the beach, including Shore Road, the bulkhead and groin system, Battery Kessler, Buildings 15-18, and the Telephone Pit Building, and created new beach habitat suitable for threatened and endangered shorebirds and plants. The National Park Service (NPS) proposed to reconstruct Shore Road with a pathway of sustainable clay base with shell aggregate and partially removes the bulkhead and completely removes the wooden groins located on the beach.

U.S. Fish and Wildlife Service. 2016. ESA Concurrence letter for the Fort Tilden Shore Access and Resiliency Project. U.S. Fish and Wildlife Service, Long Island Field Office, Shirley, NY.

National Park Service. 2016. Fort Tilden Shore Access and Resiliency Project Environmental Assessment. National Park Service, Staten Island, NY.

Jamaica Bay Marsh Island Restoration: Elders East, Elders West, Yellow Bar Hassock, Black Wall, and Rulers Bar

Between 2006-2014, under the Corps' Continuing Authorities Program (CAP), the Corps, in partnership with the Port Authority of New York and New Jersey (PANYNJ), the New York State Department of Environmental Conservation (NYSDEC), the New York City Department of Environmental Protection (NYCDEP), and the NPS, restored marshes at Elders Point East and West, Yellow Bar Hassock, Black Wall, and Rulers Bar using dredged material from the Corps' New York Harbor Deepening Project.

North Atlantic Coast Comprehensive Study

The Corps completed the North Atlantic Coast Comprehensive Study and released the report in 2015. The Corps conducted the study over a two-year period, during which they examined coastal storm and flood risk to vulnerable populations, property, ecosystems, and infrastructure affected by Hurricane Sandy in the United States' North Atlantic region. According to the Corps' website, the study "is designed to help local communities better understand changing flood risks associated with climate change and to provide tools to help those communities better prepare for future flood risks. It builds on lessons learned from Hurricane Sandy and attempts to bring to bear the latest scientific information available for state, local, and tribal planners. The conclusions of the study, as detailed in the final report, include several findings, outcomes, and opportunities, such as the use of a nine-step Coastal Storm Risk Management Framework that can be customized for any coastal watershed." More information about the study can be found online at: http://www.nad.usace.army.mil/CompStudy/.

New York New Jersey Harbor and Tributaries Coastal Storm Risk Management Study

The New York New Jersey Harbor and Tributaries Coastal Storm Risk Management Study (CSRM) spans the New York and New Jersey Harbor and the tidally-affected tributaries encompassing all of New York City, the Hudson River to Troy, New York; the lower Passaic, Hackensack, Rahway, and Raritan Rivers; and the Upper and Lower Bays of New York Harbor, Newark, Jamaica, Raritan and Sandy Hook Bays; the Kill Van Kull, Arthur Kill and East River tidal straits; and western Long Island Sound. This focus area feasibility study is one of nine that the Corps' North Atlantic Coast Comprehensive Study (NACCS) Report, issued January 2015, identified for further study. This study is authorized by PL 84-71, June 15, 1955 (69 Stat. 132), which directs the examination of damages in coastal and tidal areas due to coastal storms such as hurricanes and of possible means of preventing loss of human lives and damages to property, with due consideration of the economics of proposed storm risk measures.

The initial focused array of alternatives has been formulated ranging from harbor-wide coastal storm risk management methods to land-based, perimeter CSRM methods, with three alternatives between. Coastal storm risk measures proposed in the alternatives include storm surge barriers, floodwalls, and levee systems. All alternatives are anticipated to also include non-structural measures and natural and nature based features as appropriate.

2. Federally Authorized/Funded State or Local Actions

Additional projects which are proposed or currently underway that are relevant to the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay include:

Arverne Urban Renewal Development

The construction of the Arverne East residential development is proposed to occur north of the boardwalk between Beach 32nd and Beach 44th Streets and includes up to 1500 units of housing, up to 500,000 square ft of commercial/recreational space, and 15.5 ac of open space/nature preserve. Although no known federal funding or authorizations are required for this project, the Service provided technical assistance letters to the New York City Department of Housing, Preservation and Development (NYCDHPD) in June of 2002 and October of 2003 providing conservation measures intended to avoid/minimize impacts to federally-listed species, which the NYCDHPD incorporated into their project description.

Spring Creek (South) Storm Resilience and Ecosystem Restoration Project

The Spring Creek South Storm Resilience and Ecosystem Restoration project includes a berm and restoration of wetland and maritime forest habitats. This site is located south of the Spring Creek North project. The project is funded by a grant awarded to the NYSDEC from the Federal Emergency management Agency's (FEMA) Hazard Mitigation Grant Program. The FEMA was identified as the lead agency in April of 2016.

Jamaica Bay Self-Sustaining Oyster Population project

The Jamaica Bay Self-Sustaining Oyster Population project is a NYCDEP project that was funded on June 16, 2014, by a Department of the Interior (DOI) Sandy Coastal Resiliency grant administered by National Fish and Wildlife Foundation (NFWF). In an effort to restore eastern oysters (*Crassostrea virginica*) to Jamaica Bay, the NYCDEP proposes to develop several donor and receiver oyster beds across half an acre in the northeastern end of Jamaica Bay at Head of Bay.

Rockaway Boardwalk

The Rockaway Boardwalk project included repairing and rebuilding approximately 5 mi of boardwalk from Beach 19th Street to 126th Street. The project included the replacement of pre-disaster wood with concrete decking; new beach and landside access ramps and stairs; installation of new utilities, bathrooms, and benches; steel pipe pilings for retaining wall and boardwalk; and elevated the boardwalk.

U.S. Fish and Wildlife Service. 2014. ESA Concurrence letter for the Rockaway Boardwalk reconstruction Project. U.S. Fish and Wildlife Service, Long Island Field Office, Shirley, NY.

Plumb Beach Coastal Storm Management Project

This coastal storm management project included the construction of a beach berm with sections planted with dune grass, two terminal groins and a breakwater to minimize long-term erosion and reduce the need for future renourishments of the berm. The beach berm was constructed in 2012, and the groins and breakwater were constructed in 2013.

Breezy Point Risk Mitigation System

The proposed project would protect the Breezy Point and Roxbury Beach communities located on the western end of Rockaway peninsula from flooding. Rockaway Point Boulevard, the main ingress and egress, was flooded during Sandy, preventing firefighters from combating a fire that destroyed 115 homes. The goal of the project is to provide coastal flood protection to both Breezy Point and Roxbury with a system of dunes and other flood protective structures that work together to create a more resilient community and withstand storm and tidal forces that may impact the coastline in future years.

3. Completed and Ongoing Studies and Reports

NYCDEP's Jamaica Bay Watershed Protection Plan 2016 Update (New York City Department of Environmental Protection 2016) provides a summary of the completed and ongoing projects being carried out within the project area. A summary of the projects and their description were excerpted from the 2016 update. More information about these projects can be found at online at: http://www.nyc.gov/html/dep/pdf/jamaica_bay/jbwpp_update_10012016.pdf.

Project	Location	Description
Ribbed Mussel Pilot	Fresh Creek Tributary	To study whether the filtering capacity of mussels can be adapted to the practical application of filtering discharges to improve water quality.
Oyster Reef Pilot	Jamaica Bay	A small oyster bed and a field of reef balls were placed within Jamaica Bay to evaluate oyster growth, survival and reproduction, as well as potential water quality and ecological benefits.

Project	Location	Description
Head of Bay Oyster Project	Head of Bay	A floating "nursery" of 50,000 adult oysters was installed in Head of Bay in an effort to evaluate natural recruitment, as this has been one of the more challenging aspects to fully understand. The project includes donor and receiver beds to study recruitment within Jamaica Bay.
Jamaica Bay Wastewater Treatment Plant Upgrades	Jamaica Bay	Jamaica Bay Wastewater Treatment Plant Upgrades Description: NYCDEP is improving the overall water quality and ecology of Jamaica Bay by reducing nitrogen discharges from Jamaica Bay's wastewater treatment plants (WWTPs) through a number of innovative plant upgrades.
Long Term Control Plan	Jamaica Bay and Tributaries	NYCDEP is developing and executing a detailed water quality planning and improvement process for NYC's local waterways, as documented in ten waterbody specific Long Term Control plans (LTCPs) and one citywide Combined Sewer Overflow (CSO) LTCP.
Area-wide Sewer Improvements Description	Bay-wide	Area-wide Sewer Improvements Description: NYCDEP is designing and constructing multiple critical infrastructure projects to reduce chronic flooding and increase environmental restoration in southeast Queens, which is in the Jamaica Bay watershed. Additional sewer separation and repair projects are ongoing in the Jamaica Bay watershed as well.
Floating Wave Attenuator Study	Brant Point	A wave attenuator pilot study, acting as a proxy for future oyster beds, was implemented around a section of saltmarsh in Jamaica Bay. The objective of the study is to determine if attenuators are cost effective methods for slowing the rate of wetland loss and accreting marsh sediments to improve salt marsh resiliency. The project was constructed in August 2015.
Spring Creek South Storm Resilience and Ecosystem Restoration Project	Spring Creek	The Spring Creek South Storm Resilience and Ecosystem Restoration project will reduce the risk of storm damage and flooding in the Howard Beach neighborhood by creating a protective berm and restoring over 225 ac of wetland and coastal forest. By reshaping the landscape and adding nature-based resilience features, Spring Creek South will complement other storm resilience projects in the area to manage this region's vulnerability to coastal storms.
Paerdegat Basin Natural Area Park & Ecology Park	Paerdegat Basin	To improve water quality, reestablish native habitat, and create recreational and educational opportunities for the public, NYCDEP established 52 ac of restored wetlands, including a public Ecology Park, along the shores of Paerdegat Basin. This educational park includes restored NYC coastal and adjacent upland habitat.
Green Infrastructure Description	Bay-wide	In 2012, NYCDEP and NYSDEC signed a groundbreaking agreement to reduce combined sewer overflows (CSOs) using a hybrid green and gray infrastructure approach. NYCDEP has identified 11 Priority CSO Tributary Areas for green infrastructure implementation within the Jamaica Bay watershed. Through NYCDEP 's area-wide strategy, four of these areas have completed design and/or construction contracts for green infrastructure on City-owned streets and sidewalks. The design process for the other seven Priority CSO Tributary Areas have begun and are expected to finish design in 2017.

The Science and Resilience Institute at Jamaica Bay

The Science and Resilience Institute at Jamaica Bay is a partnership among academic institutions, nongovernmental organizations and community groups. The Institute promotes the understanding of resilience in the urban ecosystem and surrounding communities. The institute is engaged in research to understand the temporal nature and robustness of the resilience of Jamaica Bay, New York Harbor, Hudson Raritan Estuary and Gateway National Recreation Area; develop models for studying the fundamental nature of resilient systems and determine how best to manage ecosystems to ensure resilience and sustainability; provide technical assistance and guidance to the institute's governmental partners, including the NPS, New York City Parks and the NYCDEP; and serves as a center for education and the dissemination of knowledge about processes that affect resilience and contribute to the changes in the urban ecosystem (http://www.brooklyn.cuny.edu/web/academics/centers/sri.php).

APPENDIX B

Rockaway Peninsula Bird Species

Table 1. Bird species located at three bay side sites on the Rockaway Peninsula (Veit *et al.* 2002).

Species	Scientific Name	Bayswater State Park	Dubos Point	Brant Point
American Bittern	*Botaurus lentiginosus*		X	
American Black Duck	*Anas rubripes*	X	X	X
American Crow	*Corvus brachyrhynchos*	X	X	X
American Golden-plover	*Pluvialis dominica*		X	
American Goldfinch	*Carduelis tristis*		X	X
American Kestrel	*Falco sparverius*	X	X	X
American Oystercatcher	*Haematopus palliates*	X	X	X
American Redstart	*Setophaga ruticilla*	X	X	X
American Robin	*Turdus migratorius*	X	X	X
American Tree Sparrow	*Spizella arborea*	X	X	X
American Wigeon	*Anas americana*	X	X	X
American Woodcock	*Scolopax minor*		X	
Atlantic Brant	*Branta bernicla*	X	X	X
Baltimore Oriole	*Icterus galbula*	X	X	
Bank Swallow	*Riparia riparia*		X	
Barn Swallow	*Hirundo rustica*	X	X	X
Belted Kingfisher	*Ceryle alcyon*		X	X
Black Skimmer	*Rynchops niger*	X	X	
Black-and-white Warbler	*Mniotilta varia*	X		
Black-bellied Plover	*Pluvialis squatarola*	X	X	X
Black-capped Chickadee	*Poecile atricapillus*	X		
Black-crowned Night-Heron	*Nycticorax nycticorax*	X	X	X
Blackpoll Warbler	*Dendroica striata*	X		
Black-throated Green Warbler	*Dendroica virens*	X	X	
Blue Jay	*Cyanocitta cristata*	X	X	X
Blue-gray Gnatcatcher	*Polioptila caerulea*	X		
Blue-headed Vireo	*Vireo solitarius*	X		
Boat-tailed Grackle	*Quiscalus major*	X	X	
Bobolink	*Dolichonyx oryzivorus*	X		
Brown Thrasher	*Toxostoma rufum*	X	X	
Brown-headed Cowbird	*Molothrus ater*	X	X	X
Bufflehead	*Bucephala albeola*	X	X	X

Species	Scientific Name	Bayswater State Park	Dubos Point	Brant Point
Canada Goose	*Branta canadensis*	X	X	X
Carolina Wren	*Thryothorusludovicianus*	X	X	
Cedar Waxwing	*Bombycilla cedrorum*	X	X	
Chimney Swift	*Chaetura pelagica*		X	X
Chipping Sparrow	*Spizella passerina*	X		
Clapper Rail	*Rallus longirostrus*	X	X	X
Common Grackle	*Quiscalus quiscula*	X	X	X
Common Loon	*Gavia immer*	X	X	
Common Snipe	*Gallinago gallinago*		X	
Common Tern	*Sterna hirundo*	X	X	X
Common Yellowthroat	*Geothlypis trichas*	X	X	X
Cooper's Hawk	*Accipiter cooperii*		X	
Double-crested Cormorant	*Phalacrocorax auritus*	X	X	X
Downy Woodpecker	*Picoides pubescens*	X		
Dunlin	*Calidris alpina*			X
Eastern Kingbird	*Tyrannus tyrannus*	X		
Eastern Meadowlark	*Sturnella magna*	X		
Eastern Phoebe	*Sayornis phoebe*	X	X	X
Eastern Towhee	*Pipilo erythrophthalmus*	X	X	
Eastern Wood-Pewee	*Contopus virens*		X	
European Starling	*Sturnus vulgaris*	X	X	X
Fish Crow	*Corvus ossifragus*	X	X	X
Forster’s Tern	*Sterna forsteri*		X	
Gadwall	*Anas strepera*		X	
Glossy Ibis	*Plegadis falcinellus*	X	X	X
Golden-crowned Kinglet	*Regulus satrapa*	X	X	X
Gray Catbird	*Dumatella carolinensis*	X	X	X
Great Black-backed Gull	*Larus marinus*	X	X	X
Great Blue Heron	*Ardea herodias*	X	X	X
Great Cormorant	*Phalacrocorax carbo*	X	X	X
Great Egret	*Ardea alba*	X	X	X
Great-crested Flycatcher	*Myiarchus crinitus*	X		
Greater Snow Goose	*Tringa melanoleuca*	X		
Greater Yellowlegs	*Tringa melanoleuca*	X		
Green Heron	*Butorides virescens*	X	X	
Herring Gull	*Larus argentatus*	X	X	X
Hooded Merganser	*Lophodyets cucullatus*		X	
Horned Grebe	*Podiceps auritus*		X	
House Finch	*Carpodacus mexicanus*	X	X	X
House Sparrow	*Passer domesticus*	X	X	X

Species	Scientific Name	Bayswater State Park	Dubos Point	Brant Point
House Wren	*Troglodytes aedon*	X	X	
Indigo Bunting	*Passerina cyanea*	X	X	
Laughing Gull	*Larus atricilla*	X	X	X
Least Flycatcher	*Empidonax minimus*	X		
Least Sandpiper	*Calidris minutilla*	X	X	X
Least Tern	*Strnula antillarum*	X	X	X
Lesser Scaup	*Aythya affinis*	X		
Lesser Snow Goose	*Chen caerulescens*		X	X
Lesser Yellowlegs	*Tringa flavipes*		X	
Magnolia Warbler	*Dendroica magnolia*	X	X	
Mallard	*Anas platyrhynchos*	X	X	X
Marsh Wren	*Cistothorus palustris*	X	X	
Merlin	*Falco columbarius*		X	
Mourning Dove	*Zenaida macroura*	X	X	X
Mute Swan	*Cygnus olor*	X		
Myrtle Warbler	*Dendroica coronata coronata*	X	X	X
Nashville Warbler	*Vermivora ruficapilla*	X		
Northern Cardinal	*Cardinalis cardinalis*	X	X	
Northern Flicker	*Colaptes auratus*	X	X	X
Northern Harrier	*Circus cyaneus*	X	X	
Northern Mockingbird	*Mimus polyglottus*	X	X	X
Northern Waterthrush	*Seiurus noveboracensis*	X		X
Orchard Oriole	*Icterus spurius*	X		
Osprey	*Pandion haliaetus*	X		
Peregrine Falcon	*Falco Peregrinus*		X	X
Pied-billed Grebe	*Podillymbus podiceps*		X	
Purple Finch	*Carpodacus purpureus*	X		
Red Knot (rufa ssp.)	*Calidris anutus*		X	X
Red-bellied Woodpecker	*Melanerpes carolinus*	X		
Red-breasted Merganser	*Mergus serrator*	X	X	X
Red-eyed Vireo	*Vireo olivaceus*	X	X	
Red-tailed Hawk	*Buteo jamaicensis*	X	X	
Red-throated Loon	*Gavia stellate*			X
Red-winged Blackbird	*Agelaius phoeniceus*	X	X	X
Ring-billed Gull	*Larus delawarensis*	X	X	X
Ring-necked Pheasant	*Phasianus colchicus*	X	X	X
Rose-breasted Grosbeak	*Pheucticus ludovicians*		X	
Rough-legged Hawk	*Buteo lagopus*	X		
Royal Tern	*Sterna maxima*		X	X
Ruby-crowned Kinglet	*Regulus calendula*	X	X	

Species	Scientific Name	Bayswater State Park	Dubos Point	Brant Point
Ruby-throated Hummingbird	*Archilochus colubris*	X		
Ruddy Turnstone	*Arenaria interpres*		X	
Rusty Blackbird	*Euphagus carolinus*	X		
Saltmarsh Sharp-tailed Sparrow	*Ammodramus caudacutus*		X	X
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X
Seaside Sparrow	*Ammodramus maritimus*		X	
Semipalmated Plover	*Charadrius semipalmatus*		X	
Semipalmated Sandpiper	*Calidris pusilla*	X	X	X
Sharp-shinned Hawk	*Accipiter striatus*	X	X	
Short-billed Dowitcher	*Limnodromus griseus*		X	
Short-eared Owl	*Asio flammeus*		X	
Slate-colored Junco	*Junco hyemalis hyemalis*	X		
Snowy Egret	*Egretta thula*	X	X	X
Song Sparrow	*Melospiza melodia*	X	X	X
Spotted Sandpiper	*Actitis macularia*	X	X	X
Surf Scoter	*Melanitta perspicillata*	X	X	
Swamp Sparrow	*Melospiza georgiana*	X	X	X
Tree Swallow	*Tachycineta bicolor*	X	X	X
Western Palm Warbler	*Dendroica palmarum palmarum*	X	X	
Western Sandpiper	*Calidris mauri*		X	
Whimbrel	*Numenius phaeopus*	X		
White-crowned Sparrow	*Zonotrichia leucophrys*	X		
White-rumped Sandpiper	*Calidris fuscicollis*			X
White-throated Sparrow	*Zonotrichia albicollis*	X	X	X
Willet	*Catoptrophorus semipalmatus*	X	X	X
Willow Flycatcher	*Empidonax traillii*	X	X	X
Yellow Palm Warbler	*Dendroica palmarum hypochrysea*		X	X
Yellow Warbler	*Dendroica petechia*	X	X	X
Yellow-bellied Sapsucker	*Sphyrapicus varius*	X	X	
Yellow-crowned Night-Heron	*Nyctanassa violacea*		X	

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APPENDIX C

Jamaica Bay Fish Species

Table 1. Fish species found within Jamaica Bay (Compiled from: National Park Service 2007; U. S. Fish and Wildlife Service 1997; and New York State Department of State 1992).

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American shad	*Alosa sapidissima*
Atlantic cod	*Gadus morhua*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic silverside	*Menidia menidia*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Banded Killifish	*Fundulus diaphanus*
Bay Anchovy	*Anchoa mitchilli*
Black Sea Bass	*Centropristis striata*
Blueback Herring	*Alosa aestivalis*
Bluefish	*Pomatomus saltatrix*
Cunner	*Tautogolabrus adspersus*
Inland silversides	*Menidia berylinna*
Kingfish	*Menticirrhus saxatilis*
Mummichog	*Fundulus heteroclitus*

Common Name	Scientific Name
Northern Pipefish	*Syngnathus fuscus*
Scup	*Stenotomus chrysops*
Searobin	*Prionotus spp*.
Striped Bass	*Morone saxatilis*
Striped Killifish	*Fundulus majalis*
Striped Searobin	*Prionotus evolans*
Stripped Bass	*Morone saxatilis*
Summer flounder	*Paralichthys dentatus*
Tautog	*Tautoga onitis*
Weakfish	*Cynoscion regalis*
White Mullet	*Mugil curema*
White Perch	*Morone americana*
Windowpane Flounder	*Scophthalmus aquosus*
Winter Flounder	*Pseudopleuronectes americanus*

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APPENDIX D

Marine Nearshore and Offshore Fish Species

Table 1. Summary of Marine Nearshore and Offshore Fish (Compiled from: U.S. Fish and Wildlife Service 1997; Edinger *et al.* 2014; National Oceanic and Atmospheric Administration 2018; New York State 2005)**.**

Common Name	Scientific Name
American sandlance	*Ammodytes americanus*
Atlantic Butterfish	*Peprilus triacanthus*
Atlantic Cod	*Gadus morhua*
Atlantic Croaker	*Micropogonias undulates*
Atlantic Herring	*Clupea harengus*
Atlantic Mackerel	*Scomber scombrus*
Atlantic Menhaden	*Brevoortia tyrannus*
Atlantic Silverside	*Menidia menidia*
Atlantic Sturgeon	*Acipenser oxyrhynchus oxyrhynchus*
Black Sea Bass	*Centropristis striata*
Bluefin Tuna	*Thunnus thynnus*
Bluefish	*Pomatomus saltatrix*
Blue Shark	*Prionace glauca*
Clearnose Skate	*Raja eglanteria*
Cobia	*Rachycentron canadum*
Common Thresher Shark	*Alopias vulpinus*
Cunner	*Tautogolabrus adspersus*
Dusky Shark	*Carcharhinus obscurus*
King Mackerel	*Scomberomorous cavalla*

Common Name	Scientific Name
Little Skate	*Leucoraja erinacea*
Longfin Inshore Squid	*Loligo pealeii*
Monkfish	*Lophius americanus*
Northern Kingfish	*Menticirrhus saxatilis*
Pollock	*Pollachius virens*
Red Hake	*Urophycis chuss*
Sandbar Shark	*Carcharhinus plumbeus*
Sand Tiger Shark	*Carcharias taurus*
Scup	*Stenotomus chrysops*
Silver Hake	*Merluccius bilinearis*
Skipjack Tuna	*Katsuwonus pelamis*
Smooth Dogfish	*Mustelus canis*
Spanish Mackerel	*Scomberomorous maculates*
Spot	*Leiostomas xanthurus*
Striped Bass	*Morone saxatilis*
Summer Flounder	*Paralichthys dentatus*
Tautog	*Tautoga onitis*
Tiger Shark	*Galeocerdo cuvier*
Weakfish	*Cynoscion regalis*
White Shark	*Carcharodon carcharias*
Whiting	*Merluccius bilinearis*
Windowpane Flounder	*Scophthalmus aquosus*
Winter Flounder	*Pseudopleuronectes americanus*

Common Name	Scientific Name
Winter Skate	*Leucoraja ocellata*
Yellowtail Flounder	*Limanda ferruginea*

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APPENDIX E

Jamaica Bay Aquatic Invertebrate Species

Table 1. Aquatic invertebrate species found within Jamaica Bay (Compiled from: U.S. Fish and Wildlife Service 1997 and National Park Service 2007).

Common Name	Scientific Name
Acorn Worm spp.	1. *Enteropneusta spp.*
Amethyst Gem Clam	*Gemma gemma*
Amphipod	*Gammarus spp.*
Amphipod	*Gammuarus fasciatus*
Amphipod	*Hyalella spp.*
Arboreal Glass Snail	*Zonitoides arboreus*
Asian Shore Crab	*Hemigrupsiis sanguineus*
Atlantic Assiminea	*Assiminea succinea*
Atlantic Oyster Drill	*Urosalpinx cinerea*
Atlantic Surf Clam	*Spisula solidissima*
Banacle	*Bulonus spp.*
Barnacle	*Semi-bulenus balanoides*
Bay Scallop	*Argopecten irradians*
Blue Crab	*Callinectes sapidus*
Blue Mussel	*Mytilus edulis*
Circumpolar Fairy Shrimp	*Branchinecta paludosa*
Clam Worm	*Nereis succinea*
Comb Jelly	*Mnemopsis leidyi*
Common Atlantic Slippershell	*Crepidula fornicata*

Common Name	**Scientific Name**
Common Periwinkle	*Littorina littorea*
Compound Coil	*Helicodiscus parallelus*
Convex Slippershell	*Crepidula convexa*
Copepods	*Cyclops spp.*
Copepods	*Diaptomus spp.*
EA Oyster	*Crassostrea virginica*
Eastern Melampus	*Melampus bidentatus*
Eastern Mudsnail	*Ilyanassa obsoleta*
English Garden Snail	*Cepaea nemoralis*
False Angelwing	*Petricola pholadiformis*
Fiddler Crab	*Uca pugnax*
Fingerling Clam	*Sphaerlum spp.*
Glossy Pilar	*Cionella lubrica*
Golden Fossaria	*Fossaria obrussa*
Grass Shrimp	*Palaemonetes pugio*
Grass Shrimp	*Palaemonetes vulgaris*
Heavy Marsh Crab	*Sesarma reticulatum*
Horseshoe crab	*Limulus polyphemus*
Jacknife Clam	*Ensis directus*
Larvae	*Cyprinotus inconruens*
Long Clawed Hermit Crab	*Pagarus longicarpus*
Meadow Slug	*Deroceras laeve*
Mottled Dog Whelk	*Nassarius vibex*

Common Name	**Scientific Name**
Mouse-ear Ovatella	*Ovatella myosotis*
Mud Crab	*Panopeus herbstii*
Netted Slug	*Deroceras reticulatum*
Northern Dwarf Tellin	*Tellina agilis*
Northern Quahog/Hardshell Clam	*Mercinaria mercenaria*
Ostracod	*Ostracoda spp.*
Ovate Vertigo	*Vertigo ovata*
Pewter Physa	*Physella heterostropha*
Pygmy Fossaria	*Fossaria parva*
Ribbed Mussel	*Geukensia demissa*
Rotifer	*Philodina roseola*
Rough Periwinkle	*Littorina saxatilis*
Softshell Clam	*Mya arenaria*
Spotted Leopard Slug	*Limax maximus*
Stout Tagelus	*Tagelus plebeius*
Thick Lipped Drill	*Eupleura caudata*
Tube Worm	*Hydroides elegans*
Two Sutured Odostome	*Boonea bisuturalis*
Water flea	*Bosmina spp.*
Water flea	*Chydons spp.*
Water flea	*Cladocera spp,*
Water flea	*Daphnia pule*x
Wharf Crab	*Sesarma cinereum*

Common Name	Scientific Name
White Slippershell	*Crepidula plana*

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APPENDIX F

Jamaica Bay Insect, Moth, and Butterfly Species

Table 1. The insects, skippers and butterflies found within Jamaica Bay (Compiled from: U.S. Fish and Wildlife Service 1997, National Park Service 2007, New York State Department of State 1992, Waldman 2008).

Species Common Name and Scientific	Species Common Name and Scientific Name
5-Banded Tiphid Wasp (*Myzinum quinquecinctum*)	Bent-winged Owlet (*Bleptina caradrinalis*)
Abagrotis spp. (*Abagrotis cupida*)	Black Saddlebags Dragonfly (*Tramea lacerata*)
Ailanthus Webworm Moth (*Atteva punctella*)	Black Swallowtail (*Papilio polyxenes*)
Ambiguous Moth (*Lascoria ambigualis*)	Black Widow Spider (*Latrodectus mactans*)
American Copper Butterfly (*Lycaena phlaeas*)	Black-banded Brocade (*Oligia modica*)
American Hover Fly (*Metasyrphus americanus*)	Blackberry Looper Moth (*Chlorochlamys chloroleucaria*)
American Idia (*Idia americalis*)	Blow Fly (*Phaenicia sericata*)
American Lady Butterfly (*Vanessa virginiensis*)	Blue Dasher Dragonfly (*Pachydiplax longipennis*)
Angular Wing Katydid (*Microcentrum retinerve*)	Bristly Cutworm Moth (*Lacinipolia renigera*)
Annual/Dog Day Cicada (*Tibicen canicularis*)	Broadwinged Skipper Butterfly (*Poanes viator*)
Appalachian azure (*Celastrina neglectamajor*)	Brown Sting Bug (*Euschistus spp.*)
Arcigera Flower Moth (*Schinia arcigera*)	Brown-collared Dart (*Protolampra brunneisollis*)
Armyworm Moth (*Mythimna unipuncta*)	Bumble Bee (*Megabombus pensylvanicus*)
Asiatic Garden Scarab Beetle (*Maladera castaneawas*)	Bumble Bee Moth (*Hermaris diffinis*)
Bee (*Agapostemon splendens*)	Cabbage Webworm Moth (*Hellula rogatalis*)
Bee (*Apis mellifera*)	Cabbage White Butterfly (*Pieris rapae*)
Bee (*Ausochlora pura*)	Caddishfly (*Trichoptera spp.*)
Bee (*Bombus citrinus, B. griseocollis, B. impatiens*)	Camphorweed Flower Moth (*Schinia nubila*)
Bee (*Cerutina calcarata*)	Carabidae Beetle (*Catadromus lacordairei*)

Species Common Name and Scientific	**Species Common Name and Scientific Name**
Bee (*Halictus ligatus, H. affinis, H. mesillae, B. modestus*)	Carpenter Bee (*Xylocopa virginica*)
Bee (*Lasioglossum marinum, L. spp., L. vierecki*)	Carrion Beetle (*Nicrophorus marginatus*)
Bee (*Masachile centuncularis*)	Celery Leaf Tier Moth (*Udea rubigalis*)
Bee (*Mesachile mendica*)	Celery Webworm Moth (*Nomophila nearctica*)
Bee (*Perdita swenki*)	Centipede (*Scolopendra spp*.)
Beetle (*Rhipiphorus spp*.)	Checkered White Butterfly (*Pontia protodice*)
Bent-line Carpet (*Orthonama centrostrigaria*)	Chernetid (*Chthoniidae spp*.)
Chickweed Geometer (*Haematopis grataria*)	Drab Brown Wave (*Lobocleta ossularia*)
Cicada Killer (*Sphecius speciosius*)	Drone Fly (*Eristalis tenax*)
Cicada Spp.	Earthworm (*Lumbricus terrestris*)
Citrine Forktail (*Ischnura hastata*)	Eastern Pond Hawk Dragonfly (*Erythemis simplicicollis*)
Clouded Sulfur Moth (*Colias philodice*)	Eastern Tailed Blue Butterfly (*Everes comyntas*)
Cloudless Sulfur Moth (*Pheobis sennae*)	Elegant Crab Spider (*Xysticus elegans*)
Clover Looper Moth (*Caenurgina crassiuscula*)	Elongated Long-Jawed Orbweaver (*Araneus spp*.)
Clubfoot Dragonfly (*Gamhidae spp*.)	European Earwig (*Forficula auricularia*)
Common Black Ground Beetle (*Pterostichus spp*.)	Faint-spotted Palthis (*Palthis asopialis*)
Common Buckeye Butterfly (*Junonia coenia*)	Fall Webworm Moth (*Hyphantria cunea*)
Common Eupithecia (*Eupithecia miserulata*)	Familiar Bluet Damselfly (*Enallagma civile*)
Common Forktail Damselfly (*Ischnura verticalis*)	Field Cricket (*Gryllus pensylvanicus*)
Common Gray (*Anavitrinella pampinaria*)	Fiery Skipper Butterfly (*Hylephila phyleus*)
Common Idia Moth (*Idia aemula*)	Flatid Planthopper (*Anormenis spetentrionalis*)
Common Pinkband (*Ogdoconta cinereola*)	Florida Tetanolita (*Tetanolita floridana*)

Species Common Name and Scientific	**Species Common Name and Scientific Name**
Common Sprageua (*Spragueia leo*)	Forage Looper Moth (*Caenurgina erechtea*)
Common Tan Wave (*Pleuroprucha insulsaria*)	Forest Wolf Spider (*Lycosa gulosa*)
Confused Eusarca (*Eusarca confusaria*)	Fragile Forktail Damselfly (*Ischnura posita*)
Corn Earwom Moth (*Helicoverpa zea*)	Funnel Spider (*Agelenidae spp*.)
Crab Spider (*Thomisidae*)	Garden Tortrix (*Clepsis peritana*)
Crambid sp. (*Parapediasia*)	Garden Webworm Moth (*Achyra rantalis*)
Daddy Longlegs (*Phalangiidae spp*.)	Gasteruptiidae (*Gasteruptiidae spp*.)
Damsel Fly (*Zygoptera*)	Giant Leopard Moth (*Hypercompe scribonia*)
Darkling Beetle (*Alabates pennsylvanica*)	Giant Swallowtail Butterfly (*Papilio cresphontes*)
Deerfly (*Chrysops spp*.)	Glossy Black Idia (*Idia lubicalis*)
Differential Grasshopper (*Melanoplus differentialis*)	Goldenrod Crab Spider (*Misumena vatia*)
Dingy Cutworm Moth (*Feltia jaculifera*)	Grateful Midget (*Elaphria grata*)
Gray Hairstreak Butterfly (*Strymon melinus*)	Locust Borer (*Megacyllene robiniae*)
Green Cloverworm Moth (*Plathypena scabra*)	Long Legged Fly (*Dolichopus longipennis*)
Green Darner Dragonfly (*Anax junius*)	Longhorned Beetle (*Parandra brunnea*)
Green Lacewing (*Chrysopa ornata*)	Lunate Zale Moth (*Zale lunata*)
Green Lyssomanes (*Lyssomanes viridis*)	Mantidfly (*Mantispidae spp*.)
Green Peach Aphid (*Myzus persicae*)	Master's Dart (*Feltia herilis*)
Green Stink Bug (*Acrosternum hilare*)	Mayfly (*Ephemeroptera spp*.)
Halictid Bee (*Augochloropsis metallica*)	Migrating Grasshopper (*Melanoplus sanguinipes*)
Hawaiin Beet Webworm Moth (*Spoladea recurvalis*)	Mining Bee (*Andrena spp*.)
Homoptera Red/Green Hopper Bug (*Comellus comma*)	Minor Angle (*Semiothisa minorata*)
House Fly (*Musca domestica*)	Miranda Moth (*Proxenus miranda*)

Species Common Name and Scientific	**Species Common Name and Scientific Name**
Hummingbird Sphinx Moth (*Hemaris thysbe*)	Monarch Butterfly (*Danaus plexippus*)
Ichneumon (*Ichneumonidae spp*.)	Mosquito (*Anopheles spp*.)
Implicit Arches (*Lacinipolia implicata*)	Nebraska Conehead (*Neoconocephalus nebrascensis*)
Ipsilon Dart (*Agrotis ipsilon*)	no common name (*Crambus praefectellus*)
Jumping Spider (*Salticidae*)	no common name (*Dolichomia olinalis*)
June Beetle (*Phyllophaga spp*.)	no common name (*Glaphyria sequistrialis*)
Juniper Geometer (*Patalene olyzonaria*)	no common name (*Loxostege cereralis*)
Knee-joint Dart (*Trichosilia geniculata*)	no common name (*Microcrambus elegans*)
Lady Bug (*Coccinelliae spp*.)	no common name (*Mythimna oxygala*)
Large Lace-boarder Moth (*Scopula limboundata*)	no common name (*Promalactis suzukiella*)
Large Maple Spanworm Moth (*Prochoerodes*	no common name (*Pyrausta rubricalis*)
Large Milkweed Bug (*Oncopeltus fasciatus*)	no common name(*Hypenodes palustrus*)
Large Yellow Underwing (*Noctua pronuba*)	Olethreutine sp.
Leaf Beetle (*Calligrapha spp*.)	Olive-shaded Bird-dropping M. (*Tarachidia candefacta*)
Lesser Grapevine Looper Moth (*Eulithis*	Orange Sulfur Butterfly (*Colias eurytheme*)
Lesser Vagabond Crambus (*Agriphila ruricolella*)	Orbweaver (*Araneus spp*.)
Pale Lichen Moth (*Crambidia pallida*)	Small Milkweed Bug (*Lygaeus kalmii*)
Parsitic Wasp (*Ischumonidae*)	Smoky Tetanolita (*Tetanolita mynesalis*)
Pearl Crescent Butterfly (*Phycoides tharos*)	Snout Butterfly (*Libythea carinenta*)
Pecks Skipper Butterfly (*Plites peckius*)	Snowy Dart (*Euagrotis illapsa*)
Pepper-and-salt Geometer (*Biston betularia*)	Snowy Tree Cricket (*Oecanthus fultoni*)
Phragmites Wainscot (*Leucania phragmitidicola*)	Sod Webworm Moth (*Pediasia trisecta*)
Pillbug (*Armadillidium vulgare*)	Soft-lined Wave (*Scopula inductata*)

Species Common Name and Scientific	Species Common Name and Scientific Name
Pink-barred Lithacodia (*Lithacodia carneola*)	Somber Carpet (*Disclisioprocta stellata*)
plume moth (*Emmelina monodactyla*)	Sorghum Webworm Moth (*Nola sorghiella*)
Praying Mantis (*Mantis religiosa*)	Southern Emerald (*Synchlora frondaria*)
Predaceous Diving Beetle spp.	Southern Green Sting Bug (*Nezara viridula*)
Ramburs Forktail Damselfly (*Ischnura ramburii*)	Sphinx Moth (*Hiles lineata*)
Red Admiral Butterfly (*Vanessa atalata*)	Spider Wasp (*Pompilidae spp*.)
Red Banded Hairstreak Butterfly (*Calycopis cecrops*)	Spotless Ninespotted Ladybug/Beetle (*Coccinella*
Red Saddlebags Dragonfly (*Tramea carolina*)	Spotted Beet Webworm Moth (*Hymenia perspectalis*)
Red Spotted Purple Butterfly (*Limenitis arthemis*)	Spotted Datana (*Datana perspicua*)
Red-Tailed Ichneumon (*Scambus hispae*)	Stilt bug (*Berytidae spp*.)
Ruddy Quaker (*Protorthodes oviduca*)	Subgothic Dart (*Feltia subgothica*)
Rustic Quaker (*Orthodes crenulata*)	Summer Azure Butterfly (*Celastrina neglecta*)
Sachem Skipper Butterfly (*Atalopedes campestris*)	Swarthy Skipper Butterfly (*Nastra Iherminier*)
Salt Marsh Caterpillar Moth (*Estigmene acrea*)	Syrphid Fly (*Allograpta obliqua*)
salt marsh skipper (*Panoquina panoquin*)	Tawny Emperor (*Asterocampa clyton*)
Sawfly (*Sawfly spp*.)	Tent Caterpilar (*Tolype*)
Seed Bug (*Lygaeidae sp*.)	The Gem (*Orthonama obstipata*)
Showy Emerald (*Dichorda iridaria*)	The Slowpoke (*Anorthodes tarda*)
Skimmer Dragonfly (*Libellulidae spp*.)	The Sweetheart (*Catocala amatrix*)
Slender Clear Wing Moth (*Hemaris gracilis*)	Wheat-head Armyworm Moth (*Faronta diffusa*)
Tricosa Dart (*Feltia tricosa*)	white m hairstreak (*Parrhasius m-album*)
Tufted Apple Budworm (*Platynota idaeusalis*)	Woolly Bear (*BeetleIsia isabella*)
Twelve Spotted Skimmer Dragonfly (*Libellua*	Woolly Pine Adelgid (*Pineus spp*.)

Species Common Name and Scientific	Species Common Name and Scientific Name
Unicorn Catepillar (*Schizura unicornis*)	Yellow Deerfly (*Chrysops vittatus*)
Ursula Wainscot (*Leucania ursula*)	Yellow Jacket (*Vespula maculifrons*)
Vagabond Crambus (*Agriphila vulgivagella*)	Yellow-striped Armyworm Moth (*Spodoptera ornithogalli*)
Variegated Leafroller (*Platynota flavedana*)	Zabulon Skipper Butterfly (*Poanes zabulon*)
Velvet Ant (*Dasymutilla occidentalis*)	Wasp (*Vespula spp*.)
Veriegated Fritillary Butterfly (*Euptoieta claudia*)	Wasp (*Oxybelus psp*.)
Viceroy Butterfly (*Limenitis archippus*)	Wasp (*Pemphredonini spp*.)
Violet Dancer Damselfly (*Argia violacea*)	Wasp (*Podulonia spp*.)
Wasp (*Crabronini spp*.)	Wasp (*Polistes dominulus*)
Wasp *(Eumenes fruternus, Eumeninae spp.*)	Water Strider (*Gerridae spp*.)
Wasp (*Isodontia mexicana*)	Wavy-lined Emerald (*Synchlora aerata*)
Wasp (*Monodontia quadridens*)	Wheat Head Armyworm Moth (*Faronta diffusa*)
Wasp (*Tachyles spp*.)	

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APPENDIX G

Army Corps of Engineers' Responses to Draft Fish and Wildlife Coordination Act Report

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, NEW
YORK DISTRICT JACOB K.
JAVITS FEDERAL BUILDING
26 FEDERAL PLAZA
NEW YORK NEW YORK
10278-0090

Environmental Analysis Branch

November 16, 2018

Mr. David Stilwell
Field Supervisor
U.S. Fish and Wildlife Service 3817
Luker Road
Cortland, New York 13045

Dear Mr. Stilwell:

The U.S. Army Corps of Engineers (USACE), New York District (District) is in receipt of your draft FWCAR, dated October 2018 submitting recommendations on the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Draft Integrated Hurricane Study.

Please find attached our responses to your Planning and Mitigation Recommendations. The District looks forward to working with your office throughout the Pre-Engineering and Design and Construction phases of this study and thank you for your continued assistance and input to this process which helps to advance the execution of this regionally-significant project.

If you require any additional information, please feel free to contact Ms. Daria Mazey Project Biologist/Planner at 917-790-8726.

Sincerely,

WEPPLER.PETER
.M.1228647353

Digitally signed by WEPPLER.PETER.M.1228647353
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=WEPPLER.PETER.M.1228647353
Date: 2018.11.15 13:19:13 -

Peter Weppler
Chief, Environmental Analysis Branch

USACE concurs with the Service's overall Planning and Mitigation Recommendations. We are committed to coordination and collaborating with FWS to advance our joint goals and obligations to ensure environmental protection and sustainability, and we offer responses to specific Recommendations, as follows:

XII. Service Planning and Mitigation Recommendations

B. Planning Recommendations

1. Habitat Loss, Degradation, and Fragmentation

FWS Recommendation: "*An adaptive management plan for mitigation measures should be developed to ensure implementation and success. Further coordination with the Service under a separate scope of work will be necessary to achieve this goal.*"

Response: Habitat mitigation is not associated with the proposed project. As part of the integrated approach for the Rockaway/Jamaica Bay study, the District considered human and ecosystem community resilience as part of the overall solution to manage risk associated with the high frequency flood areas. To minimize erosion, maximize stability and longevity, and attenuate wave energy that could cause scour within the locations of the HFFRRFs, the NED Plan has been designed to minimize and in some areas preserve the functional effectiveness of the bayside habitat.

In the Pre-Construction and engineering/design (PED) phase, further evaluation will be undertaken to minimize impacts associated with the project. If it is determined that there will be mitigation, the District will working with the resource agencies for the appropriate mitigation measure(s) per ER 1105-2-100, Planning Guidance Notebook.

3. Wildlife Management

FWS Recommendation: "*In accordance with the 2003 MOA entitled, "Aircraft-Wildlife Strikes," and the subsequent 2007 circular entitled, "Hazardous Wildlife Attractants on or Near Airports," the Corps should commence coordination with the Service and the FAA for activities in close proximity to JFK Airport so that the NNBFs can be sited and designed without creating hazardous conditions for aircraft.*"

Response: In accordance with the FAA Advisory Circular 150/5200-33B and the Memorandum of Agreement with FAA to address aircraft-wildlife strikes, when considering proposed flood risk management measures and mitigation areas, USACE must take into account whether the proposed action could increase wildlife hazards. The FAA recommends minimum separation criteria for land-use practices that attract hazardous wildlife to the vicinity of airports. These criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport's approach or departure airspace or air operations area (AOA).

These separation criteria include:

- Perimeter A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest AOA;
- Perimeter B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest AOA; and
- Perimeter C: Five-mile range to protect approach, departure, and circling airspace.

As stated, the closest airport to the study area that must comply with these standards is the John F. Kennedy International Airport, Queens County, New York. The natural features in the recommended alternative are within the limits of the 5-mile perimeter of the airport, and as designed are note expected to introduce hazardous wildlife attractants. Also, the habitat acreage created is not large enough provide nesting habitat for the potential species that cause hazards. The District will confirm these designs with the FAA and PANYNJ.

4. Environmental Contaminants

FWS Recommendation: "*We recommend pre-construction monitoring for sediment contaminants at the locations of the NNBFs. Construction should not proceed without prior screening for contaminants. If concentrations of contaminants in sediment exceed acceptable thresholds, biological testing and/or remediation may be necessary.*"

Response**:** Hazardous, Toxic and Radioactive Waste (HTRW) can occur within the urban environment such as NYC. In the PED phase, a scope of work will be prepared to conduct specific testing for HTRW in the HFFRRF areas. If it is determined, during sampling that HTRW contamination exists, the District will assess if the project can be realigned to avoid the contaminated site. In accordance with ER 1165-2-132, if the project alignment cannot be revised, the project's non-Federal sponsor would be responsible for the removal of any contaminants to allow the construction of the alignment. The non-federal sponsor will conduct, at 100 percent their expense, those remedial activities necessary to remove contaminated materials in accordance with ER 1165-2-132. USACE will continue to coordinate with all parties, including the State of New York, City of New York, and NPS.

C. Mitigation Recommendations

1. Habitat Loss and Modification

b. Composite Seawall

FWS Recommendation: "*As it is designed, the landward side of the composite seawall is exposed at the crest of the dune. Based on the current project description, it appears this would result in the loss of approximately 9 ac of sandy maritime dune habitat that may serve as has habitat for beach-nesting birds. The Corps should mitigate for this loss of habitat.*"

Response. During PED, the District will evaluate potential options of covering the exposed portion of the composite seawall.

e. HFFRRFs: Shoreline Armoring

FWS Recommendation: "*The Service requests that further consideration is given to the proposed construction of bulkhead along the shoreline of Thursby Basin Park on the western shore of Sommerville Basin. We recommend evaluating the feasibility of a structure further landward around the perimeter of the undeveloped lot, instead of hardening the shoreline at this location.*"

Response: During PED, the alignment of hard structures will be located to minimize impacts to sensitive areas.

f. HFFRRFs: Natural and Nature Based Features

FWS Recommendation: "*Recognizing the impacts of nourishment on beach invertebrates and shorebird foraging, and that renourishment is scheduled to occur every four years for the life of the project, we recommend that Corps mitigate by creating potential shorebird foraging habitat elsewhere within the Study Area.*"

Response: It is acknowledged that beach nourishment results in short-term declines in abundance, biomass, and taxa richness. However, studies within the NY/NJ Bight have shown recovery of intertidal assemblages are complete within 2-6.5 months of the conclusion of filling. Differences in the rate of recovery were most likely due to differences in when nourishment was complete. Recovery was the quickest when filling was completed before the low point in the seasonal cycle of infaunal abundance. It is important that the grain size of the fill material matched that of the beaches to be nourished.

D. Enhancement Opportunities

FWS Recommendation: "*A number of areas of saltmarsh habitat along the north shore of the Rockaway Peninsula were identified as potential restoration areas in the Corps' Jamaica Bay Navigational Channels and Shoreline Environmental Surveys Final Report (U.S Army Corps of Engineers 1997). Some of these areas are within or adjacent to the proposed HFFRRFs. The Corps may consider restoring saltmarsh and other coastal communities in these areas in order to provide added habitat for fish and wildlife.*"

Response: The purpose of this study was to provide coastal storm risk management measures to the study area. The Hudson Raritan Estuary Ecosystem Restoration Study will be focusing and recommending restoration opportunities within the Jamaica Bay Planning Region.

APPENDIX H

NOAA Fisheries' Comments on Draft Fish and Wildlife Coordination Act Report

NOAA Fisheries transmitted the following comments and attachment to the Service via e-mail on December 6, 2018:

The report was comprehensive and very thorough. We just have a few comments:

1) Please update the URL for our EFH mapper in your document. Here's the link:
https://www.fisheries.noaa.gov/resource/map/essential-fish-habitat-mapper
The URL that you have listed is an old one from several years ago. Also, I have attached our scoping letter so that you can see the species that the mapper picked up (including highly migratory species) to revise/update your list.

2) Also in our attached scoping letter you'll see at the end of the letter some up-to-date information on NOAA MMPA and ESA species to check against the info in your report. That information is directly from our Protected Resources Division.

E-mail Attachment:

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive Gloucester, MA 01930-2276

OCT 3 1 2018

Peter Weppler
Chief Environmental Analysis Branch Planning Division
New York District
U.S. Army Corps of Engineers 26 Federal Plaza
New York, NY 10278-0900

RE: Draft Final Integrated Hurricane Sandy General Reevaluation Report and Environmental Impact Statement, Essential Fish Habitat Assessment Atlantic Coast of New York, East Rockaway Inlet to Rockaway Inlet and Jamaica Bay

Dear Mr. Weppler:

We have reviewed the Draft Final Integrated Hurricane Sandy General Reevaluation Report and Environmental Impact Statement (DEIS) and essential fish habitat (EFH) assessment for the Atlantic Coast of New York, East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study. The project area includes the Atlantic coast of New York City between East Rockaway Inlet and Rockaway Inlet, areas within Jamaica Bay, and an offshore borrow area.

The report addresses the reevaluation of solutions to flooding attributed to storm surges in Jamaica Bay that inundate the bay shorelines of Rockaway (back bay flooding) and that overtop the Rockaway beachfront and flow across the peninsula to meet the surge into Jamaica Bay (cross shore flooding). The Recommended Plan (RP) has been formulated with two planning reaches, including 1) a reinforced dune and berm construction on the Atlantic shorefront and 2) high frequency flood risk reduction features (HFFRRF) in locations surrounding Jamaica Bay.

The Atlantic shorefront planning reach includes Rockaway Beach between Beach 9th Street and Beach 169th Street and an offshore borrow area in the Atlantic Ocean. The RP includes beach renourishment and construction of a 60 ft. wide beach berm for the length of the reach resulting in approximately 259 acres of dune and beachfill, as well as beach renourishment on a four year cycle for the 50-year life of the project. An approximately 33,000 If composite seawall, extension of five existing groins and construction of 13 new groins are also proposed. The sand material for beach fill and berm construction will be dredged from an existing, 1830-acre offshore borrow area, two miles south of East Rockaway in waters depths of 35 - 60 feet.

The HFFRRF planning reach consists of flood control subreaches in Cedarhurst-Lawrence, Motts Basin North, Mid-Rockaway- Edgemere, Mid-Rockaway - Arveme, and Mid-Rockaway

- Hammels. The RP for all of these subreaches includes construction of 11 acres of rock sills and 5,250 lf of bulkhead, modification of existing and construction of new stormwater outfalls and culverts, and installation of pump stations. The rock sills are components of natural and nature-based features (NNBFs) proposed for the Mid-Rockaway- Edgemere and Mid-Rockaway- Arverne subreaches, Tidal marsh habitats with upland buffers will be created, restored or enhanced shoreward of the sills and will be designed to allow their shoreward migration with rising sea levels.

Magnuson Stevens Fisheries Management and Conservation Act (MSA)

The project area has been designated as EFH for a number of federally managed species including Atlantic butterfish *(Peprilus triacanthus),* Atlantic mackerel *(Scomber scombrus),* Atlantic sea herring *(Clupea harengus),* black sea bass *(Centropristis striata),* bluefish *(Pomatomus saltatrix),* clearnose skate *(Raja eglanteria),* cobia *(Rachycentron canadum),* king mackerel *(Scomberomorus cavalla),* little skate *(Leucoraja erinacea),* long-finned inshore squid *(Loligo pealei),* monkfish *(Lophius americanus),* red hake *(Urophycis chuss),* scup *(Stenotomus chrysops),* Spanish mackerel *(Scomberomorus maculates),* summer flounder *(Paralichthys dentatus),* whiting *(Merluccius bilinearis),* windowpane flounder *(Scophthalmus aquosus),* winter flounder *(Pseudopleuronectes americanus),* winter skate *(Leucoraja ocellata)* and others.

The project area is also EFH for several highly migratory species including blue shark *(Prionace glauca),* dusky shark *(Carcharhinus obscurus),* sandbar shark *(Carcharhinus plumbeus),* and sand tiger shark (*Odontaspis taurus).* Sand tiger and dusky sharks have also been designated as Species of Concern by NOAA. Species of Concern are those about which we have concerns regarding their status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act (ESA). The goal of designating a species as a Species of Concern is to promote proactive conservation efforts for these species in order to preclude the need to list them in the future.

The MSA requires federal agencies to consult with us on projects such as this that may affect EFH adversely. This process is guided by the requirements of our EFH regulation at 50 CFR 600.905, which mandates the preparation of EFH assessments, lists the required contents of EFH assessments, and generally outlines each agency's obligations in this consultation procedure.

The EFH final rule published in the Federal Register on January 17, 2002 defines an adverse effect as "any impact which reduces the quality and/or quantity of EFH" and further states that:

> An adverse effect may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystems components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from action occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

We have reviewed the EFH assessment for this project. The assessment adequately evaluates many of the impacts of the project on EFH in the Atlantic shorefront and Jamaica Bay project reaches, and we agree with your conclusions on those impacts. However, some information, such as a full evaluation of impacts of dredging on the borrow area, was not provided. We understand that at this stage of the planning process, site specific information and design details are not yet available; as a result additional coordination and consultation will take place during the Preconstruction, Engineering and Design Phase of the project so our EFH conservation recommendations provided in this letter can be refined.

The Atlantic shorefront project plan includes seawall and groin construction, dredging and beach renourishment that will result in 259 acres of dune and beach fill with subsequent renourishment efforts every four years. The NNBF rock sills constructed as part of the Jamaica Bay HFFRRF project have been designed to control erosion, help manage coastal storm risk, and provide opportunities for habitat restoration and enhancement. Construction of the sills will result in a habitat conversion of 11 acres of unconsolidated bottom to hard structure in two sub-reaches. Tidal marshes will be created, restored, or enhanced shoreward of the sills in eroded and/or degraded subtidal and intertidal habitats, and will be designed to allow their shoreward migration with rising sea levels. Construction of the NNBFs will create a mix of low and high marsh habitat and upland buffers that will have a positive effect on EFH, federally managed species and NOAA trust resources.

In the DEIS it states that as HFFRRF features are further developed, additional NEPA documentation and resource agency coordination would be provided, as necessary. We agree with this process. Also, impacts to EFH for longfin inshore squid in the borrow area were not fully evaluated because you were not aware of new research examining squid spawning in the area offshore of Long Island. We will continue to coordinate with your office to further evaluate impacts to EFH of longfin inshore squid in the borrow area, including providing additional EFH conservation recommendations as necessary.

Aquatic Resources

Long/in Inshore Squid
Longfin inshore squid spawn throughout the New York Bight; early life stages are found in coastal waters and throughout Jamaica Bay. Egg masses are demersal and are typically attached to low-relief structure (e.g. rocks, small boulders) on sandy or muddy substrate in water depths less than 50 feet (Jacobson 2005). Recent research indicates that spawning may be concentrated in coastal waters off of the Rockaway peninsula (D. Stevenson, personal communication, 2018), which could result in increased vulnerability to EFH of longfin inshore squid to dredging operations. Our office is currently investigating the locations of highest egg mass concentration, seasonal occurrence, and egg mass residence time to better define EFH, in order to evaluate dredging impacts to the species in the Atlantic shorefront borrow area.

Shellfish
Surf clam *(Spisula solidissima),* razor clam *(Ensis directus),* and tellin *(Tellina agillis)* occur in the vicinity of the offshore borrow area. Shellfish also occur in the Jamaica Bay portion of the project area, including hard clam *(Mercenaria mercenaria),* soft shell clam *(Mya arenaria),* blue mussel *(Mytilus edulis),* oyster *(Crassostrea virginica),* blue crab *(Callinectes sapidus),* and horseshoe crab *(Limulus polyphemus).*

Coen and Grizzle (2007) discuss the ecological value of shellfish habitat to a variety of managed species (e.g. American lobster, American eel, and winter flounder) and have suggested its designation as EFH for federally managed species. Clams are a prey species for a number of federally managed fish including skates, bluefish, summer flounder and windowpane; siphons of hard clams provide a food source for winter flounder and scup (Steimle et al. 2000). Infaunal species such as clams filter significant volumes of water, effectively retaining organic nutrients from the water column (Nakamura and Kerciku 2000; Forster and Zettler 2004).

Horseshoe crabs may use multiple habitats along the shoreline of the Jamaica Bay reach, including subtidal bottoms, intertidal mudflats, and sandy beaches (Botton et al. 2006). Their eggs are a key seasonal food resource for a number of fish species including summer flounder and winter flounder (Botton and Shuster 2003); as a prey species, horseshoe crabs are considered EFH for those fishes.

Winter flounder
Winter flounder transit inlets such as East Rockaway Inlet to reach spawning areas within mid-Atlantic estuaries when water temperatures begin to decline in the fall. Tagging studies show that most return repeatedly to the same spawning grounds (Lobell 1939, Saila 1961, Grove 1982 in Collette and Klein-MacPhee 2002). Winter flounder typically spawn in the winter and early spring, although the exact timing is temperature dependent and thus varies with latitude (Able and Fahay 1998), however movement into these spawning areas may occur earlier, generally from mid- to late November through December. Winter flounder have demersal eggs that sink and remain on the bottom until they hatch. After hatching, the larvae are initially planktonic, but following metamorphosis they assume an epibenthic existence. Winter flounder larvae are negatively buoyant (Pereira et al. 1999) and are typically more abundant near the bottom (Able and Fahay 1998). These life stages are less mobile

and thus more likely to be affected adversely by any impact to benthic habitat. As adults often spawn in shallow water within estuaries such as Jamaica Bay, they are especially vulnerable to benthic impacts associated with construction of the NNBFs in the Jamaica Bay HFFRRF reach.

Anadromous Fishes

Anadromous fishes such as river herring (alewife *Alosa pseudoharengus* and blueback herring *Alosa aestivalis)* use inlets such as East Rockaway Inlet as a migratory pathway to nursery and forage habitat within the estuary beyond the inlet. Alewife and blueback herring spend most of their adult life at sea, but return to freshwater areas to spawn in the spring. Both species are believed to be repeat spawners, generally returning to their natal rivers (Collette and Klein- MacPhee 2002). Because landing statistics and the number of fish observed on annual spawning runs indicate a drastic decline in alewife and blueback herring populations throughout the mid- Atlantic since the mid-1960's (ASMFC 2007), they have been designated as Species of Concern by NOAA.

Increases in turbidity due to the resuspension of sediments into the water column during renourishment can degrade water quality, lower dissolved oxygen levels, and potentially release chemical contaminants bound to the fine-grained estuarine/marine sediments, and can impede river herring migration (Auld and Schubel 1978; Breitburg 1988; Newcombe and MacDonald 1991; Burton 1993; Nelson and Wheeler 1997). Noise from beach renourishment activities may also result in adverse effects. Our concerns about noise effects come from an increased awareness that high-intensity sounds have the potential to harm both terrestrial and aquatic vertebrates (Fletcher and Busnel 1978; Kryter 1984; Popper 2003; Popper et al. 2004). Buckel and Conover (1997) in Fahay et al. (I 999) reported that diet items of juvenile bluefish include *Alosa* species such alewife and blueback herring. Juvenile *Alosa* species have also been identified as prey species for windowpane flounder and summer flounder in Steimle et al. (2000). As a result, activities that adversely affect the spawning success and the quality for the nursery habitat of these anadromous fish can adversely affect the EFH for juvenile bluefish, windowpane and summer flounder by reducing the availability of prey items.

Wetlands

Jamaica Bay is regionally significant for shellfish and marine, estuarine, and anadromous fishes, as well as for its significant migratory and wintering waterfowl concentrations. The wetlands and uplands in the bay are important as fish nursery areas and foraging areas for shorebirds and waterbirds. Wetlands in the project area perform many important ecological functions including water storage, nutrient cycling and primary production, sediment retention, water filtration or purification, and groundwater recharge. The estuary is subject to severe anthropogenic impacts, and has incurred a loss of 63% of wetlands between 1951 and 2003. During this time period, the rate of marsh loss increased from 17 acres lost per year during 1951 - 1974 to 33 acres lost per year during 1989 - 2003 (NPS 2007). Vegetated wetlands are also considered to be special aquatic sites under the Clean Water Act. Because of their ecological value, impacts on these special aquatic sites should be avoided and minimized; wetlands should be created, restored, or enhanced where feasible.

Tidal wetlands provide nursery habitat for many species of fish, including winter flounder and summer flounder. Summer flounder larvae migrate inshore into estuarine nursery areas, settling to the bottom of tidal marsh creeks to transform to their juvenile stage. These juveniles will then make extensive use of the creeks, preying on creek fauna such as Atlantic silversides and mummichogs. Juvenile summer flounder may also be found in salt marsh cord grass habitat during flood tides. Juveniles utilize the marsh edges for shelter, burying themselves in the muddy substrates. Keefe and Able (1992) in Packer et al. (1999) found that summer flounder juveniles that inhabit tidal marsh creeks exhibit the fastest growth. Larval and juvenile black sea bass also concentrate and feed extensively and shelter within these habitats. As a consequence, growth rates are high and predation rates are low, which makes these habitats effective nursery areas. Juvenile black sea bass are also known to inhabit the mouths of tidal marsh creeks as well as shallow shoals and tidal marsh edge habitat. Within these habitats, young-of-year black sea bass display high site fidelity; they may be territorial and move very little (Musick and Mercer 1977; Werme 1981; Able and Hales 1997). Black sea bass have been observed defending small areas of nursery habitat rather than fleeing to other suitable areas (Able and Fahay 1998).

An unimpeded marsh edge is important to estuarine and tidal marsh community dynamics, both to allow tidal flushing and concomitant transport of plankton, nekton, nutrients and sediment as well as to enable access to edge habitat by estuarine biota, including federally managed species, diadromous fishes, and other important prey for federally managed species. Marshes and marsh edge habitat can therefore be considered EFH for summer flounder, black sea bass, and other species.

Atlantic Shorefront

Beach Nourishment and Dredging

The dredging of sand for beach nourishment has the potential to impact both the EFH of a particular species as well as the organisms themselves in a variety of ways. Dredging can result in the impingement of eggs and larvae in the dredge plant and create undesirable suspended sediment levels in the water column. As stated above, increased suspended sediment levels can reduce dissolved oxygen, mask pheromones used by migratory fishes, and smother immobile benthic organisms and newly-settled juvenile demersal fish (Auld and Schubel 1978; Breitburg 1988; Newcombe and MacDonald 1991; Burton 1993; Nelson and Wheeler 1997). Sustained water column turbulence can reduce the feeding success of sight-feeding fish such as winter flounder and summer flounder.

Dredging can remove the substrate used by federally managed species as spawning, refuge and forage habitat. Benthic organisms that are food sources for federally managed species may also be removed during dredging. These impacts may be temporary if the substrate returns to preconstruction condition and the benthic community recovers with the same or similar organisms. The impacts may be pe1manent if the substrate is altered in a way that reduces its suitability as habitat, and if the benthic community is altered in a way that reduces its suitability as forage.

Overall, the dredging and placement of sand along the coastline will have some adverse effects on EFH and federally managed species due to the entrainment of early life stages in the dredge, alteration or loss of benthic habitat and forage species, and altered forage patterns and success due to increased, noise, turbidity and sedimentation. We agree that some effects will be temporary and others can be minimized using some of the management practices mentioned in the EFH assessment, such as dredging in the fall to avoid sensitive life stages of certain species, not dredging deep holes and leaving similar substrate in place to allow for recruitment.

Dredging in the borrow area can also affect EFH adversely through impacts to prey species. The EFH final rule states that the loss of prey may be an adverse effect on EFH and managed species because the presence of prey makes waters and substrate function as feeding habitat; the definition of EFH includes waters and substrate necessary to fish for feeding. Steimle et al. (2000) reported that winter flounder diets include the siphons of surf clams *(Spisula solidissima).* As a result, activities that adversely affect surf clams can adversely affect the EFH for winter flounder by reducing the availability of prey items

According to the DEIS, the offshore borrow area provides habitat for Atlantic surf clams; however surveys conducted by the USACE in 2003 and by the NYSDEC in 2012 indicate that the borrow area itself contains very low to no localized populations of surf clams. To ensure that impacts to surf clams are minimized, the borrow areas should be surveyed prior to each dredging cycle and areas of high densities should be avoided. Copies of the shellfish survey results should also be provided to us prior to any dredging in the borrow area.

The Mid-Atlantic Fisheries Management Council (MAFMC) has developed a policy statement on sand mining and beach nourishment activities that may affect federally managed species under their purview including summer flounder, scup, black sea bass, monkfish and butterfish. These policies are intended to articulate the MAFMC's position on various development activities and facilitate the protection and restoration of fisheries habitat and ecosystem function. The MAFMC's policies on beach nourishment are:

1. Avoid sand mining in areas containing sensitive fish habitats (e.g., spawning and feeding sites, hard bottom, cobble/gravel substrate, shellfish beds).

2. Avoid mining sand from sandy ridges, lumps, shoals, and rises that are named on maps. The naming of these is often the result of the area being an important fishing ground.

3. Existing sand borrow sites should be used to the extent possible. Mining sand from new areas introduces additional impacts.

4. Conduct beach nourishment during the winter and early spring, when productivity for benthic infauna is at a minimum.

5. Seasonal restrictions and spatial buffers on sand mining should be used to limit negative impacts during fish spawning, egg development, young-of-year development, and migration periods, and to avoid secondary impacts to sensitive habitat areas such as SAV.

6. Preserve, enhance, or create beach dune and native dune vegetation in order to provide natural beach habitat and reduce the need for nourishment.

7. Each beach nourishment activity should be treated as a new activity (i.e., subject to review and comment), including those identified under a programmatic environmental assessment or environmental impact statement.

8. Bathymetric and biological monitoring should be conducted before and after beach nourishment to assess recovery in beach borrow and nourishment areas.

9. The effect of noise from mining operations on the feeding, reproduction, and migratory

behavior of marine mammals and finfish should be assessed.

10. The cost effectiveness and efficacy of investments in traditional beach nourishment projects should be evaluated and consider alternative investments such as non-structural response and relocation of vulnerable infrastructure given projections of sea level rise and extreme weather events.

Sand Placement Effects on Fishes
Beach renourishment activities produce turbidity and sound impacts; fish may move away from those impacts in open water but cannot avoid them in inlets and channels. Fish that transit through inlets and channels on spawning migrations are therefore vulnerable to these impacts. As discussed earlier, winter flounder and river herring ingress through inlets to access estuarine spawning habitats. Winter flounder migrate into mid-Atlantic estuaries from mid-November through December. River herring enter these same estuaries on their spawning migrations from early March through May. Because project plans include beach renourishment along Rockaway Beach at East Rockaway Inlet, sequencing of beach nourishment activities may be necessary in order to avoid impacts to ingressing winter flounder and river herring. This may include seasonal in-water work restrictions for winter flounder from November 15 through December 31 and from March 1 to May 31 for river herring. Any in-water work undertaken at the inlet at other times of the year should be designed with 50% of the inlet unobstructed to allow ingress and egress of fish past the work site.

Jamaica Bay HFFRRF

Impacts ofNNBF Construction on EFH
The Jamaica Bay HFFRRF project plan proposing construction of NNBFs in the Edgemere and Arverne subreaches will result in permanent impacts to shallow water and tidal wetland habitat, including EFH for winter flounder. Rock sills are proposed for two subreaches of the Jamaica Bay HFFRRF, including four sections in Edgemere totaling approximately 3100 If and three sections in Arverne totaling approximately 4800 If, with a combined footprint of 11 acres. Tidal marshes will be created, restored, or enhanced shoreward of the proposed rock sills and will be designed to allow their shoreward migration with rising sea levels. We appreciate the Corps' use of NNBFs in this project and encourage their use in future projects when practicable.

The construction of the NNBFs, including rock sills and tidal wetlands, will result in a permanent loss of winter flounder EFH associated within the footprints of the sills and in areas shoreward of the sills due to natural sediment accretion and tidal wetlands creation. Seasonal in- water work restrictions from January 1 to May 31 will minimize impacts to winter flounder early life stages and their EFH during the construction activities and the NNBF features will provide habitat for other aquatic resources.

Impacts to Prey Species
Construction of the NNBFs may impede access by horseshoe crabs to spawning beaches. Horseshoe crab eggs are an important seasonal food source for summer flounder and winter flounder. Seasonal in-water work restrictions in areas suitable for horseshoe crab spawning from April 15 to July 15 minimize adverse effects to this prey species. Shellfish are also prey species for a number of federally managed fish including bluefish, scup, skates, summer flounder, windowpane and winter flounder. Site design and placement of the NNBFs should include an evaluation of shellfish

resources in the project area; NNBFs should not be placed in areas of moderate to high densities of shellfish.

Tidal flushing and access to tidal marsh fringe habitat are important to maintain estuarine and marsh community dynamics; impediments to marsh edge habitat may therefore impact EFH for federally managed species, including winter flounder and summer flounder. Seven rock sills, approximately 350 lf to 2000 lf, are proposed in the Edgemere and Arverne subreaches. The individual sills as proposed appear to be of solid construction, with gaps between each sill but no gaps (vents/windows) within the sills. Vents/windows provide a number of benefits, including facilitating transport of plankton, nekton, sediment and nutrients into aquatic food webs that include federally managed species, diadromous fishes, and other important prey for federally managed species. These openings should generally be 10-15 feet in width, as measured from the bottom, and spaced evenly across the sill (e.g., one every 100 feet). Rock sills without vents/windows placed at regular intervals can severely restrict biological functions and impact the marsh community. Additionally, though rare, displacement of sills either as a whole or as individual elements is a concern in highly dynamic environments.

All living shorelines must be properly maintained, which may require periodic repair of sills/reefs. A long-term maintenance plan should be developed for the proposed NNBFs, including plans to address the potential migration of hardened materials/structures. As we continue to coordinate on this project and plans are developed, information on incorporation of vents/windows and dropdowns into the sill design, overall wetland design, invasive species management, and monitoring, maintenance, and long-term stewardship of the NNBFs should be provided to us.

<u>Essential Fish Habitat Conservation Recommendations</u>

Pursuant to Section 305 (b) (4) (A) of the MSA, we offer the following EFH conservation recommendations to minimize adverse effects to EFH for summer flounder, bluefish, windowpane, little skate and other federally managed species:

Atlantic Shorefront

1. Coordinate with our office to determine impacts of dredging in the borrow area to longfin inshore squid EFH. If warranted, we will provide you with additional EFH conservation recommendations to address impacts to longfin inshore squid as information becomes available. We will work with you to incorporate conservation recommendations into the initial construction or subsequent maintenance dredging events.

2. Reinitiate consultation prior to each dredging event. Notification should be provided to our office prior to commencement of each dredging event and should include the location of the segment to be nourished, volume of sand to be dredged, depth of sand to be removed and the boundaries of the dredging within the borrow area.

3. Design and undertake dredging within the borrow areas in a manner that maintains geomorphic characteristics of the borrow area. Employ best management practices such as not dredging too deeply and leaving similar substrate in place to allow for benthic community recovery.

4. Incorporate MAFMC policies on sand mining and beach nourishment into the final design of this project and its long-term management plan as practicable.

5. Avoid areas of high surf clam densities within the borrow area. To ensure that impacts to surf clams are minimized, the borrow areas should be surveyed prior to each dredging cycle and areas of high densities should be avoided. Copies of the shellfish survey results should also be provided to us prior to any dredging in the borrow area.

6. Avoid turning on the intakes on the dredge plant until the dredge head is in the sediment and turn off before lifting out of the sediment to minimize larval entrainment in the dredge.

7. Provide annual reports to us on the acres of borrow area disturbed, dredging location, cubic yardage removed, depth of removal and post-dredging bathymetry of the borrow area.

8. Avoid beach renourishment activities in East Rockaway Inlet from November 15 to December 31 (winter flounder) and March 1 to May 31 (river herring) of each year to maintain access to estuarine and freshwater spawning habitats. At other times of the year, at least 50 % of the channel should remain unobstructed to allow ingress and egress of these species.

9. Use best management practices to minimize the release of suspended sediments during beach nourishment activities, including placing the material above the spring high tide line at low tide where possible and using turbidity barriers where feasible.

Jamaica Bay HFFRRF

10. Avoid construction of NNBFs below mean low water (MLW) from January 1 to May 31 of each year to minimize impacts to EFH for winter flounder. Work is permissible above MLW when the work area is exposed during low tide cycles.

11. Avoid construction of NNBFs from April 15 to July 15 of each year to protect horseshoe crab spawning habitat.

12. NNBFs should not be placed in areas of moderate to high shellfish density as practicable.

13. Incorporate vents/windows and dropdowns into rock sill design according to best management practices. Sills should be designed to optimize tidal flow and to ensure that horseshoe crabs do not get trapped behind them.

14. Provide design plans for tidal wetland creation/restoration and enhancement as well as monitoring, maintenance, adaptive management and long-term stewardship plans to us for review prior to construction.

15. Continue to coordinate with us during the Preconstruction, Engineering and Design Phase of the project.

Please note that Section 305 (b)(4)(B) of the MSA requires you to provide us with a detailed written response to these EFH conservation recommendations, including the measures adopted by you for avoiding, mitigating, or offsetting the impact of the project on EFH. In the case of a response that is inconsistent with our recommendations, Section 305 (b)(4)(B) of the MSA also indicates that you must explain your reasons for not following the recommendations. Included in such reasoning would be the scientific justification for any disagreements with us over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate or offset such effect pursuant to 50 CFR 600.920 (k). Please also note that a distinct and further EFH consultation must be reinitiated pursuant to 50 CRF 600.920 (j) if new information becomes available, or if the project is revised in such a manner that affects the basis for the above EFH conservation recommendations.

Endangered Species Act

Atlantic Large Whales

Federally endangered North Atlantic right and fin whales occur year round off the New York coast in the Atlantic Ocean. Right whales are most likely to occur in the offshore borrow areas between November and April and fin whales are most likely to occur between October and January. Right whales feed on copepods and could be foraging in the action area if suitable forage is present; right whales are also likely to occur in the action area while migrating along the Atlantic coast. Fin whale sightings off the eastern United States are centered along the 100m isobath, but fin whales are well spread out over shallower and deeper water, including submarine canyons along the shelf break (Kenney and Winn 1987; Hain et al. 1992). Fin whales feed on small schooling fish, squid, and crustaceans, including krill. Sperm and sei whales are limited to the offshore area beyond the continental shelf.

Sea Turtles

Four species of ESA listed threatened or endangered sea turtles under our jurisdiction are seasonally present off the New York coast in the Atlantic Ocean and could occur in the Rockaway Inlets and Jamaica Bay: the threatened Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead, the threatened North Atlantic DPS of green, and the endangered Kemp's ridley and leatherback sea turtles. Sea turtles typically occur along the Long Island coast from May to mid-November, with the highest concentration of sea turtles present from June through October.

Atlantic Sturgeon

Atlantic sturgeon are present off the New York coast in the Atlantic Ocean and could occur in the Rockaway Inlets and Jamaica Bay. The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPS of Atlantic sturgeon are endangered; the Gulf of Maine DPS is threatened. Adult and subadult Atlantic sturgeon originating from any of these DPSs could occur in the proposed project area. As young remain in their natal river/estuary until approximately age 2, and early life stages are not tolerant of saline waters, no eggs, larvae, or juvenile Atlantic sturgeon will occur within the waters off the New York coast in the Atlantic Ocean or in the Rockaway Inlets and Jamaica Bay.

Shortnose Sturgeon

Shortnose sturgeon are not expected to be present in waters south of Long Island.

As project details develop, we recommend you consider the following effects of the project on whales, sea turtles, and sturgeon:

- For any impacts to habitat or conditions that temporarily render affected water bodies unsuitable for the above-mentioned species, consider the use of timing restrictions for in water work.
- For activities that increase levels of suspended sediment, consider the use of silt management and/or soil erosion best practices (i.e., silt curtains and/or cofferdams).
- Consider the related effects to water quality after an outfall is built (i.e. , will the standards still be met, will the effluent volume change, and will there be any effects to the species).
- For pile driving or other activities that may affect underwater noise levels, consider the use of cushion blocks and other noise attenuating tools to avoid reaching noise levels that will cause injury or behavioral disturbance to sea turtles, and sturgeon - see the table below for more information regarding noise criteria for injury/behavioral disturbance in sturgeon or sea turtles.

Organism	**Injury**	**Behavioral Modification**
Sturgeon	206 dB re 1 µPaPeak and 187 dB cSEL	150 dB re 1 µPaRMS
Sea Turtles	180 dB re I µPaRMS	166 dB re I µPaRMS

Depending on the amount and duration of work that takes place in the water, listed species of whales, sea turtles, and sturgeon may occur within the vicinity of your proposed project. The Corps will be responsible for determining whether the proposed action may affect listed species. If you determine that the proposed action may affect a listed species, you should submit your determination of effects, along with justification and a request for concurrence to the attention of the Section 7 Coordinator, NMFS, Greater Atlantic Regional Fisheries Office, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930 or nmfs.gar.esa.section7@noaa.gov Please be aware that we have recently provided on our website guidance and tools to assist action agencies with their description of the action and analysis of effects to support their determination. See http://www.greateratlantic.fisheries.noaa.gov/section7. After receiving a complete, accurate comprehensive request for consultation, in accordance to the guidance and instructions on our website, we would then be able to conduct a consultation under section 7 of the ESA. Should project plans change or new information become available that changes the basis for this determination, further coordination should be pursued. If you have any questions regarding these comments, please contact Edith Carson-Supino (978-282-8490; Edith.Carson- Supino@noaa.gov).

We look forward to our continued coordination with your office on this project as it moves forward. We can work with your staff to complete a programmatic consultation for the beach replenishment portion of the project to reduce the need for individual consultations. If you have any questions or need additional information, please do not hesitate to contact Ursula Howson at ursula.howson@noaa.gov or (732) 872-3116.

Sincerely,

a_Q___

Louis A. Chiarella,
Assistant Regional Administrator
for Habitat Conservation

cc:
ACOE- C. Alcoba, D. Mezey
PRO - D. Marrone, E. Carson-Supino
FWS - S. Sinkevich
EPA - D. Montella
NYSDEC- D. McReynolds
NEFMC - T. Nies
MAFMC - C. Moore
ASMFC - L. Havel

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APPENDIX I

New York State Department of Environmental Conservation's Comments on Draft Fish and Wildlife Conservation Act Report

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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December 5, 2018

Kerri Dikun
Fish and Wildlife Biologist
USFWS - Long Island Field Office
340 Smith Road
Shirley, NY 11967

Dear Ms. Dikun:

Thank you for providing the New York State Department of Environmental Conservation (the Department) the opportunity to review the U.S. Fish and Wildlife Services' (Service) Draft Fish and Wildlife Coordination Report for the *Atlantic Coast of New York, East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study.*

The Department shares the Services' endorsement of the proposed project, provided that the Services' recommendations regarding additional surveys to further delineate and quantify potential impacts to the aquatic and shoreline environment, as well as its recommendations to minimize impacts to sensitive natural resources and to compensate to the fullest practicable extent for any unavoidable impacts to these resources are followed.

We look forward to working with the Service and the U.S. Army Corps of Engineers to achieving the project objectives while preserving and perhaps enhancing the State's valuable natural resources.

Sincerely,

Ken Scarlatelli
Regional Natural Resources Supervisor

cc: Daria Mazey, USAGE
Pete Weppler, USAGE
Matt Cheblus, NYSDEC