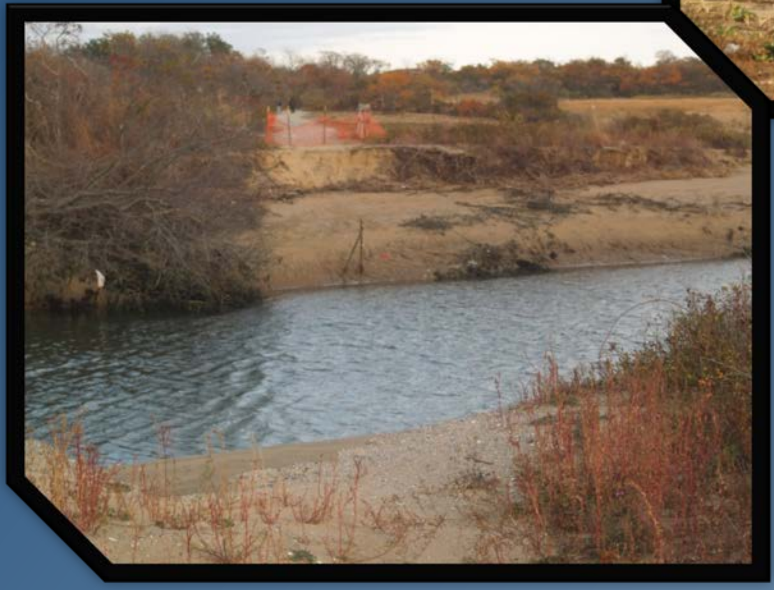
Gateway National Recreation Area
Jamaica Bay Unit
Jamaica Bay Wildlife Refuge

National Park Service
U.S. Department of the Interior

Jamaica Bay Wildlife Refuge West Pond Trail Breach Repair Environmental Assessment



October, 2015

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United States Department of the Interior
National Park Service
Gateway National Recreation Area
Jamaica Bay Wildlife Refuge West Pond Trail Breach Repair Environmental Assessment
October 2015

The National Park Service (NPS) at Gateway National Recreation Area has prepared this environmental assessment to analyze the effects of repairing the breach, restoring and improving the ecological resources and improving and maintaining a more resilient trail system at West Pond. The purpose of the project is to plan for environmentally sensitive and resilient conditions along the West Pond loop trail that support a diversity of Jamaica Bay habitats, wildlife, and enhanced visitor experiences. This document has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA); regulations of the Council on Environmental Quality (CEQ) (40 CFR 1500-1508); and NPS Director's Order #12: *Conservation Planning, Environmental Impact Analysis, and Decision-Making* and accompanying DO-12 Handbook (2001).

Four alternatives were analyzed for meeting the objectives of the plan: the no action alternative and three action alternatives based on preliminary conceptual designs, described as follows:

Alternative A, No Action / Continue Current Management: No additional measures would be taken to alter the state of the primary or secondary breached areas or the integrity of the berm over time. Natural processes would proceed uninhibited. The breach sites and berm would be monitored for safety. Salinity levels in West Pond would remain similar to those in Jamaica Bay and wetland conditions and species composition would continue to shift in response. The loop trail around the pond would remain interrupted by the primary breach.

Alternative B, Repair the Breach and Improve Habitat Conditions, the NPS Preferred Alternative: Alternative B would emphasize repair of the primary and secondary breaches and the subsequent restoration of West Pond and the loop trail. This alternative would also include replacing the water control structure, possible installation of a groundwater well or municipal water source, use of best management practices to improve seasonal use by wildlife, and opportunities for natural resource-based recreation such as birding and walking, and improved interpretive activities. Alternative B would be implemented in phases, with phase 1 addressing filling and repairing the primary and secondary breaches, replacing the water control structure, the possible installation of a supplemental water supply system (either groundwater or municipal water) to provide freshwater to the pond, and restoring the West Pond loop trail. An additional option would be to rely solely on natural precipitation and runoff to be the water source to provide freshwater to the pond. Future phases of work would include upland habitat restoration at Terrapin Point, shoreline and saltmarsh restoration to increase resiliency against potential future storm damage, and installation of other visitor amenities, such as boardwalks, trails, pathways, viewing blinds, and educational signage.

Alternative C, Create Different Types of Habitat: Alternative C would entail reconfiguring the site to construct a new berm further inland thereby establishing a smaller, more inland West Pond and converting Terrapin Point into an island. The new configuration would create a mosaic of wetland and upland habitat types to support a diversity of species across the study area. This alternative would also include installing a freshwater source supplied by groundwater and water control structure within the newly reconfigured West Pond. Best management practices would be used to control the growth of invasive plant species and monitor site conditions. A new trail system would be created around the newly established West Pond and around Terrapin Point with opportunities for recreation and education.

Alternative D, Bridge the Breach: Under alternative D, the primary breach would be bridged to restore the loop trail around West Pond and the banks of the primary and secondary breaches would be stabilized. Two different structures to span the breach would be considered, a steel truss bridge or a box culvert, both of which would continue to allow for tidal conveyance within West Pond. As a result, salinity levels in West Pond would remain similar to those in

Jamaica Bay and wetland conditions and species composition would continue to shift in response.

PUBLIC COMMENT

If you wish to comment on the environmental assessment, you may mail comments to the name and address below or post comments online at http://parkplanning.nps.gov/gate. This environmental assessment will be on public review for 30 days. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. Although you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Please address written comments to:

Jennifer T. Nersesian, Superintendent

Office of the Superintendent
Gateway National Recreation Area
Attn: Jamaica Bay Wildlife Refuge West Pond EA
210 New York Avenue
Staten Island, NJ 10305

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CHAPTER 1: PURPOSE AND NEED

The National Park Service proposes to repair the breached berm and damaged trail at West Pond, Jamaica Bay Wildlife Refuge. In October, 2012 Hurricane Sandy affected 24 states from Florida to New England causing billions of dollars of damage to property. Its storm surge hit New York City on October 29. Between October 26 and 30, 2012, President Obama issued major disaster declarations in the States of New Hampshire, New York, and Connecticut. This declaration entitles eligible projects to receive relief through the Emergency Relief for Federally Owned Roads program, which supports federal response to disasters and emergencies. Established in 1977, the mission for the Emergency Relief for Federally Owned Roads program is to provide funding and engineering services to restore access to public lands. This project is being conducted by the National Park Service (NPS) in cooperation with the Federal Highway Administration (FHWA) Eastern Federal Lands Highway Division (EFLHD).

The NPS proposes to address the breached berm and damaged trail at West Pond. This project is located within the Jamaica Bay Wildlife Refuge (refuge), which is within the Jamaica Bay Unit of Gateway National Recreation Area. Damaging winds and storm surge from Hurricane Sandy breached both West Pond and East Pond, which are both located within the refuge. East Pond was quickly repaired by the Transit Authority as part of its efforts to restore train service to the Rockaways. West Pond remains breached and the resulting sea water inundation has increased the salinity, created tidally influenced conditions, and changed habitat composition within the pond. West Pond comprises approximately 44 acres and is approximately 3 to 4 feet deep. The West Pond loop trail, which lies along the top of the berm encircling the pond, was breached and other portions of the trail were damaged. West Pond provides opportunities for recreation, scenic vistas, and birding along the self-guided trail and the nearby visitor center provides opportunities for visitor orientation and environmental education.

This environmental assessment evaluates four alternatives to address the damages to West Pond and the trail; a no-action alternative and three conceptual design action alternatives (alternatives B, C, and D). The environmental assessment further analyzes the potential impacts these alternatives would have on the natural and human environment. This environmental assessment has been prepared in accordance with the requirements of the National Environmental Policy Act of 1969 and its implementing regulations (40 CFR 1500-1508), and NPS Director's Order #12, *Conservation Planning, Environmental Impact Analysis, and Decision-Making* and accompanying DO-12 Handbook (2001).

PURPOSE OF AND NEED FOR ACTION

The purpose of this project is to provide for environmentally sensitive and resilient conditions along the West Pond loop trail that support a diversity of Jamaica Bay habitats, wildlife, and enhanced visitor experiences.

The proposed project is needed for the following reasons:

- Conditions in the area around the breach and the portion of West Pond loop trail that previously crossed the embankment (berm) are not currently safe for public access.
- The existing breached condition is vulnerable to reoccurring storm activity and susceptible to future damage from erosion.
- The West Pond loop trail has typically provided opportunities for access by visitors from near and far to view wildlife, enjoy the bay, and learn about the resources in an urban area

where these opportunities are limited. The breach in the berm limits access to portions of the trail and prevents visitors from walking all the way around the pond.

- The refuge does not currently provide habitat to support a diversity of species in an environment that is resilient by sustainable means.

An environmental assessment is needed to evaluate the environmental impacts of addressing damages to the West Pond caused by Hurricane Sandy at the refuge within the Jamaica Bay Unit of Gateway National Recreation Area.

GOALS AND OBJECTIVES

The project goal is to provide for environmentally sensitive and resilient conditions along the West Pond loop trail that support a diversity of Jamaica Bay habitats, wildlife, and enhanced visitor experiences.

Objectives are specific statements of purpose; they describe what must be accomplished, to a large degree, for the project to be considered a success. The following objectives were identified for this project:

- Provide habitat that supports a diversity of species.
- Contribute toward a healthy, productive, and biologically diverse ecosystem.
- Promote environmental education and interpretation that supports appropriate visitor use and recreational opportunities.
- Improve resiliency and protection of the West Pond berm and trail against future storm damage.

STUDY AREA DESCRIPTION

Gateway National Recreation Area, established in 1972, consists of three administrative units: Staten Island, Sandy Hook, and Jamaica Bay. The refuge is located within the Jamaica Bay Unit. The Jamaica Bay Unit is one of the largest expanses of open space in the region, consisting of over 19,000 acres of land, bay, and ocean waters within the densely populated and urban areas of Brooklyn and Queens, New York.

This entire Jamaica Bay Unit is located within the Jamaica Bay watershed. The Jamaica Bay watershed is located at the southwestern tip of Long Island. It falls within the broader Atlantic Ocean/Long Island Sound watershed, which consists of approximately 91,000 acres (142 square miles) and includes portions of Brooklyn, Queens, and Nassau County, New York. This watershed is one of seventeen watersheds within the state of New York. Jamaica Bay itself encompasses approximately 13,000 acres ranging from brackish to saline conditions with an average depth of 13 feet and a tidal range of about 4.9 feet. The center of the bay is dominated by sub-tidal open water and extensive low-lying islands composed of saltmarsh, tidal flats, mudflats, and adjacent uplands.

Within Jamaica Bay, the refuge encompasses approximately 9,000 acres that include a portion of the bay itself, several islands, two brackish ponds (East Pond and West Pond –now breached), trails, and a visitor center. The refuge is composed of saltmarsh, natural inlets, grassy hassocks, sand dunes, small beaches, and upland habitats. It is located along the Atlantic flyway and is a significant bird sanctuary with sightings of over 300 species of songbirds, shorebirds, and waterfowl over the last 30 years. Shoals, bars, and mud flats provide habitat for a number of small mammals, reptiles, and amphibians. The refuge provides opportunities for recreation, scenic vistas, birding, visitor orientation, environmental education, national recreation area maintenance, and ranger operations. West Pond is one of the few places within the greater New York City metropolitan area that visitors can easily access the refuge.

The study area includes West Pond and the surrounding area west of the visitor center (see figure 1 below). West Pond is located on the Broad Channel island within the refuge and is about 0.7 mile north of the town of Broad Channel, about 3 miles north of the Atlantic Ocean, about 4.5 miles south of the Belt Parkway, and less than 3 miles southwest of JFK International Airport (figure 2). Cross Bay Boulevard bisects the island and provides access to West Pond and the refuge. The most prominent manmade features of the refuge, East and West Ponds, are located east and west of the roadway, respectively. The majority of the island is located in Queens (Queens County), New York, but the extreme western edge, including a portion of West Pond, is located in Brooklyn (Kings County).

Facilities in the study area include trails around West Pond, a visitor center, gardens, and viewing areas with benches. West Pond was approximately 44 acres and approximately 3 to 4 feet deep prior to Hurricane Sandy. West Pond was breached during Hurricane Sandy, allowing waters from Jamaica Bay to flow unabated into the pond thereby changing habitat conditions in and around the pond. The east and west banks of the breach continue to erode with tidal and storm activity.

HISTORY AND SIGNIFICANCE OF GATEWAY NATIONAL RECREATION AREA AND JAMAICA BAY WILDLIFE REFUGE INCLUDING WEST POND

The area known as Jamaica Bay Wildlife Refuge was established in the 1950s and was owned and managed by New York City. Robert Moses, former Commissioner of the New York City Parks Department (1934-1960), with aid from the U.S. Fish and Wildlife Service, surveyed Jamaica Bay in 1951 to further plans for a bird sanctuary and park with breeding ponds in the bay. In 1954, the New York City Parks Department partnered with the New York State Conservation Department to establish Jamaica Bay Bird Sanctuary. East and West Ponds were constructed in 1954 to provide attractive feeding habitat and freshwater plants for birds in Jamaica Bay (NPS 2014b). West Pond was created in the center of the refuge when dikes were built on the west side of Rulers Bar Hassock (figure 3).

Sparked by environmental and recreational movements of the 1960s, national recreation areas were designed and developed to provide space for a variety of recreational activities, while protecting natural and cultural resources. In 1972, legislation gave control of the sanctuary to the NPS as part of the newly formed Gateway National Recreation Area. The refuge became actively operated by the NPS in 1974. Gateway National Recreation Area was one of the first urban national recreation areas established by the NPS (NPS 2014b).

Special mandates in the national recreation area's enabling legislation include conservation and management of wildlife and natural resources in the Jamaica Bay Unit. This mandate states that the Secretary shall administer and protect the islands and waters within the Jamaica Bay Unit with the primary aim of conserving the natural resources, fish, and wildlife located therein and shall permit no development or use of this area that is incompatible with this purpose (NPS 2014a). The refuge has been a significant birding destination for local and international visitors.

The West Pond area within the refuge contains an assemblage of coastal ecosystems that includes estuary, bay, and maritime uplands. Habitats that comprise these ecosystems, so rare in such a highly developed area, support a rich biota that includes migratory birds, marine finfish, and shellfish; plant communities; and rare, threatened, and endangered species. These features provide opportunities to restore, study, enhance, and experience coastal habitats and ecosystem processes (NPS 2014a).

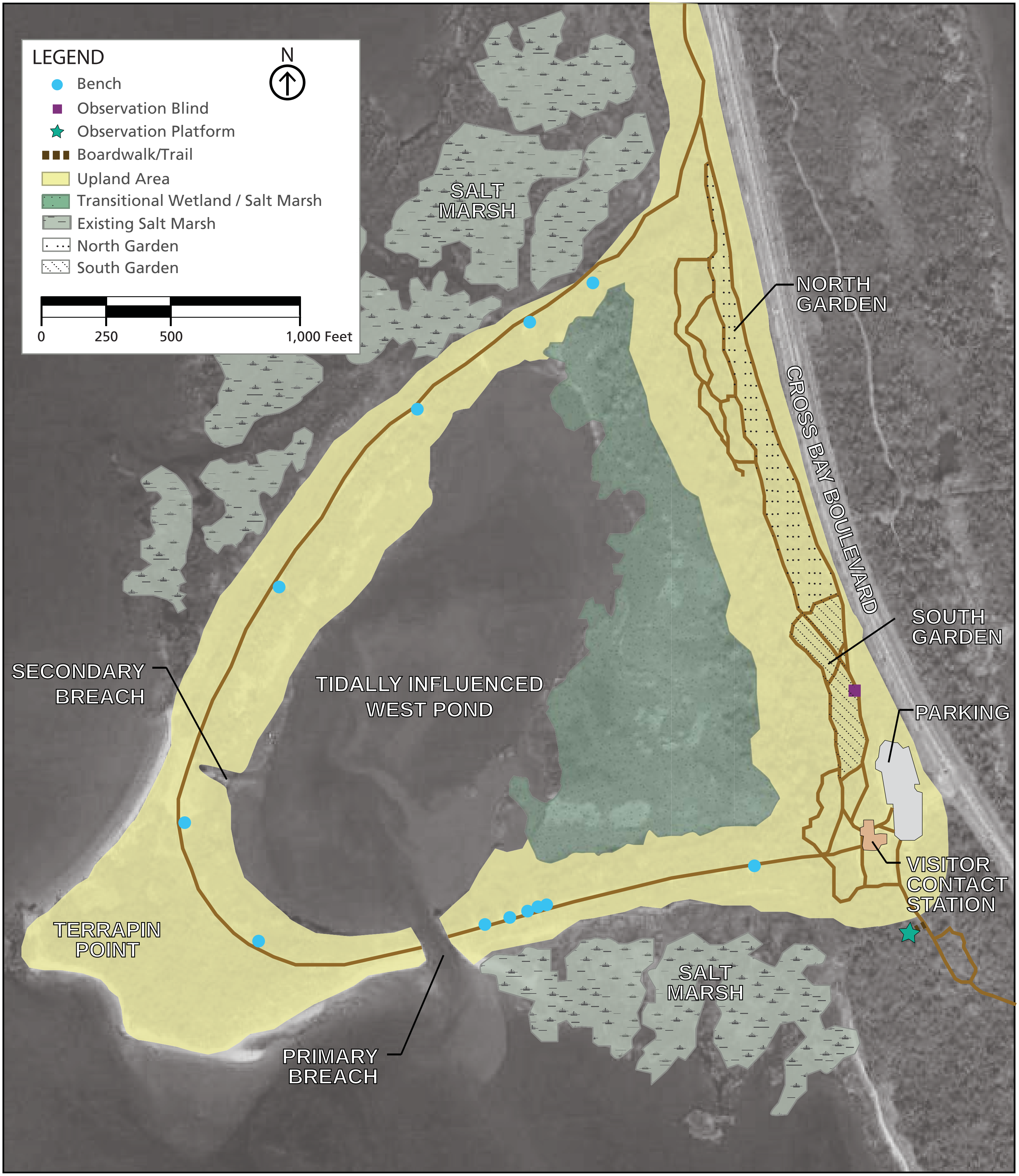

FIGURE 1: WEST POND STUDY AREA

Gateway National Recreation Area

United States Department of the Interior / National Park Service

Figure 2: Gateway National Recreation Area and the Jamaica Bay Wildlife Refuge Map

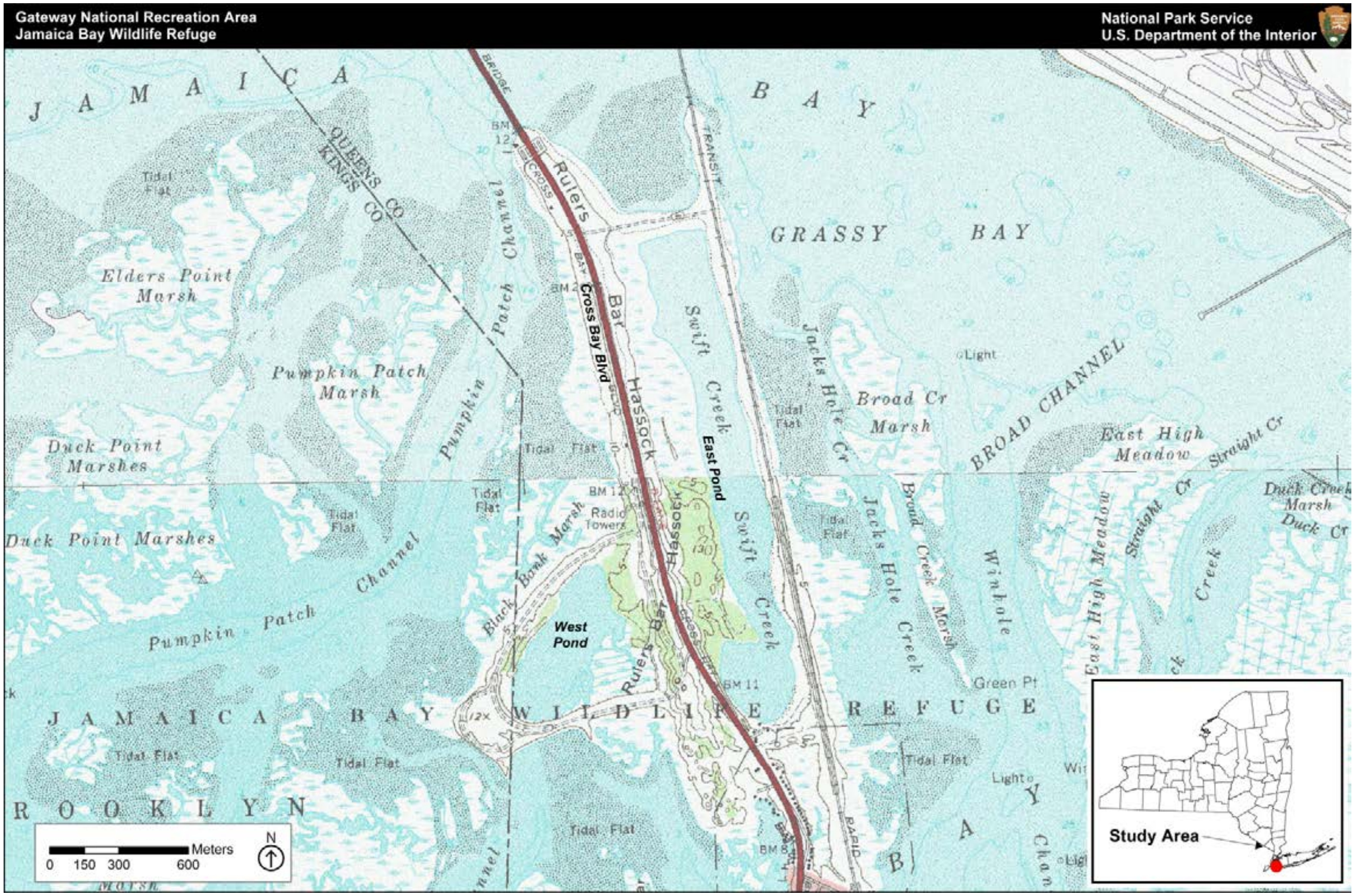

Figure 3: West Pond and East Pond Area, Jamaica Bay Wildlife Refuge
(Source: USGS 7.5 Minute Topographic map, Far Rockaway and Jamaica Quadrangles, New York 1999)

PLANNING ISSUES AND IMPACT TOPICS

ISSUES SELECTED FOR DETAILED ANALYSIS

During public scoping and the initial phases of the proposed project, the NPS identified critical issues that could affect project development. These issues describe environmental problems or relationships between a resource or national recreation area function and an action. Together with the purpose and need, these issues guided the development of the conceptual design alternatives. Preliminary issues identified include the following:

- Speed of restoration efforts –Concern was expressed regarding how much time has passed since Hurricane Katrina and the desire for an alternative that can be implemented quickly.
- Wildlife habitat concerns:
  - Decline in species diversity – A lack of freshwater habitat and an increase in invasive vegetation species has resulted in a decline in species diversity at West Pond.
  - Disturbance to birds at West Pond– To reduce human disturbance to birds at West Pond, the NPS considered an alternate walkway material to reduce noise, installation of observation blinds, and limited access in certain areas at West Pond.
- Visitor use and experience concerns:
  - A loss of recreational resources – Two important user groups have been negatively affected by the breach: bird watchers and walkers.
  - Safety concerns regarding the breach – Visitors walking down to the edge of the breach, including young children, could fall into the water.
- NPS management and maintenance of West Pond – Public scoping expressed a desire for increased management to monitor and control salinity levels in West Pond and to address invasive vegetation species.
- Sustainability of restoration efforts – Public scoping identified a need for the water control structure to be replaced to enable managers to seasonably control water levels within the pond and in response to a change in conditions resulting from future storm events.
- Local business concerns - The reduced visitation rates at West Pond post-Sandy have the potential to reduce area business use that can be attributed to non-local visitors.

IMPACT TOPICS

Impact topics are derived from the issue statements, federal laws, regulations, executive orders and NPS *Management Policies 2006* (NPS 2006) and are used to analyze the degree to which a resource or national recreation area function would be affected by a proposed action.

Impact Topics Retained for Analysis

Impact topics identified and analyzed in this environmental assessment are listed below along with reasons for their selection. Each impact topic is further discussed in detail in “Chapter 3: Affected Environment and Environmental Consequences.”

Soils and Sediment. Hurricane Sandy created a breach in the berm that surrounds West Pond. Soils are eroding at the breach, and in the vicinity of a secondary breach along the northern berm at West Pond. Sediment distribution patterns subsequent to the breach are tidally influenced. Many of the actions proposed in this environmental assessment would involve ground-disturbing activity. There is the potential for soil erosion associated with this activity and for changing soils and sediment conditions in the vicinity of construction activity. Proposed site activities would not alter geologic features; however, substantial surface disturbance could occur under some of the alternatives. Therefore, soils and sediment were retained as an impact topic for analysis.

Water Resources. Many actions proposed in this environmental assessment would involve ground-disturbing activity and the associated potential for soil erosion and stormwater runoff. Erosion and sediment control measures and best management practices would be used to address runoff but there is the potential for water resources in Jamaica Bay and West Pond to be impacted. Changes to the salinity levels in West Pond have occurred as a result of the breach caused by Hurricane Sandy. Public concern was raised with regard to the desire for the NPS to control water levels in West Pond. Individuals also expressed the desire for freshwater ponded conditions to be established, that would change water quality parameters in the pond. The NPS will determine the quality of park surface and groundwater resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside the national recreation area as stated in NPS *Management Policies 2006* (NPS 2006). Therefore, this impact topic was retained for analysis.

Wetlands and Floodplains. According to Federal Emergency Management Agency flood insurance rate maps (community panel number 3604970377F), West Pond falls within a special flood hazard area subject to inundation by the 1% annual chance flood. Additionally, wetlands occur within the proposed project area. These wetland areas were delineated and considered during planning and preliminary design of alternatives. Best management practices would be followed during implementation of the proposed actions, these actions could alter estuarine habitat conditions at West Pond. The public expressed the desire to restore the near freshwater conditions at West Pond and improve freshwater habitat conditions. The NPS will comply with the provisions of Executive Order 11988 (Floodplain Management) and NPS Director’s Order #77-2 (see chapter 4). A floodplain statement of findings was written in compliance with these orders and is included in appendix A. The NPS will comply with the provisions of Executive Order 11990 (Protection of Wetlands) and NPS Director’s Order #77-1 (see chapter 4). A wetlands statement of findings was written in compliance with these orders and is included in appendix B. Because of the potential impacts, wetlands and floodplains will be further assessed.

Vegetation. The NPS strives to maintain all components and processes of naturally evolving park unit ecosystems, including the natural abundance, diversity, and ecological integrity of plants (NPS 2006). Some actions proposed in this environmental assessment could require clearing existing vegetation and establishing newly vegetated areas. Construction activity could also damage some vegetation, or compress soils that would in turn affect vegetation. There is also the potential for proposed actions to alter salinity levels and ecological conditions that could affect the types of vegetation around the pond. Proposed changes in ponded conditions and associated vegetation would also affect the health and diversity of wildlife species in and around West Pond. Public concerns were also raised with regard to controlling invasive vegetation species. Therefore, vegetation is addressed as an impact topic in this environmental assessment.

Wildlife and Special Status Species. West Pond falls within the Atlantic migratory flyway. Wetland areas at West Pond provide habitat and a resting place for some of these birds. While West Pond is not a breeding area for any federally listed species, state-listed species of concern are known to be present. A number of wildlife and habitat concerns were voiced during public scoping, including the need to address the decline of species diversity that resulted from the breach of West Pond and lack of freshwater habitat in the area that is essential for birds and other wildlife. As stated in the refuge Natural Resources Maintenance Plan within the 1981 *Final Resources Management Plan*, "practices aimed at improving habitat quality for native species will occur. Direct management of the natural resource will consist primarily of protection and allowing natural processes to occur. However, because much of the refuge's area on Rulers Bar Hassock is man-made and not "natural" in the purest sense, management activities will maintain these areas for maximum wildlife diversity."

A range of alternatives were developed to address these concerns and maintenance objectives for the refuge. Alternatives developed would consider replacing the water control structure to manage both salinity and water surface levels to improve species diversity at West Pond. Implementing the alternatives would cause temporary disturbance or displacement of wildlife during construction activity. Salinity levels could also be altered that would shift ecological conditions supporting fish and wildlife. Because of the potential to impact wildlife and special status species, this impact topic was retained for further assessment.

Visitor Use and Experience and Scenic Resources. The refuge and the West Pond area provide access and opportunity for outdoor recreation, wildlife viewing, interpretation, and scenic observation, which are unique values in such an urban environment. As visitors near the breach and Terrapin Point, views of Jamaica Bay and the pond become fully visible, however since Hurricane Sandy access has been diminished. The West Pond trail is mostly flat, provides an easy walk for most visitors, and therefore serves multiple user groups, including birders, photographers, educational groups, and walkers. A portion of West Pond loop trail on the berm was breached and damaged by Hurricane Sandy and as such visitors are no longer able to walk the 1.6-mile loop trail around the pond, and instead must retrace their steps on the 0.3 mile or 1.3 mile sections. As such, much of the current visitation is concentrated in the 0.3 miles between the visitor center and the breach. The public has voiced their desire to "fix the trail around the pond." Due to conditions of the West Pond trail and the pond itself, the number of visitors has decreased since Hurricane Sandy. Public safety associated with pedestrian access and trail use is also a concern due to trail erosion at the edge of the breach. During scoping, the public expressed a need for additional access to view birds and wildlife in terms of improved vantage points for viewing wildlife and trail conditions more conducive to wildlife viewing.

Actions proposed in this environmental assessment could alter trail configurations, viewing access, habitat conditions, opportunities for education, visitor experience, and scenic resources in the area surrounding West Pond. In addition, temporary closures to the area during construction could affect visitor use and experience. Therefore, visitor use, experience, and scenic resources are addressed as an impact topic in this environmental assessment.

Socioeconomics. The refuge has played a significant role in the greater New York area as an important national and international birding destination. The refuge offers varied opportunities for respite from the busy urban community surrounding this unit of Gateway National Recreation Area. There could be localized effects during construction under some of the proposed actions. The action alternatives would provide beneficial effects to the local economy. Socioeconomics is included for further assessment because of the potential effects of visitor spending on local communities.

Impact Topics Dismissed from Further Analysis

This section explains why some impact topics were not evaluated in more detail. Impact topics were dismissed from further evaluation either because the resource does not occur in the area or because implementing the alternatives would have only slight impacts on the resource or value.

Cultural Resources. No ethnographic resources or sacred sites have been identified within the national recreation area, and therefore these resources were dismissed from further consideration.

Museum collections would be unaffected by implementing any of the alternatives. Surveys completed in support of the proposed action did not yield any museum objects that would require accessioning or cataloguing. Therefore, museum collections were not further analyzed as an impact topic.

No previously identified archaeological sites were identified in the area of potential effect for the project. Archival research indicates that the area has limited potential to contain intact archaeological resources due to prior disturbance from the creation of West Pond and other filling on Rulers Bar Hassock within the wildlife refuge. Should construction unearth previously undiscovered archeological resources, work would cease in the area of any discovery and the national recreation area cultural resources specialist would be contacted. Consultation with the New York State Historic Preservation Officer would be conducted in accordance with 36 CFR§ 800.13, Post Review Discoveries. Therefore, archeological resources was dismissed from further analysis.

Rulers Bar Hassock, the largest central island and developed portion of the refuge where West Pond is located, was evaluated as a cultural landscape for eligibility in the National Register of Historic Places. The landscape includes topographic, water, and vegetation features as well as the addition of furnishings and small structures to enhance visitor use. Due to lack of integrity, the NPS determined that the cultural landscape was not eligible for the National Register of Historic Places. In a letter dated September 18, 2014, the New York State Historic Preservation Office concurred. Therefore, cultural landscapes were dismissed from further analysis.

Within the area of potential effect, the only structure identified of sufficient age was a water control structure on the western side of West Pond. The structure was evaluated for eligibility as part of the Rulers Bar Hassock cultural landscape, and was determined to be not eligible for the National Register of Historic Places. The New York State Historic Preservation Office concurred with this determination in a letter dated September 18, 2014. Therefore, historic structures were dismissed from further analysis.

Indian Trust Resources. Indian trust assets are owned by American Indians but are held in trust by the United States. Requirements are included in the Secretary of the Interior's Secretarial Order 3206, "American Indian Tribal Rites, Federal–Tribal Trust Responsibilities, and the Endangered Species Act," and Secretarial Order 3175, "Departmental Responsibilities for Indian Trust Resources." No Indian trust assets occur within the Jamaica Bay Unit of Gateway National Recreation Area. Therefore, there would be no effects on Indian trust resources resulting from any alternative. Therefore, the topic was not retained for further analysis.

Ecologically Critical Areas or Other Unique Natural Resources. The proposed action and alternatives being considered would not affect any federally designated ecologically critical areas, wild and scenic rivers, or other unique natural resources, as referenced in the Wild and Scenic Rivers Act, NPS *Management Policies 2006*, 40 *Code of Federal Regulations* [CFR] 1508.27, or the 62 criteria for national natural landmarks. Coastal resources are addressed under floodplains, wetlands, and wildlife and wildlife habitat, including vegetation. West Pond falls within the Jamaica Bay Critical Environmental Area designated by the County of Queens, New York on February 1, 1990. The NPS would prepare a coastal zone consistency determination in accordance with the Coastal Zone Management Act as part of the decision making process for this project. In addition, as part of the decision making process, the NPS would coordinate appropriately for consistency with New York's coastal management policies. Therefore, the topic was not retained for further analysis.

Land Use. The proposed project would not interfere with plans or policies for the Jamaica Bay Unit, or the other units within Gateway National Recreation Area, other regional watershed management plans, or land use plans. The preferred alternative is consistent with the national recreation area's general management plan. Therefore, land use was dismissed from further analysis.

Energy Requirements and Conservation Potential. The NPS reduces energy costs, eliminates waste, and conserves energy resources by using energy-efficient and cost-effective technologies. Energy efficiency is incorporated into the decision making process during the design and acquisition of buildings, facilities, and transportation systems that emphasize the use of renewable energy sources. Under any alternative, the NPS would continue to implement its policies of reducing costs, eliminating waste, and conserving resources by using energy-efficient and cost-effective technologies (NPS 2006). The proposed alternatives would not appreciably change short- or long-term energy use or conservation practices. The fuel used during construction activities would not result in detectable changes in energy consumption at a local or regional level; therefore this impact topic was dismissed from further evaluation.

Environmental Justice. Executive Order 12898 *General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. Guidelines for implementing this executive order under the National Environmental Policy Act are provided by the Council on Environmental Quality. According to the U.S. Environmental Protection Agency (1998a), environmental justice is defined as:

> The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The goal of this "fair treatment" is not to shift risks among populations, but to identify potentially disproportionately high and adverse effects and identify alternatives that may mitigate these impacts.

Residents within the surrounding communities of the national recreation area are not disproportionately minority or low-income. The proposed actions and associated activities would not disproportionately affect low-income or minority populations. Therefore, this topic was dismissed from further consideration.

Prime and Unique Agricultural Lands. Prime farmland has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. Unique land is land other than prime farmland that is used for production of specific high-value food and fiber crops. Both categories require the land to be available for farming uses (Council on Environmental Quality 1980). The project area is located in an urban setting and much of the area is either pond or wetlands and is therefore not available for farming. Therefore, this impact topic was not further evaluated.

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CHAPTER 2: ALTERNATIVES

This chapter explores a range of reasonable alternatives and analyzes what impacts the alternatives could have on the natural and physical environment and the relationship of people with that environment. The action alternatives presented are conceptual level designs that present the principal elements of each concept and emphasize the physical and functional relationships throughout the project area. Each conceptual alternative is described in terms of habitat conditions, visitor experience, and sustainability and resiliency and how these characteristics would meet the purpose and need. Upon selecting a final alternative, the design process would continue and engineers would develop final designs and construction documents that would specify the full detail for implementing the selected alternative.

There are a variety of project components that would be implemented under all action alternatives, and these elements are described in the "Elements Common to All Action Alternatives" section below. In addition, this chapter describes the alternatives that were considered but dismissed from detailed analysis, identifies the NPS preferred and environmentally preferable alternatives, and provides a summary of the alternatives and their environmental consequences. Impacts associated with the alternatives are further described in "Chapter 3: Affected Environment and Environmental Consequences."

ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Under alternative A, no additional measures would be taken to alter the state of the primary or secondary breached areas or the integrity of the berm over time. Natural processes would proceed uninhibited. The breach sites and berm would be monitored for safety. Salinity levels in West Pond would remain similar to those in Jamaica Bay and wetland conditions and species composition would continue to shift in response. The loop trail around the pond would remain interrupted by the primary breach. This alternative would represent a continuation of current actions in the West Pond area without any modifications to water resource conditions, habitat enhancements, or marshland restoration.

HABITAT CONDITIONS

Under the no action alternative, there would be no substantial changes implemented at the West Pond area. The existing primary breach would remain open and would expand due to erosion, continuing the conveyance of tidal ebb and flow through the breach. The area identified as the secondary breach location would likely continue to erode and breach after a significant storm event (or series of events). The conveyance at the secondary breach location would likely resemble a channelized estuarine mudflat or low marsh. Other areas of the berm may erode over time and the sediment would be transported outward into Jamaica Bay or captured in tidal and intertidal estuarine mudflats and low marshes within the study area. Natural processes would proceed uninhibited. The West Pond basin would remain approximately 44 acres in size and salinity levels in the pond would be similar to those of Jamaica Bay. Wetland conditions and species composition would continue to shift in response to salinity levels and site conditions.

Management would include the continuation of wildlife research and evaluation and management of invasive vegetation in the vicinity of West Pond.

VISITOR EXPERIENCE

Under alternative A, infrastructure at the site would remain in use in its current condition and would include a one-way return trail out to the breach, a spur trail at the western end of the pond (to Terrapin Point), and a one-way return trail around the northwest portion of the former ponded area. Other types of visitor amenities, including benches (13), signage, and various viewing areas would remain in their current conditions and locations. Trail access could diminish as safety concerns arise due to changing conditions.

Management would include the continuation and implementation of educational and interpretive programs that inform the public about ecological processes and wildlife within the vicinity of West Pond. Cooperation with various partners and organizations, such as birding groups and The Nature Conservancy, would continue.

SUSTAINABILITY AND RESILIENCY

As stated above, under the no action alternative, the existing primary breach would remain open, continuing the conveyance of tidal ebb and flow through the breach. No additional measures would be taken to alter the state of the primary breached area or the integrity of the berm structure over time, and continued erosion would likely threaten adjacent trails and other facilities. Without any additional measures to increase resiliency, the area identified as the secondary breach location would likely continue to erode and breach after a significant storm event (or series of events). Over time, the landscape would continue to respond to changing conditions and other areas of the berm could begin to erode over time. The water control structure would remain abandoned in place and the NPS would not be able to manage water or salinity levels within West Pond. No other measures would be taken to increase resiliency against future storms. There would be minimal use of energy and materials over time. Additional measures would be required to monitor the berm and breach site to ensure safe conditions over time and the only modifications to the berm would be to address visitor safety concerns.

Management would include the coordination of activities such as educational and interpretive activities, enforcement of existing regulations to protect the resources within the West Pond area, and the management of facilities related to the trail and West Pond.

PRELIMINARY COST ESTIMATE

Estimated net construction cost for alternative A was not developed because the alternative would not include any planned additional construction.

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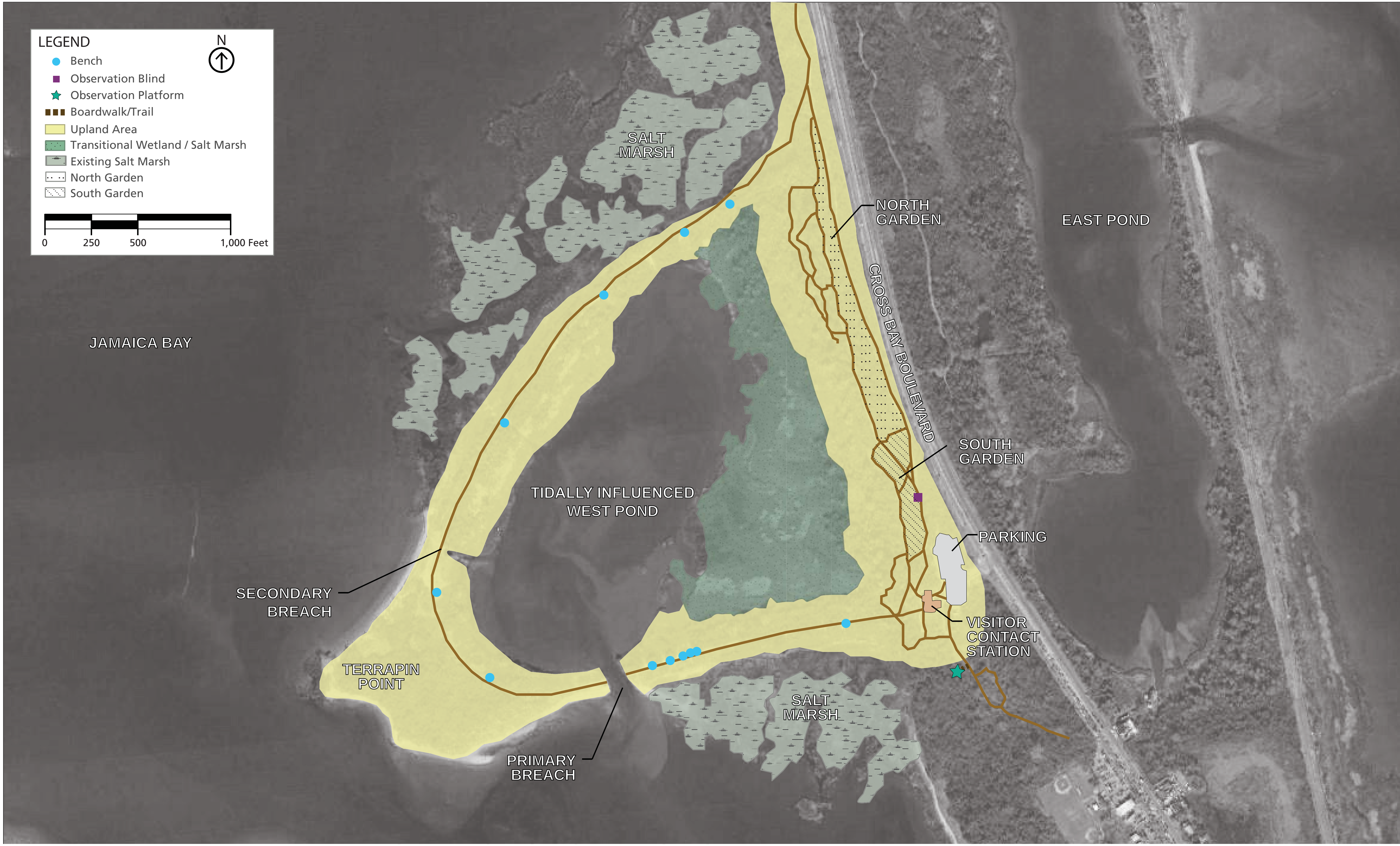

FIGURE 4: ALTERNATIVE A - NO ACTION / CONTINUE CURRENT MANAGEMENT

Gateway National Recreation Area

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ELEMENTS COMMON TO ALL ACTION ALTERNATIVES

The NPS would take the following actions under all of the proposed action alternatives:

- Develop management measures specific to West Pond and surrounding area resources to address the changes proposed. Such management measures would include control of invasive vegetation species, berm monitoring, resource monitoring, and other measures specific to additional components of each alternative.
- Provide educational/interpretive signage and opportunities for education/outreach, particularly with regard to the following:
  - resource protection sensitivities
  - the need for enforcement to protect wildlife
- Maintain 13 benches/areas for wildlife viewing (including the no action alternative).The West Pond breach/trail repair would be reconstructed with a trail surface at the breach location that meets federal accessibility standards (Architectural Barriers Act Accessibility Standard (ABAAS)). Specifically, the contractor would be required to construct the trail surface with 3/8" minus gravel/crusher fines, compacted to create a firm stable trail surface. The repaired trail would be graded from both ends of the repaired breach to meet the existing trail at a 5% grade, or less. Where possible, surfacing material would be selected to lessen noise and minimize wildlife disturbance.
- Any damage to the trail caused by construction equipment would be repaired, such as regrading and filling holes and depressions in the trail surface, and matching the color of existing gravel.

During construction, materials and equipment would be staged in the visitor center parking area. Efforts would be made to keep a portion of the parking lot open to visitors who wish to access the visitor center or the East Pond area. Where possible, construction access would be provided on the existing trail. Trees and vegetation along the existing trail would be trimmed within 15 feet of either side of the centerline with clear height of approximately 16 feet to allow for construction vehicle access. In addition, a 50 foot by 50 foot vehicle turn-around area would be cleared. The action alternatives represent conceptual/schematic level design.

Detailed design and planning would be completed subsequent to the environmental assessment and monitoring and maintenance requirements and schedule would be determined following detailed design. Any permitting would be completed prior to construction. Estimated timeframes for the completion of design, planning, and permitting are not included in the estimated construction timeframes provided within each alternative description below. The impact analysis provided in chapter 3 considers the estimated construction timeframes not including the additional time needed for design, planning, and permitting since there would be no management and/or physical changes made to the West Pond area during that timeframe. Exact details with regard to implementing any of the action alternatives would depend on several factors, including permitting requirements and agency approvals, additional detailed geotechnical studies, level of partnering and funding, and any final engineering design that would be necessary to complete prior to conducting any site work. Project work elements could be completed consecutively or simultaneously.

ALTERNATIVE B: REPAIR THE BREACH AND IMPROVE HABITAT CONDITIONS, THE NPS PREFERRED ALTERNATIVE

Alternative B would emphasize repair of the primary and secondary breaches and the subsequent restoration of West Pond and the loop trail. This alternative would also include replacing the water control structure, possible installation of a groundwater well or municipal water source, implementation of resource management strategies to improve seasonal use by wildlife, and opportunities for natural resource-based activities such as birding, walking, and improved interpretive activities.

Alternative B would be implemented in phases, with phase 1 addressing filling and repairing the primary and secondary breaches, replacing the water control structure, the possible installation of a groundwater well or municipal water source to provide freshwater to the pond, and restoring the West Pond loop trail. An additional option would be to rely solely on natural precipitation and runoff to be the water source to provide freshwater to the pond. Future phases of work would include upland habitat restoration at Terrapin Point, shoreline restoration, saltmarsh restoration, and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage). The period of construction to implement alternative B could last up to a year, depending on environmental and other applied work restrictions.

HABITAT CONDITIONS

Under phase 1 of the preferred alternative, the primary and secondary breaches (figure 5) would be repaired and the water control structure would be replaced. This alternative would establish freshwater conditions within West Pond by either installing a freshwater source to supplement natural precipitation and runoff, or relying on natural precipitation and runoff to be the water source.

The primary breach would be repaired utilizing an earthen embankment overlying a reinforced timber or fiber-reinforced pile core with a surface load transfer platform, with riprap from the toe of the slope to the top of the load platform on the bay side. The reinforced supporting pile core topped with a surface load transfer platform increases the internal strength of the pond embankment and reinforced side slopes in the breached area. Additional measures would be taken to reinforce the secondary breach that has started to form on the banks opposite the primary breached area (see figure 5). The proposed repairs at the secondary breach would consist of placing gabion baskets along the pond-side edge and backfilling the eroded embankments on either side of the trail to tie into the adjacent slope. This work would occur within approximately 0.08 acres of upland, intertidal sand, and emergent wetland. Implementation of the conceptual design in the area of the secondary breach along West Pond would primarily be located above the mean high tide line and most likely above the 5 foot contour. Stabilization efforts may use gabion baskets at the base of the berm. Berm repairs would stop saltwater tidal flow into West Pond. Within the interior of West Pond, revegetation would rely on natural recruitment only and no habitat restoration activities would occur.

Under phase 1 of alternative B, construction access could take place in up to approximately 4.1 acres of upland area (to include vegetated areas trimmed within 15 feet of either side of the centerline of the 1.6-mile trail and a 50 by 50 foot area for vehicle turnaround). This area would be graded and seeded prior to project completion. The NPS would strive to avoid construction during peak visitation times and, if necessary, construction activity would cease during periods of peak seasonal bird migration (as identified below in the "Mitigation Measures" section).

Conceptual designs for this alternative would consider three freshwater source options. One option would be to install a groundwater well to supply groundwater to supplement natural precipitation and runoff. Hydrogeologic information regarding the aquifer and specific requirements for the proposed groundwater use is provided in appendix C. If a groundwater well was installed, installation would likely occur within an area of approximately 25 square feet and would avoid wetland and seasonally flooded areas. However, during construction the area would need to accommodate a drill rig or trailer which would be approximately 20 feet in length and would remain on the existing trail. An exact location would be determined during final design and care would be taken to minimize the acreage of disturbance during installation.

A second option would include the use of municipal drinking water as a source to supplement natural precipitation and runoff. Because of the potential toxicity to aquatic resources associated with treated drinking water, municipal drinking water would require treatment prior to supplementing water in West Pond in order to provide safe use for pond resources. Information regarding the local municipal drinking water supply and necessary treatment prior to use for West Pond is provided in appendix D. The exact type of water treatment would be determined during final engineering design and specifications. If a municipal water source connection was installed, ground disturbance would be minimized during installation of necessary piping. An exact location for the piping would be determined during final design and care would be taken to minimize the acreage of disturbance during installation.

A third option would be to rely solely on natural freshwater replenishment by precipitation and runoff.

Replacement in kind of the water control structure would enable national recreation area staff more control of water and salinity levels for purposes of wildlife management at West Pond. Installation of the new water control structure would require construction access through intertidal sand and mudflat wetlands. Construction of the new water control structure would occur within approximately 0.15 acres in proximity to the existing structure. Maintenance access to the water control structure would extend from the trail to the pond. Replacement of the water control structure, in combination with the installation of a groundwater well or municipal water source as a freshwater source would provide the national recreation area staff with additional capacity to manage salinity levels in West Pond than reliance solely on natural replenishment by precipitation and runoff.

As part of future phases, actions to improve habitat conditions at Terrapin Point would include approximately 4.9 acres of upland vegetation restoration, including removal of exotic plants and thinning of the undergrowth. Additionally, about 1.0 acres of shoreline habitat would be restored along the western edge of the point (see figure 5) which would improve terrapin and tern nesting habitat. Immediately south of the primary breach, approximately 2.7 acres of shoreline habitat would be restored and 5.0 acres of saltmarsh would be restored here and around Terrapin Point (see figure 5). Salt marsh restoration would consist of planting saltmarsh vegetation (for example, saltmarsh cordgrass) similar to the marsh habitat that currently exists to the southeast and southwest of the primary breach area.

Additional resources would be necessary to monitor shoreline habitat restoration. The NPS would lead coordination efforts with volunteers, members of the Student Conservation Association, and partners to assist with management efforts to control invasive vegetation species and conduct monitoring. If a groundwater well or municipal water source were chosen, management strategies would identify measures to treat and/or monitor water quality.

VISITOR EXPERIENCE

Under alternative B, improvements to the visitor experience would include trail restoration, and additional opportunities for wildlife viewing, education, and outreach. Under phase 1, repair of the berm would allow for the approximately 1.6-mile loop trail to be restored around West Pond, similar to the loop that existed prior to Hurricane Sandy. Future phases of the conceptual design implementation would include construction of a 0.3-mile trail around Terrapin Point to provide visitor access in this area, although closures would be expected during nesting seasons. Additional wildlife viewing areas and boardwalks would be strategically placed around West Pond to enhance the visitor experience. Mitigation measures would be implemented to minimize impacts to natural resources as a result of these amenities (as identified in the "Mitigation Measures" section). Wildlife observation platforms and boardwalks would provide opportunities to enjoy views, observe wildlife, and provide areas where education and outreach activities could occur. As part of the conceptual design, potential visitor amenities under future phases could include the following:

- Up to 2,000 linear feet of boardwalk could be installed along the northern border of the pond, extending into the tidal marsh.
- Up to 925 linear feet of boardwalk could be installed along the southern berm, extending into the tidal marsh.
- Up to 250 linear feet of boardwalk and an observation platform could be installed just south of the visitor center, extending into the tidal marsh.
- Up to 4 observation blinds could be installed in upland areas around Terrapin Point and just north of the visitor center near South Garden.
- Up to 3 observation platforms could be installed in upland areas on the eastern edge of Terrapin Point and just south of the visitor center.
- Enhanced opportunities for outreach and education would increase the amount of interpretive activity at the refuge. Additional training would be required for volunteers and Student Conservation Association staff members providing outdoor education. Additional wildlife protection education for visitors would address the need to avoid wildlife disturbance either by foot or via water (such as kayakers) at Terrapin Point and the areas surrounding West Pond.

Types of national recreation area staff activity would be similar to the no action alternative; however, opportunities to interact with visitors would increase due to additional opportunities for wildlife viewing and visitor education.

SUSTAINABILITY AND RESILIENCY

Once fully implemented, alternative B would result in reinforcement of the breached area so that it could accommodate periodic overflow. Shoreline and saltmarsh restoration would create a breakwater to attenuate tidal wave action and increase the resiliency of the repaired berm. In addition, the eventual natural regeneration of wetlands and vegetation within the interior of West Pond would absorb interior wave action and provide additional protection to the repaired berm.

Replacement of the water control structure would provide NPS staff with additional capacity to control water levels and respond to seasonal changes to support resident and migratory wildlife. A water control structure would also give the NPS some ability to control water levels to aide recovery from storm events that might inundate the pond. Installation of a groundwater well or municipal water source would give NPS staff additional capacity to manage water and salinity levels within West Pond both seasonally and in response to future storm events. The NPS would take additional measures to maintain, manage, and monitor the constructed conditions to be sustainable over time. There would be a moderate use of energy and materials over time.

PRELIMINARY COST ESTIMATE

A 'Class C' cost estimate was developed for each of the proposed alternatives. These net construct cost estimates are based on the conceptual design square foot cost (or unit cost) of similar construction. Net construction costs include the estimated cost of all labor, equipment, and materials required for construction of the proposed project in addition to mark-ups that include the location factor, design contingency, general conditions, and overhead and profit. These costs would be subject to changes as final design progressed.

The net construction costs provided for alternative B and the subsequent proposed alternatives were based on conceptual designs and geotechnical investigations by Eastern Federal Lands at the primary and secondary breach locations. Cost estimates for habitat restoration were based on U.S. Environmental Protection Agency literature and demonstrated costs within the New York area (USEPA 1994, NYSDOT 2014).

The net construction cost estimates for visitor amenities are based upon all potential locations where amenities could be accommodated and initial assumptions for length of trail required to access those amenities. Actual siting of visitor amenities, such as boardwalks and viewing blinds would be further assessed as the site naturally adapted to change. Trails, boardwalks, and viewing platforms would be sited in appropriate locations to minimize impacts to bird species while providing opportunities for wildlife observation. Therefore, there is potential for final design to include fewer amenities than what were costed, but not more.

The preliminary estimated net construction cost and funding sources for alternative B are summarized below in table 1.

Table 1: Preliminary Cost Estimate Net Construction (2015) – Preferred Alternative B

<table>
<tr><th>Phase</th><th>Component</th><th>Funding Source</th><th>Net Estimate</th></tr>
<tr><td rowspan="9">Currently Funded Project Work (Phase 1)</td><td>Primary Breach Repair
Secondary Breach Repair
• Earthwork
• Trail replacement*</td><td>Emergency Relief for Federally Owned Roads Program</td><td>$1,240,000 - $1,510,000</td></tr>
<tr><td>Water Control Structure</td><td rowspan="5">Hurricane Sandy Funds</td><td>$309,600 - $378,400*</td></tr>
<tr><td>Water Replenishment Option
• Groundwater well</td><td>$45,000 - $55,000</td></tr>
<tr><td>Water Replenishment Option
• Municipal water**</td><td>$309,600 – $378,400*</td></tr>
<tr><td>Water Replenishment Option
• Natural precipitation and runoff</td><td>$0</td></tr>
<tr><td>Design for Shoreline Restoration
• Shoreline habitat restoration
• Marsh restoration</td><td>$160,000 - $200,000</td></tr>
<tr><td colspan="3">PHASE 1 (GROUNDWATER WELL OPTION) TOTAL $1.8 - $2.1 M</td></tr>
<tr><td colspan="3">PHASE 1 (MUNICIPAL WATER OPTION) TOTAL $2 - $2.5 M</td></tr>
<tr><td colspan="3">PHASE 1 (NATURAL PRECIPITATION OPTION) TOTAL $1.7 - $2.1 M</td></tr>
<tr><td rowspan="4">Future Work
(Future Phases)</td><td>Implement Shoreline Restoration
• Shoreline habitat restoration
• Marsh restoration</td><td>Unidentified***</td><td>$1,630,000 - $1,990,000</td></tr>
<tr><td>Terrapin Point
• Habitat enhancement
• Invasive vegetation species control
• Trail system*</td><td>Unidentified***</td><td>$625,000 – $760,000</td></tr>
<tr><td>Visitor Amenities
• Viewing blinds / platforms
• Trail / boardwalk system</td><td>Unidentified***</td><td>$2,835,000 - $3,465,000</td></tr>
<tr><td colspan="3">FUTURE WORK TOTAL $5.1 - $6.2 M</td></tr>
<tr><td colspan="4">ALTERNATIVE B TOTAL $6.8 – 8.7 M</td></tr>
</table>

*Assumed trail repair $22.75 / LF for a total of approximately 1,850 linear feet of trail (at 10 feet wide) for this alternative
**If a municipal water source is used, additional future costs may be incurred dependent upon the amount of water usage, rates, and treatment.
***Unidentified sources could include future federal funding, non-federal partnership funds, or some combination thereof.

FIGURE 5: ALTERNATIVE B CONCEPTUAL DESIGN - THE NPS PREFERRED ALTERNATIVE

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ALTERNATIVE C: CREATE DIFFERENT TYPES OF HABITAT

Alternative C would entail reconfiguring the site to construct a new berm further inland thereby establishing a smaller, more inland West Pond and converting Terrapin Point into an island. The new configuration would create a mosaic of wetland and upland habitat types to support a diversity of species across the study area. This alternative would include installing a freshwater source from groundwater and a water control structure within the newly reconfigured West Pond. Best management practices would be implemented to control the growth of invasive vegetation species and monitor site conditions. Based on conceptual design, a new trail system would be established to extend to Terrapin Point. The existing loop trail would be reconfigured to connect with opportunities for activities such as trail walking, birding, and education. The period of construction for alternative C could last up to 3 years due to the magnitude of earthwork required and environmental and other applied work restrictions, with the potential to take longer depending on how the conceptual design is implemented and availability of funding. Implementation of alternative C would not be formally phased, although construction would occur in stages over multiple seasons.

HABITAT CONDITIONS

Under alternative C, a portion of the existing berm around the southern and northern portions of the existing West Pond would be removed and a new berm would be constructed further inland to create a smaller West Pond (approximately 31.6 acres) (see figure 6). This reconfiguration would convert Terrapin Point into an island. The newly constructed berm would be reinforced where necessary with sheet pile or other construction techniques that would be determined during design. Reconfiguration of the berm would convert approximately 8.0 acres of subtidal channel and estuarine intertidal emergent marsh into upland habitat. Approximately 4.3 acres of existing upland habitat would be converted into estuarine intertidal marsh.

The multi-season construction timeframe would be sensitive to seasonal needs to protect wildlife habitat and natural resources. As much as possible, construction access would be provided on the existing trail. To the extent practicable, the NPS would strive to avoid construction during periods of peak bird migration (as identified below in the “Mitigation Measures” section) in order to minimize sensitive resource impacts. Installation of a groundwater well to supplement natural precipitation and runoff would provide a consistent supply of freshwater to the smaller West Pond. The exact location for the groundwater well is unknown at this time, but care would be taken to minimize the acreage of disturbance during installation

Replacement in kind of the water control structure would provide additional capacity for national recreation area staff to manage water and salinity levels for purposes of wildlife management. Installation of a water control structure may require construction access through intertidal sand and mudflat wetlands. Construction of the new water control structure would occur within approximately 0.15 acres in proximity to the existing structure. Maintenance access to the water control structure would extend from the trail to the pond. Replacement of the water control structure, in combination with the installation of a groundwater well would provide the national recreation area staff with additional capacity to manage salinity levels in West Pond.

Reconfiguration of the West Pond area would result in a mosaic of different habitat types, including uplands, palustrine marsh, estuarine low and high marsh, and estuarine mudflats. The pond would provide various freshwater wetland habitats, as well as upland habitats that are less tolerant to saline conditions found in estuaries. Based on conceptual design, approximately 32.3 acres of freshwater wetland habitat restoration (to include plantings) would occur along the northern, eastern, and southern perimeters of the West Pond basin and a small portion of the western perimeter. Habitats that would be restored inside the pond include palustrine emergent marshes and open waters.

By reconfiguring the berm, Terrapin Point would become an island created by tidal conveyance. The configuration would allow ebb and flow of tides through a channelized estuarine marsh, including low and high marsh habitats and mudflats. Salinity in this tidal conveyance would be the same or similar to tidal marshes within Jamaica Bay. Within this tidal conveyance area, approximately 14.3 acres of saltmarsh habitat would be restored. On the island, approximately 8.6 acres of upland vegetation would be restored, including removal of exotic plants and thinning of the undergrowth. Additionally, about 2.9 acres of shoreline habitat would be restored along the southern edge of the point (see figure 6) which would improve terrapin and tern nesting habitat.

Additional resources would be necessary to monitor and manage the new pond and environs, including identifying measures to monitor water quality and pond resources. The NPS would lead coordination efforts with volunteers, members of the Student Conservation Association, and partners to assist with management efforts to control invasive vegetation species and conduct monitoring.

VISITOR EXPERIENCE

Under alternative C, improvements to the visitor experience would include trail restoration, additional opportunities for wildlife viewing, education, and outreach. Trail access would be enhanced by creating an approximate 1.3-mile trail system around the newly established West Pond. In addition, a 0.8-mile trail network would be constructed out to and around Terrapin Point to provide visitor access to this newly created island area, although seasonal closures would be expected during nesting seasons. The trail out to Terrapin Point would consist of a boardwalk / bridge to allow access to Terrapin Point over the tidal marsh. Kayak landings would not be appropriate at Terrapin Point or within the tidal wetlands, and additional visitor education efforts would be necessary to explain the importance of protecting wildlife habitat and avoiding disturbances.

Additional wildlife viewing areas and boardwalks would be strategically placed around West Pond and Terrapin Point to enhance the visitor experience. Wildlife observation platforms and boardwalks would provide opportunities to enjoy views, observe wildlife, and provide areas where education and outreach activities could occur. As part of the conceptual design, potential visitor amenities proposed could include the following:

- Up to 2,000 linear feet of boardwalk, an observation blind, and an observation platform could be installed along the northern border of the pond, extending into the marsh.
- Up to 250 linear feet of boardwalk and an observation blind could be installed just south of the visitor center, extending into the tidal marsh.
- Up to 300 linear feet of boardwalk and a blind could be installed east of Terrapin Point, extending into the saltmarsh between the newly created island and West Pond.
- Up to 2 observation blinds could be installed in upland areas on the northern berm and just north of the visitor center near South Garden.
- Up to 3 observation platforms could be installed in upland areas to the west and south of the visitor center.

Additional wildlife protection education for visitors would address the need to avoid wildlife disturbance either by foot or via water (such as kayakers) at Terrapin Point and surrounding marshes and the areas surrounding West Pond.

Types of national recreation area staff activity would be similar to the no action alternative; however, opportunities to interact with visitors would increase due to additional opportunities for wildlife viewing and visitor education.

SUSTAINABILITY AND RESILIENCY

The presence of a freshwater source and a water control structure would enable NPS staff to manage water and salinity levels and respond to seasonal changes and storm events to support resident and migratory wildlife. The NPS would take additional measures to maintain, manage, and monitor the constructed conditions to be sustainable over time. The energy demand and use of materials and labor would be high for alternative C.

Reconfiguring the berm further inland and reconfiguring wetlands in the surrounding area would decrease fetch (distance over open water relative to the berm) and thereby increase the resiliency of the relocated West Pond. Installation of a freshwater source and water control structure would enable NPS staff to manage water levels within the pond in response to storm events. “Softening” of edges and sculpting the slopes to accommodate outplantings of upland and wetland vegetation would decrease erosion during storm events. These efforts would be refined during the final design phase and would occur on both sides of the newly created berm and along both shoreline edges of the tidal channel between West Pond and Terrapin Point. Revegetation would include plantings to supplement the natural recruitment of both upland and wetland species, depending on the specific location. These vegetated buffers, along with an increased shoreline complexity, would create a breakwater to reduce the effects of tidal wave action and attenuate future storm surges.

Trail access to Terrapin Point may not be resilient to future storm damage and sustaining a boardwalk type of trail crossing would be challenging in these dynamic conditions.

PRELIMINARY COST ESTIMATE

Net construction cost estimates for the conceptual design of alternative C were developed in the same manner described above for alternative B.

The preliminary estimated net construction cost and funding sources for alternative C are summarized in table 2.

Table 2: Preliminary Cost Estimate Net Construction (2015) – Alternative C

	Component	Funding Source	Net Estimate
Project Implementation	Berm Reconfiguration Site Preparation • Site Preparation • Trail replacement*	Unidentified**	**$7,863,000 - $9,610,000**
	Berm Reconfiguration Earthwork • Excavation • Contouring		**$19,484,000 - $23,814,000**
	Water Control Structure		**$309,600 - $378,400**
	Water Replenishment • Well		**$45,000 - $55,000**
	Habitat Restoration • Shoreline habitat restoration • Marsh restoration • Invasive vegetation species control • Trail System*		**$5,000,000 - $6,110,000**
	Visitor Amenities • Viewing blinds / platforms • Trail / boardwalk system		**$3,250,000 -$3,970,000**
	ALTERNATIVE C TOTAL $36.0 - $44.0 M		

Note: It is assumed that Alternative C would be completed in one construction period. All funding for alternative C would come from as of yet unidentified sources.

*****Assumed trail repair $22.75 / LF for a total of approximately 5,740 linear feet of trail (at 10 feet wide) for this alternative plus the cost of a bridge out to Terrapin Point (approximately $875,000).

**Unidentified sources could include future federal funding, non-federal partnership funds, or some combination thereof.

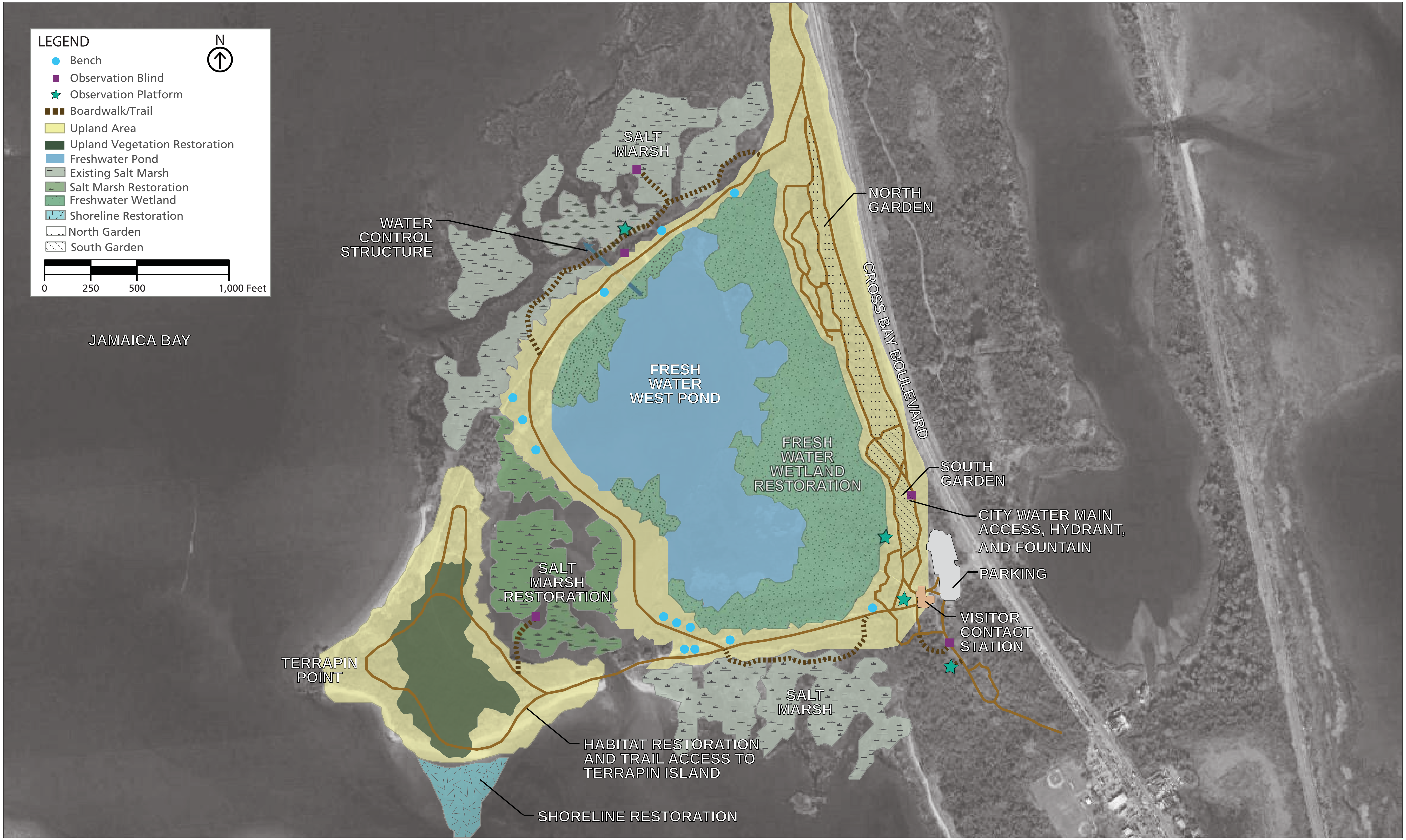

FIGURE 6: ALTERNATIVE C CONCEPTUAL DESIGN - MULTI-HABITAT PLAN

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ALTERNATIVE D: BRIDGE THE BREACH

Under alternative D, the primary breach would be bridged to restore the loop trail around West Pond and the banks of the primary and secondary breaches would be stabilized. Two different structures to span the breach would be considered, a steel truss bridge or a box culvert, both of which would continue to allow for tidal conveyance within West Pond. As a result, salinity levels in West Pond would remain similar to those in Jamaica Bay and wetland conditions and species composition would continue to shift in response. The period of construction to implement alternative D would last up to 6 months.

HABITAT CONDITIONS

Under the bridge the breach alternative, either of two different structural approaches could be taken to bridge the breach - either a steel truss bridge, or a bridged culvert system. A steel truss bridge would be installed across the subtidal channel created by the breach. The banks along the primary breach would be stabilized by embankment construction and riprap and/or sheet pile walls if necessary. Depending on the final design, placement of supporting infrastructure on either side of the bridge could occur in the intertidal sand and mud flat habitat within the breached area.

The alternative approach of the bridge the breach alternative would consist of installing a bridged culvert system. The trail would go across the earth-covered culvert and provide a surface for a continuous loop trail. This type of structure would be similar to the steel truss bridge in all other regards, including measures to stabilize banks at the existing primary breach and secondary breach to maintain tidal conditions. The concrete box culvert would require the placement of rip-rap on both banks for stabilization.

The bridge or box culvert would be constructed to withstand shifting sands and designed to withstand a 100 year flood.

Additional measures would be taken to reinforce the secondary breach that has started to form on the banks opposite the primary breached area (see figure 7). The proposed repairs at the secondary breach would consist of placing gabion baskets along the pond-side edge and backfilling the eroded embankments on either side of the trail to tie into the adjacent slope. This work would occur within approximately 0.08 acres of upland and intertidal sand and emergent wetland. Implementation of the conceptual design in the area of the secondary breach along West Pond would primarily be located above the mean high tide line and most likely above the 5 foot contour. Stabilization efforts may use gabion baskets at the base of the berm.

Under alternative D, construction access would occur in up to approximately 4.1 acres of upland area (to include vegetated areas trimmed within 15 feet of either side of the centerline of the 1.6-mile trail and a 50 by 50 foot vehicle turnaround). This area would be graded and seeded prior to project completion.

The West Pond area would continue to function as a tidally influenced habitat with salinity levels similar to Jamaica Bay. The NPS would monitor invasive vegetation species and control measures would be instituted, with targeted reduction efforts.

NPS Staff would monitor berm repairs and stabilization measures over time.

VISITOR EXPERIENCE

Under alternative D, improvements to the visitor experience would include trail restoration. The trail at West Pond would be routed over the breach by a steel truss bridge or box culvert, restoring the approximate 1.6-mile loop trail that existed prior to Hurricane Sandy. Additional wildlife viewing areas and boardwalks would be strategically placed around West Pond to enhance the visitor experience. Wildlife observation platforms and boardwalks would provide opportunities to enjoy views, observe wildlife, and provide areas where education and outreach activities could occur. As part of the conceptual design, visitor amenities proposed could include the following;

- Up to 950 linear feet of boardwalk could be installed along the southern berm, extending into the tidal marsh.
- Up to 250 linear feet of boardwalks and an observation platform could be installed just south of the visitor center, extending into the tidal marsh.
- One observation platform could be installed in an upland area along the northeastern corner of the pond along the edge of the tree line overlooking the north marsh.
- One observation blind could be installed in upland area just north of the visitor center near South Garden.

Types of national recreation area staff activity would be similar to the no action alternative; however, opportunities to interact with visitors would increase somewhat due to additional opportunities for wildlife viewing and visitor education.

SUSTAINABILITY AND RESILIENCY

Under this alternative, the NPS would take additional measures to stabilize the banks (utilizing erosion control, plantings, or other measures if deemed necessary), and maintain and monitor the berm and bridge structures to be sustainable over time. The energy demand and use of materials and labor would be somewhat moderate. The physical infrastructure and ecosystem functions would be considered resilient in terms of their ability to withstand the forces of large storms because the habitat and salinity conditions would not be expected to change.

PRELIMINARY COST ESTIMATE

Net construction cost estimates for the conceptual design of alternative D were developed in the same manner described above for alternative B.

The preliminary estimated net construction cost and funding sources for alternative D are summarized in table 3.

Table 3: Preliminary Cost Estimate Net Construction (2015) – Alternative D

	Component	Funding Source	Net Estimate
Project Implementation	Bridge Option • Trail replacement*	Emergency Relief for Federally Owned Roads Program	**$576,000 - $704,000**
	Culvert Option • Trail replacement*		**$477,000 - $583,000**
	Site Work • Earthwork and stabilization		**$1,924,000 - $2,473,000**
	Habitat Restoration • Invasive vegetation species control • Trail system	Unidentified**	**$125,000 - $155,000**
	Visitor Amenities • Viewing blinds / platforms • Trail / boardwalk system		**$2,790,000 - $3,410,000**
	ALTERNATIVE D BRIDGE TOTAL $5.4 - $6.7 M		
	ALTERNATIVE D CULVERT TOTAL $5.3 - $6.6 M		

Note: It is assumed that alternative D would be completed in one construction period. Funding for the structural breach crossing (bridge or culvert) and secondary breach repair would be available from the Emergency Relief for Federally Owned Roads Program. The remainder of funding would come from unidentified sources.
Costs would vary approximately $2,000 depending on whether a steel truss bridge or culvert bridge was installed.
*****Trail replacement costs over the breach are incorporated into the cost of each structural option.
**Unidentified sources could include future federal funding, non-federal partnership funds, or some combination thereof.

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FIGURE 7: ALTERNATIVE D CONCEPTUAL DESIGN - BRIDGE THE BREACH

Gateway National Recreation Area

United States Department of the Interior / National Park Service

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FIGURE 8: ALTERNATIVE D RENDERING OF BRIDGE

Gateway National Recreation Area

United States Department of the Interior / National Park Service

FIGURE 9: ALTERNATIVE D RENDERING OF BOX CULVERT

Gateway National Recreation Area
United States Department of the Interior / National Park Service

MITIGATION MEASURES

To prevent and minimize potential adverse impacts associated with the action alternatives, best management practices and mitigation measures would be implemented during the construction and post construction phases of the project. General and resource specific best management practices and mitigation measures are listed below by impact topic. This list provides a framework for mitigation measures that would be included in the contractor's specifications; future mitigation measures could be added to this list at the discretion of the NPS. Furthermore, the state and federal permits that would be required before this project proceeds with construction would likely include a variety of conditions specifically related to the protection of water quality and natural resources from additional construction-related impacts (see the "Consultation and Coordination" section in chapter 4).

Various best management practices would be adopted as part of the selected alternative and would be incorporated into design plans and specifications, providing a contractual requirement that any contractor retained for any phase of the action would abide by the conditions and procedures identified in this document and permits. Those typical mitigation measures that could be applied under each of the action alternatives are described below. Mitigation measures would be refined as the design of the project develops and as permit conditions are defined by the regulatory agencies (see the "Consultation and Coordination" section in chapter 4).

GENERAL

- A contractor kickoff meeting would be held to ensure that all workers are apprised of proper protocol to follow in the event of an emergency, including contact information for first responders.
- The contractor would not leave vehicles idling for extended periods when parked or not in use.
- Stockpile materials would be placed in the construction staging areas within the West Pond visitor center parking lot to avoid impacting natural features unnecessarily.
- Construction equipment would be restricted to paved or previously disturbed compacted surfaces where practicable to avoid impacts on natural resources, including wetland areas. If construction equipment must be used or staged off such surfaces, best management practices, such as those described in the sections below, would be implemented to minimize potential for adverse impacts.
- Temporary advanced warning signs would be installed to warn of closures during construction.

NATURAL RESOURCES

- Construction would strive to avoid estuarine areas during horseshoe crab spawning season (May through late June) to protect horseshoe crabs, ensure recruitment, and avoid disruption of red-knot foraging activity. The critical feeding time for the red knot in Jamaica Bay is typically in late May.

- Based on the seasonal presence of the essential fish habitat species, the optimal time for construction and other water disturbing activities is during winter to avoid delicate life stages of the fish. However, it does not benefit the habitat to prolong the project to accommodate this window and winter construction may not be practicable.
- Access to nesting areas would be limited during certain times of the year to provide for species protection, as appropriate.
- Areas disturbed from and/or during construction would be kept as small as possible to minimize exposed soils and the potential for erosion.
- Any exposed soils or fill material would be permanently stabilized at the earliest practicable date.
- During construction, every effort would be made to appropriately use adjacent excavated soils if the fill source is appropriate. However, sources and types of fill would be dependent on final project design. Sources of fill would be obtained in accordance with agency approvals and permitting requirements and fill would be certified free of exotic invasive vegetation species or weed free.
- Any vegetation lost during the construction process would be mitigated with the planting of native species. Exotic species lost would be replaced with native species as mediation for loss of mature growth. A native species planting list and plan would be approved by the NPS before planting.
- Measures would be implemented to prevent the spread or introduction of invasive vegetation, such as ensuring that construction-related equipment arrives at the site free of mud or seed-bearing materials and certifying that any seeds or straw material are weed free. Tools and machinery would be thoroughly cleaned when moving from an area heavily covered with invasive vegetation, to an area without invasive vegetation. The tires or tracks of trucks and equipment entering and leaving project sites would be washed off to prevent seed transport.
- Construction would be mindful to avoid/minimize impacts to migrating and nesting birds between April 1 and October 31.
- Temporary construction fences would be installed to identify areas that require clearing, grading, revegetation, or recontouring and to delimit work areas. Fences would be required to be installed before site preparation work or earthwork begins.
- As appropriate, erosion control measures would be implemented to prevent sediment from entering surface waters, including the use of silt fences or fiber rolls to trap sediments.
- Volatile wastes and oils would be disposed of in approved containers for removal from the project site to avoid contamination of soils, drainages, and watercourses.
- Care would be taken to avoid any rutting by vehicles or equipment. The operation and movement of construction equipment would be restricted to defined work areas.
- A pocket guide of the special status species would be kept on site and would include pictures and identification guides for the restoration crew to refer to when or if they encounter potential sign of special status species. This guide would also include names and radio numbers on whom to contact if a positive identification were made.
- The crew would be briefed about special status species and what to look for via a PowerPoint presentation. This would include any contractors or national recreation area staff working on the project.

CULTURAL RESOURCES

- The NPS would ensure that all personnel would be instructed on procedures to follow in case previously unidentified archeological resources were uncovered during construction. Should construction unearth previously undiscovered archeological resources, work would cease in the area of any discovery and the national recreation area's cultural resources specialist would be contacted. Consultation with the New York State Historic Preservation Officer would be conducted, in accordance with 36 CFR§ 800.13, Post Review Discoveries. In the unlikely event that human remains were discovered during construction, provisions outlined in the Native American Graves Protection and Repatriation Act (1990) would be followed.

SPILL PREVENTION AND RESPONSE PLAN

A spill prevention and response plan that regulates the use of hazardous and toxic materials, such as fuels and lubricants for construction equipment would be prepared. The NPS would oversee implementing the spill prevention and response plan. Elements of the plan would include the following:

- Workers would be trained to avoid and manage spills.
- Construction and maintenance materials would be prevented from entering surface waters and groundwater.
- Green (biodegradable) hydraulic fluids and oils would be used on mechanical equipment.
- A spill kit with boom and sorbent materials would be on site at all times during construction.
- Spills would be cleaned up immediately and appropriate agencies would be notified of spills and of the cleanup procedures employed.
- Staging and storage areas for equipment, materials, fuels, lubricants, solvents, and other possible contaminants would be located at least 100 feet away from surface waters.
- No vehicles would be fueled, lubricated, or otherwise serviced within 200 feet of the normal high water area of any surface water body.
- Vehicles would be immediately removed from work areas if they are leaking.

MEASURES TO PROTECT AIR QUALITY

- Vehicle emissions controls would be implemented, such as keeping equipment properly tuned and maintained in accordance with manufacturers' specifications and implementing best management construction practices to avoid unnecessary emissions (e.g., engines would not idle for extended periods of time).
- To the degree possible, of best management practices would be used to reduce generation of dust, such as covering loose soil, use of preapproved organic dust palliatives, and/or watering activities.

MEASURES TO PROTECT WATER RESOURCES, WETLANDS, AND FLOODPLAINS

In accordance with NPS Procedural Manual #77-1: Wetland Protection; the following best management practices and special conditions would be implemented.

- Specific provisions would be identified in the construction contract(s) to prevent stormwater pollution during construction activities, in accordance with the National Pollutant Discharge Elimination System permit program of the Clean Water Act and all other federal regulations, and in accordance with the stormwater pollution prevention plan to be prepared for this project.
- Buffers between areas of soil disturbance and waterways would be planned and maintained. Soil erosion best management practices would be used such as sediment traps, erosion check screen filters, and hydro mulch to prevent the entry of sediment into waterways.
- Any hazardous waste that is generated in the project area would be promptly removed and properly disposed of.
- Onsite fueling and maintenance would be minimized. If these activities could not be avoided, fuels and other fluids would be stored in a restricted/designated area and fueling and maintenance would be performed in designated areas that were bermed and lined to contain spills.
- Actions would be taken to minimize effects on site hydrology and fluvial processes, including flow, circulation, water level fluctuations, and sediment transport. Care would be taken to avoid any rutting caused by vehicles or equipment.
- Actions would be conducted to minimize adverse effects on normal movement, migration, reproduction, or health of terrestrial fauna, including at low flow conditions.
- Actions would be conducted so as to minimize effects on site hydrology and fluvial processes, including flow, circulation, velocities, hydroperiods, water level fluctuations, sediment transport, and channel morphology. Care would be taken to avoid any rutting caused by vehicles or equipment.
- Best management practices would be properly followed during the installation of any supplemental surface water supply system.
- Any necessary structure or fill would be properly maintained so as to avoid adverse impacts on aquatic environments or public safety.
- Heavy equipment use in wetlands would be avoided if at all possible. Heavy equipment used in wetlands would be placed on mats, or other measures would be taken to minimize soil and plant root disturbance and to preserve preconstruction elevations.
- Whenever possible, excavated material would be placed on an upland site. However, when this is not feasible, temporary stockpiling of excavated material in wetlands would be placed on filter cloth, mats, or some other semipermeable surface, or comparable measures would be taken to ensure that underlying wetland habitat was protected. The material would be stabilized with straw bales, filter cloth, or other appropriate means to prevent reentry into the waterway or wetland.
- Temporary stockpiles in wetlands would be removed in their entirety as soon as practicable. Wetland areas temporarily disturbed by stockpiling or other activities during construction would be returned to their preexisting elevations, and soil, hydrology, and native vegetation communities would be restored as soon as practicable.

- Revegetation of disturbed soil areas would be facilitated by salvaging and storing existing topsoil and reusing it in restoration efforts in accordance with NPS policies and guidance. Topsoil storage would be for as short a time as possible to prevent loss of seed and root viability, loss of organic matter, and degradation of the soil microbial community.
- Where plantings or seeding were required, native plant material would be obtained and used in accordance with NPS policies and guidance. Management techniques would be implemented to foster rapid development of target native plant communities and to eliminate invasion by exotic or other undesirable species.
- Minimizing shade impacts, to the extent practicable, would be a consideration in designing boardwalks and similar structures. (Placing a boardwalk at an elevation above the vegetation surface at least equal to the width of the boardwalk would be one way to minimize shading.)
- Actions would be consistent, to the maximum extent practicable, with state coastal zone management programs.
- Actions would not jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, including degradation of critical habitat.

MEASURE TO ADDRESS VISITOR USE

- Information on upcoming closures, including closure dates and arrangements for alternate trail access points, would be posted on the national recreation area website, distributed at other visitor centers within the national recreation area, and posted at the project site. Information on alternate opportunities for visitor use would be publicized on the national recreation area website, in the national recreation area newsletter, and in signage at the trailheads when closures are necessary.

MEASURE TO ADDRESS NOISE

- The contractor will create and implement a noise reduction plan. The contractor may elect any combination of legal, non-polluting methods to maintain or reduce noise to threshold levels or lower. The plan for attenuating construction-related noises will be implemented prior to the initiation of any work. The noise reduction plan will be reviewed and approved by the National Park Service. The noise reduction plan shall include a monitoring methodology to include the protection of marine species from the potential impacts of construction noise.

ALTERNATIVES AND ACTIONS CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

The following options were considered during the early stages of the planning process but were dismissed based on their inability to best meet the purpose and need and/or the objectives of the project.

MULTI-HABITAT PLAN WITHOUT ACCESS TO TERRAPIN POINT

An alternative was proposed that would be similar to alternative C but would not include any access to, or upland habitat restoration of, Terrapin Point. This was considered as a sub-alternative to alternative C. Since alternative C includes access and habitat changes at Terrapin Point, it was determined that that alternative would be carried forward, and that the sub-alternative would be redundant to a certain degree. While this sub-alternative would meet the purpose and objectives of the proposed action, it would not meet them as effectively as the version carried forward.

Given the historic use of Terrapin Point for terrapin and tern nesting, a lack of upland habitat restoration at this location would not best fulfill the national recreation area's objective to contribute toward a healthy, productive, and biologically diverse ecosystem. Alternative C provides greater habitat diversity and the potential for an enhanced visitor experience at Terrapin Point.

MAINTAIN THE BREACH

During initial alternatives development, an alternative to maintain the breach with certain enhancements was considered. Enhancements would include installation of erosion control and stabilization measures at the primary and secondary breaches, and creation of a softer trail surface. Without any changes to habitat conditions, this alternative would not fully meet project objectives to contribute toward a healthy, productive, and biologically diverse ecosystem or promote future desired resource conditions. Additionally, without restoring the connectivity of the loop trail around the pond, or taking any measures to address resiliency of the area, this alternative would not meet the project purpose to provide resilient conditions that would support an enhanced visitor experience. Initial public comments expressed a desire for trail connectivity and the creation of a system more resilient to future storms. Therefore, this alternative was not carried forward.

OTHER ACTIONS CONSIDERED

Construct a Wooden Bridge Across the Breach

Other suggestions included an elevated boardwalk. These methods of spanning the breach were considered; however, wood (either bridge or boardwalk) was not considered strong enough to span the breach nor durable enough to survive the harsh conditions. These alternatives were also considered less sustainable over time. A steel truss bridge was selected and carried forward under alternative D.

Install Other Stabilizations Measures

A variety of engineered shoreline stabilization options were considered as defensive measures, such as hardscape, including cobble, rock toes, cross vanes, rock or concrete sea walls, rip rap, and other types of armoring the shoreline. However, the NPS preferred the proposed shoreline/marsh restoration.

Relocate the Trail

This alternative was considered to be very similar to the no-action alternative, and was therefore not considered as a separate alternative. The rationale for dismissal is similar to the description above for the option to maintain the breach.

Utilize East Pond as a Freshwater Source

Water could be piped from East Pond under Cross Bay Boulevard to West Pond. A water control structure could be installed to control water levels and input on a seasonal basis. This was considered; however, pumping water from East Pond would drawdown water levels in East Pond and affect conditions at East Pond. It was unknown if there was capacity to service both ponds and sustain life in both ponds. There would also be difficulties during drought conditions. In addition, permitting of this activity would likely be problematic.

SUMMARY COMPARISON OF THE ENVIRONMENTAL CONSEQUENCES

Table 4 summarizes the environmental consequences that would result from each alternative. More detailed summaries of the factors responsible for the effects are presented in the conclusion sections at the end of the analysis for each impact topic. Full analyses of the impacts are presented in chapter 3.

Table 4: Summary of the Impacts of the Alternatives

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
Soils and Sediments	Adverse impacts would result from continued erosion and the loss of structural integrity at the mouth of the breach and the secondary breach as a result of continued exposure to tidally influenced water flows and scour.	Under phase 1, construction activities and earthmoving equipment accessing the primary and secondary breach areas could impact soils and sediments at several locations around West Pond. Impacts from construction associated with implementation of phase 1 would be considered negligible because best management practices would be in place, the activities would be localized, and the recoverability after disturbance due to revegetation efforts, long-term consequences to soils and sediments are not expected to result from construction activities associated with breach repairs. Over the long-term, filling the breaches and stabilizing the banks would provide slightly beneficial impacts to soils and sediments because it would provide increased soil stabilization by reducing exposure to storm surge and increasing the success of reestablishing vegetation. Under future phases, habitat restoration activities would contribute largely beneficial impacts because of soils and sediment.	Implementing alternative C would result in substantial adverse construction related impacts to soils and sediment because of ground disturbance, compaction, material removal, fill, erosion and sedimentation. Vigilant best management practices would be used to reduce the effects of erosion and sedimentation. Because of the extent of construction and substantial level of disturbance across the study area, the timeframe for the area to restabilize could take multiple growing seasons and the timeframe to regain fully functioning soils is unknown. The adverse impacts to sediments in the vicinity of Terrapin Point could be severe and long-term over the life of the project because of the erosion risks created as a result of subjecting the area previously within the confines of West Pond to a new tidal regime. Over time, beneficial impacts would occur as a result of stabilization of site conditions associated with reconfiguring a berm and pond that is more buffered from Jamaica Bay.	Temporary minor adverse impacts would result from disturbance, compaction, fill, erosion, and sedimentation during construction. Over time, some slight beneficial impacts would result from the increased structural integrity at the breach and secondary breach. Slight adverse impacts would result from tidal flow and storm surges on the structural function of soils and sediments along the margins of West Pond.

Table 4: Summary of the Impacts of the Alternatives cont.

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
Water Resources	Regular tidal flushing would maintain water conditions similar to Jamaica Bay, which is designated as "impaired/stressed." The primary and secondary breaches would likely continue to erode, impacting water quality. Because there would be no construction activities and no expected changes to water quality parameters under alternative A, there would be no impacts to water resources.	Under phase 1, temporary construction related adverse impacts would result from disturbances to water resources and increased sedimentation during construction activities. These impacts would be mitigated using best management practices. Over the long-term, large beneficial impacts on water quality within West Pond would result from active water control management to manage water levels and flush nutrients and wetland habitats, which would remove sediments and contaminants within the pond. Seasonal drawdowns of the pond through the water control structure could have an adverse impact on water quality near the water outfall; however, these impacts would be expected to be negligible because the NPS would develop management strategies to address these seasonal releases to ensure the letdown rates were compatible with the flushing rates and tidal cycles to the extent practicable. Under future phases of work, temporary and minimal adverse impacts would result from sedimentation during construction. Over the long-	Temporary, but substantial adverse impacts would result from erosion and runoff, suspended sediments and turbidity, and changes in sedimentation dynamics due to earth moving activities and tidally influenced water flows near Terrapin Point during construction. Over the long-term, large beneficial impacts on water quality within West Pond would result from active water control management to manage water levels and flush nutrients and wetland habitats, which would remove sediments and contaminants within the pond. Seasonal drawdowns of the pond through the water control structure could have an adverse impact on water quality near the water outfall; however, these impacts would be expected to be negligible because the NPS would develop management strategies to address these seasonal releases to ensure the letdown rates were compatible with the flushing rates and tidal cycles to the extent practicable. Over the long-term, reconfiguring the berm, stabilization, habitat restoration, and	Temporary adverse impacts would result from erosion and runoff during construction. Over the long-term, beneficial impacts would result from a reduction in erosion and continued tidal flushing within the formerly ponded area. However, the water quality would continue to match Jamaica Bay, designated as "impaired/stressed" (NYCDEP 2012) and salinity levels would also be similar to Jamaica Bay.

Table 4: Summary of the Impacts of the Alternatives cont.

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
		term, restoration of shoreline and saltmarsh habitat would attenuate wave action and storm surges, which would result in beneficial impacts to water resources by reducing the potential for erosion and sedimentation in the water column. The shoreline habitat restoration would also function to trap sediments and aid in the accretion process to further improve water quality.	reestablishment of vegetation would attenuate wave action and storm surges, which would result in beneficial impacts to water resources by reducing the potential for erosion and sedimentation in the water column. The establishment of wetlands would also function to trap sediments and aid in the accretion process to further improve water quality.	
Wetlands and Floodplains	There would be localized benefits for saltmarsh wetlands from open mixing with the waters of Jamaica Bay. The loss of freshwater influenced wetlands at and surrounding West Pond would result in adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay. There would be adverse impacts to floodplains because of the increased extent of the floodplains as a result of the eventual erosion of the berm, which would increase fetch and remove a protective barrier against storm surges.	Under phase 1, there would be beneficial impacts to wetlands because of the reestablishment of freshwater wetlands and the importance of their functions and values within the region. Slight adverse impacts to wetlands would result from ground disturbance during repair of the breaches and installation of a water control structure. There would be beneficial impacts to floodplains because of decreased fetch, increased protection from storm surges, and protection of facilities and resources provided from the repair of the berm. Replacement of the water control structure would result in long-term beneficial impacts to wetlands because of the additional capacity it would afford to manage the hydrology of West Pond to	Temporary, but substantial adverse impacts would result from the removal of existing wetlands during construction, ground disturbance, erosion and runoff, and changes in sedimentation dynamics across the site. Over time, beneficial impacts would result from the establishment of a variety of wetland features which would offer greater diversity to the wetland complex within Jamaica Bay. The ability to manage the hydrology of the pond, afforded by the addition of a water control structure and freshwater source, would have beneficial impacts to wetlands by allowing for a faster transition to a palustrine system, provided increased recovery in the event of future storm damage, and the ability to manage for improved	The continued loss of freshwater wetlands at and surrounding West Pond would result in continued adverse effects due to the rarity of this type of habitat in the area. Keeping the berm open would result in localized beneficial impacts to saltmarsh wetlands within West Pond. Adverse impacts to floodplains would result from the open berm, the increased extent of the floodplain and the lack of a protective barrier against future storm surges. Temporary and slight adverse impacts would result from ground disturbance to wetlands during construction of the bridge and repair of the secondary breach.

Table 4: Summary of the Impacts of the Alternatives cont.

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
		improve wetland function. Under future phases, habitat restoration activities would have beneficial impacts on wetland quantity and floodplain quality because of the increased acreage of wetlands and the added protection provided by saltmarsh restoration outside of the repaired berm. There would be minimal temporary adverse impacts during construction due to ground disturbance. Installation of amenities would have minimal temporary adverse impacts during construction as a result of ground disturbance. Over the long-term, slight beneficial impacts would result from increased awareness of wetland importance due to increased educational opportunities.	wetland function.	
Vegetation	Adverse impacts would result from the continued overall decline of diversity of plant species as freshwater species were lost, as the habitat continued to shift from freshwater to saltmarsh, in addition to a regional adverse impact since freshwater habitat is rare in this region. There would be localized benefits for saltmarsh wetland species from the continued open mixing	Under phase 1, slight, adverse impacts to vegetation would occur during construction as a result of ground disturbances to repair the breaches, replace the water control structure, and provide access to the various construction sites. The ability to manage the hydrology of West Pond provided by the water control structure would have beneficial impacts to vegetation because it could	Substantial adverse impacts would result from disturbance during the multi-year construction phase and extend through multiple growing seasons until the study area was stabilized and vegetation became reestablished. Over the long term, there would be beneficial impacts to vegetation diversity as freshwater vegetation communities recovered within	Adverse impacts would be similar to those described under alternative A and would result from the continued overall decline of diversity of plant species as freshwater species continued to be lost and the habitat continued to shift from freshwater to saltmarsh. In addition, this would result in a regional adverse impact to vegetation since freshwater habitat is rare in this region. There would be localized

Table 4: Summary of the Impacts of the Alternatives cont.

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
	with the waters of Jamaica Bay.	allow for the recruitment of particular freshwater vegetation. Under future phases, temporary adverse impacts during implementation would be minimal because of the limited period of construction, the localized area of construction, and the implementation of best management practices. Overall, moderately beneficial effects to vegetation would occur from an increase in the amount of high saltmarsh along the West Pond area, additional protection to upland and marsh vegetation by decreasing fetch, decreasing the exposure to future storm surges, attenuating wave action, and providing increased resiliency of the berm.	West Pond. Long-term benefits would result from increased soil stability and increased diversity resulting from freshwater and the establishment of a mosaic of upland habitats. By creating a freshwater pond and establishing associated vegetation, the project would contribute to vegetative and ecosystem diversity in the immediate area and within the region.	benefits for saltmarsh wetland species from the continued open mixing with the waters of Jamaica Bay.
Wildlife and Special Status Species	Minimally adverse impacts would result from the continued overall decline of diversity of fauna and habitats, as the area continued to shift from freshwater to saltmarsh. Some special status species could benefit from these conditions, while others that have depended on freshwater and freshwater-influenced habitats would likely continue to decline. Minimally adverse impacts would also include decreases in upland	Under phase 1, activities to improve and maintain freshwater habitat conditions would result in beneficial impacts for those wildlife and special status species that rely on this type of habitat. There would be minimally adverse impacts to wildlife individuals that do not rely on freshwater habitats because of the availability of suitable habitat in the surrounding estuary of Jamaica Bay. Minimal, short,	Temporary, but substantial adverse impacts would result from the length and magnitude of disturbance during the multi-year construction period. Reestablishment and the possible management of a freshwater habitat from the installation of a groundwater well and replacement of the water control structure would result in long- term benefits by increasing the diversity of	Limited temporary adverse impacts would result from disturbance during construction. Over the long-term, minimally adverse impacts would result from the continued overall decline of diversity of habitat conditions, as the area continues to shift from freshwater to saltmarsh and from continued predation. Because the adverse effects to essential fish habitat would be

Table 4: Summary of the Impacts of the Alternatives cont.

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
	habitats that once supported a diverse assemblage of migratory passerines, amphibians, and reptiles. Because there would be no construction activities, pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, there would be no adverse effects on habitats designated as essential fish habitat. Pursuant to section 7 of the Endangered Species Act, the NPS would make a finding that alternative A may affect, but not likely adversely affect the red knot. Because alternative A would not alter any habitats, and because of the unlikelihood of their presence in the area, pursuant to section 7 of the Endangered Species Act, alternative A would have no effect on the northern long-eared bat or the roseate tern.	and long-term adverse impacts to populations of wildlife and special status species as a result of disturbances caused by construction would not be expected due to the availability of suitable adjacent habitat and the short duration of construction. Under future phases, habitat restoration activities would have long term beneficial impacts for wildlife because these activities would result in improvements to habitat quality and quantity, in an area that has a history of degradation and habitat loss. Adverse impacts from construction activities associated with future phases would be minimal because they would be temporary, limited to the time of construction, and localized to relatively small areas. Because the adverse effects to essential fish habitat would be minimal, localized to the area of construction, and temporary to the timeframe of construction activities, pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, it is anticipated that phase 1 and	habitats. Because the adverse effects to essential fish habitat would be minimal, localized to the area of construction, and temporary to the timeframe of construction activities (over several years), it is anticipated that alternative C would have no more than a minimal impact on habitats designated as essential fish habitat. There would be de minimis impacts relative to the available habitat within Jamaica Bay. Reconfiguration of West Pond would remove some potential spawning area for horseshoe crabs; however, shoreline restoration south of Terrapin Point may provide additional spawning habitat, which may indirectly beneficially impact the red knot. Reconfiguration of the site and shoreline may also benefit the roseate tern by providing potential nesting habitat. No northern long-eared bat habitat would be impacted under alternative C. Pursuant to section 7 of the Endangered Species Act, the activities proposed under alternative C may affect, but not likely adversely affect the red knot and roseate tern. There would be no effect on the northern long-eared bat.	minimal, localized to the area of construction, and temporary to the timeframe of construction activities, pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, there would be de minimis impacts relative to the available habitat within Jamaica Bay. The remaining presence of estuarine habitat, mudflats, and shorelines may be conducive for horseshoe crab spawning. Because horseshoe crab spawning habitat may be a limiting factor for red knot use of the West Pond area, alternative D may benefit the red knot. Because alternative D would not alter any habitats for the northern long-eared bat or the roseate tern and because of the unlikelihood of their presence in the area during construction activities alternative D would have no effect on the northern long-eared bat and the roseate tern. Pursuant to section 7 of the Endangered Species Act, the activities proposed under alternative D may affect, but not likely adversely affect the red knot. There would be no effect on the roseate tern and northern long-eared bat.

Table 4: Summary of the Impacts of the Alternatives cont.

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
		future phases of alternative B would have no more than a minimal impact (de minimis impacts) on habitats designated as essential fish habitat. Future phases of work may have a beneficial impact on the red knot because additional spawning habitat for horseshoe crabs could be provided with habitat restoration activities. There could be beneficial impacts for the roseate tern because potential nesting habitat would be restored. There would not be any impacts to the northern long-eared bat because habitat for this species is not likely to occur at the site. State-listed passerine species would likely benefit over time because upland habitat conditions would improve. Pursuant to section 7 of the Endangered Species Act, activities under alternative B may affect, but not likely adversely affect the red knot and roseate tern and there would be no effect on the northern long-eared bat.		
Visitor Use and Experience and Scenic Resources	Moderate adverse impacts would result from the continued inability to walk around the pond, a continued decline in opportunities for wildlife observation resulting from a	Under phase 1 and future phases, temporary and moderate adverse impacts would result from temporary closures and construction-related intrusions during	Temporary but substantial adverse impacts would result from extended closures and construction-related intrusions during implementation due to the extended multi-year	Temporary adverse impacts would result from short-term closures and construction-related intrusions during implementation. The intensity of these impacts would vary

Table 4: Summary of the Impacts of the Alternatives cont.

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
	decline in species diversity, and from sustained visual evidence of the damages caused by Hurricane Sandy.	implementation. Under phase 1, reestablishing freshwater habitat from the installation of a freshwater source (a groundwater well or municipal water source) to supplement natural precipitation and runoff would result in a beneficial impact to visitor experience by allowing for a faster transition to freshwater habitat conditions and increased resiliency and recovery of the ecosystem in the event of future storm damage or saltwater influence. Impacts from a reliance on replenishment of freshwater could fluctuate based on precipitation rates and freshwater conditions within the pond, dependent upon conditions. Over the long-term, under phase 1 and future phases, beneficial impacts would result from improved wildlife observation resulting from restoration of freshwater habitat and restored and improved visitor amenities.	construction period. Over the long-term, beneficial impacts would result from improved wildlife observation resulting from freshwater habitat, restored and improved visitor amenities, and increased resiliency of the site.	depending on the length of the closure. Over the long-term, beneficial impacts would result from restoration of the loop trail.
Socioeconomic	Slight beneficial impacts would result from continued visitor use spending, however slight it may be. A continued decline in visitation at West Pond could result in additional loss of business in the	Temporary adverse impacts would result from a temporary decrease in visitor spending during construction closures. Due to the nature of businesses in the area that serve mostly local residents, these impacts would not be	Temporary adverse impacts would result from a temporary decrease in visitor spending during the extended construction closure. Due to the nature of businesses in the area that serve mostly local residents, these impacts would	Temporary and ongoing beneficial impacts would result from increased visitor spending from a slight increase in visitation related to restoration of the loop trail. Additional economic benefits would result from the addition of short-term

Table 4: Summary of the Impacts of the Alternatives cont.

Impact Topic	Alternative A: No Action / Continue Current Management	Alternative B: The NPS Preferred Alternative	Alternative C: Create Different Habitats	Alternative D: Bridge the Breach
	immediate area, which could contribute a slight adverse impact to the overall local economy.	substantial. Temporary and ongoing beneficial impacts would result from increased visitor spending from an increase in visitation related to the proposed improvements, and the addition of short-term jobs during construction.	not be substantial. Temporary and ongoing beneficial impacts would result from increased visitor spending from an increase in visitation related to the proposed improvements, and the addition of short-term jobs during construction.	jobs during construction and continued national recreation area spending and operations.

THE PREFERRED ALTERNATIVE AND THE ENVIRONMENTALLY PREFERABLE ALTERNATIVE

THE ALTERNATIVE PREFERRED BY THE NATIONAL PARK SERVICE

Alternative B, consisting of repair of the primary and secondary breaches and the subsequent restoration of West Pond and the loop trail, is the NPS' preferred alternative. This alternative best meets the purpose and need for the project, improves the conditions and resources at West Pond, provides improved visitor enjoyments through better service and educational and recreational opportunities, improves sustainability and maintenance of the site, and can be implemented efficiently.

THE ENVIRONMENTALLY PREFERABLE ALTERNATIVE

In accordance with the DO-12 Handbook, the NPS identifies the environmentally preferable alternative in its National Environmental Protection Act documents for public review and comment [Sect. 4.5 E(9)]. The environmentally preferable alternative is the alternative that causes the least damage to the biological and physical environment and best protects, preserves, and enhances historical, cultural, and natural resources. The environmentally preferable alternative is identified upon consideration and weighing by the responsible official of long-term environmental impacts against short-term impacts in evaluating what is the best protection of these resources. In some situations, such as when different alternatives impact different resources to different degrees, there may be more than one environmentally preferable alternative (43 CFR 46.30). Alternative B would reestablish and maintain freshwater habitat at West Pond thereby increasing species diversity with conditions similar to those prior to Hurricane Sandy. The installation of a water control structure and the potential installation of a freshwater source under alternative B would increase the NPS staff's ability to manage water and salinity levels within the pond in response to storm events, which would increase the resiliency of the freshwater ecosystem within West Pond. Under future phases of alternative B, shoreline and saltmarsh restoration would create a breakwater to attenuate tidal wave action and further increase the site's resiliency against future storm damage. While alternative C would also diversify habitat, species abundance, and resiliency against future storm damage, impacts from construction would be greater due to extensive earthwork and a construction period of several years. As a result, the magnitude of impacts and the duration of construction and period of transition for alternative C would be greater than under alternative B. Alternative C would also create an island at Terrapin Point, which would introduce new tidal patterns around the island and could increase this area's susceptibility to tidal erosion. Alternative B would best restore and improve habitat conditions for wildlife management with the least amount of impact to the study area. Based on the analysis of environmental consequences of each alternative described in chapter 3, alternative B is the environmentally preferable alternative.

CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Situated in Gateway National Recreation Area along the coast in New York, West Pond and the surrounding area are home to a variety of natural and visitor use resources. This chapter describes the resources that could be impacted by the proposed action. Impact topics are presented in the order they appear in chapter 1.

GENERAL METHODS FOR ANALYZING IMPACTS

In accordance with the Council on Environmental Quality regulations, direct, indirect, and cumulative impacts are described (40 CFR 1502.16) and the impacts are assessed in terms of context and intensity (40 CFR 1508.27). Where appropriate, mitigating measures for adverse impacts are also described and incorporated into the evaluation of impacts.

GEOGRAPHIC AREA EVALUATED FOR IMPACTS

The geographic study area for the assessment of impacts for each of the natural resource impact topics generally includes West Pond and the area of the refuge surrounding West Pond. This includes the area surrounding the primary and secondary breach and areas where any improvements are proposed (see figure 1). Since West Pond is currently tidally influenced, the area and waters of Jamaica Bay outside the breach to the south of the primary breach and to the north of West Pond are also included within the study area.

Details regarding the area included in the groundwater analysis, inclusive of regional aquifers, in King and Queens Counties, New York is presented in appendix C.

The area of analysis considered for the socioeconomic impact topic includes the community of Broad Channel with a regional context for surrounding counties.

METHODS AND ASSUMPTIONS

The impact analysis was conducted for each of the alternatives based on conceptual designs for a project timeframe of approximately 25 years. The analysis for each alternative was based on review of existing literature and maps, information provided by the NPS, U.S. Environmental Protection Agency, U.S. Geological Survey and other federal and state agencies as referenced, professional experience related to restoration of marshes in the area, and professional judgment. Assumptions made for the impact assessment are summarized below.

- Groundwater: limitations and assumptions of the groundwater portion of the water resources analysis are outlined in appendix C. The analysis is primarily based on a qualitative analysis of groundwater conditions and estimated demands.
- Water Resources: should a municipal drinking water source be selected as a supplemental water source for West Pond, the drinking water would be treated to prevent toxicity to aquatic pond life. Toxic characteristics of treated drinking water for freshwater pond conditions are briefly summarized in appendix D.

TYPE OF IMPACT

Impacts are discussed by type, as follows (the terms "impact" and "effect" are used interchangeably throughout this document):

- **Direct:** Impacts that would occur as a result of the proposed action at the same time and place of implementation (40 CFR 1508.8).

- **Indirect:** Impacts that would occur as a result of the proposed action but later in time or farther in distance from the action (40 CFR 1508.8).
- **Adverse:** An impact that causes an unfavorable result to the resource when compared to the existing conditions.
- **Beneficial:** An impact that would result in a positive change to the resource when compared to the existing conditions.

CUMULATIVE IMPACT ANALYSIS METHODS

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts were determined for each impact topic by combining the impacts of the alternative being analyzed and other past, present, and reasonably foreseeable actions that would also result in beneficial or adverse impacts. Because some of these actions are in the early planning stages, the evaluation of the cumulative impact is based on a general description of the projects. These actions were identified through the internal and external project scoping processes and are summarized below.

Past, Present, and Reasonably Foreseeable Future Actions

Cumulative impacts consider the effects of historical and ongoing urbanization, land development, and land uses in the area surrounding West Pond and the refuge. Influences from the surrounding urbanized watersheds include impacts from hardened shorelines, impervious surfaces, and channelized runoff, diversion of natural surface flow, dredging of bay sediments, changes to sediment transport dynamics, elimination and fragmentation of natural habitats, pollution of surface waters, landfill leachates, ocean dumping and waste disposal, development, agricultural practices, transportation, non-point pollution sources, and other contributing actions have degraded resource conditions in the watershed and Jamaica Bay. These influences have cumulative effects to West Pond due to the wetland, current tidal conditions, and interface within the greater Jamaica Bay ecosystem in which West Pond is an integral part. These influences are described in greater detail in the national recreation area's general management plan (NPS 2014a).

Management plans that would influence ecosystems in the vicinity of West Pond and the refuge are described below. Many include collaborative efforts with the NPS to restore wetlands, address invasive species, improve water quality, establish protected areas, and address many of the historical influences. Additional details regarding these plans and other efforts planned by the NPS and others are included in the national recreation area's general management plan (NPS 2014a).

The **2014** ***Gateway National Recreation Area General Management Plan*** is a 15-25 year plan that serves as the national recreation area's primary guidance document and reflects a systematic approach to management whereby recreational use and development is balanced with the need to ensure long-term preservation of natural resources and values (NPS 2014a). The plan provides overall direction for future management of the national recreation area, and a framework for managers to use in making decisions about how best to protect national recreation area resources, how to respond to climate change and sea level rise, what levels and types of uses are appropriate, what facilities should be developed, and how people should access the national recreation area. Under the *General Management Plan*, the perimeter of West Pond falls within the natural zone and the pond itself falls within the sensitive resource subzone. The natural zone is managed to preserve natural resources while allowing for the enjoyment of the outdoors and nature. The sensitive resource subzone includes areas designated for current or future restoration and is managed for the highest level of protection, scientific investigation, and monitoring. Public access within the sensitive resource subzone is restricted to minimize impacts. Within the refuge, the natural zone is managed to promote nature study, environmental education, and nature-based interpretation while offering opportunities for nature-based activities. Habitats are protected, maintained, and managed to support a diversity of migratory birds. Within the natural zone, the *General Management Plan* identifies a desire to expand a network of trails, boardwalks, and nature study facilities to facilitate self-guided exploration. The proposed actions in this environmental assessment are consistent with the goals set out for the Jamaican Bay Wildlife Refuge within the *General Management Plan*. The plan also identifies intensified collaboration and outreach efforts to address resource conditions in the area influencing the natural and cultural resources of Gateway National Recreation Area. These collaborative efforts are also considered as part of the cumulative impact analysis, and are provided in greater detail in the *Gateway National Recreation Area General Management Plan*.

Transportation planning efforts in the ***Gateway National Recreation Area, Jamaica Bay Transportation Studies, Development Concept Plan / Environmental Assessment/Assessment of Effect*** and the ***New York Harbor Transportation Strategy, Building Connections to National Parks and other Destinations*** proposes improvements to transportation and circulation within the national recreation area sites of the Jamaica Bay Unit. Recommendations for the Jamaica Bay Unit include seasonal shuttle bus connections between mass transit stations/ stops and national recreation area sites; improved wayfinding, pedestrian, and bicycle signs; and providing guided kayak/canoe tours.

The ***Invasive Vegetation Management Plan for Gateway National Recreation Area*** describes the impacts of invasive vegetation species on natural resources and presents strategies and tactics for preventing their invasion and spread. The proposed action would comply with invasive vegetation management efforts within the national recreation area.

The national recreation area, in partnership with The Nature Conservancy and the Jamaica Bay-Rockaway Parks Conservancy, is in the planning stages to restore native vegetation at the North and South Gardens near West Pond.

PlaNYC 2030 (2011) establishes a vision and bold agenda to meet New York City's challenges, prepare for 1 million more residents, strengthen its economy, combat climate change, and enhance the quality of life for all New Yorkers by working toward the vision of a greener, greater New York. PlaNYC complements the environmental assessment's effort in its goals for improving existing parks, restoring coastal ecosystems and waterways, and improving resiliency.

Vision 2020: New York City's Comprehensive Waterfront Plan (NYCDCP 2011) sets the stage for expanded use of New York City's waterfront for parks, housing, and economic development, and its waterways for transportation, recreation, and natural habitats. The 10-year plan lays out a vision for the future with new citywide policies and site-specific recommendations. It provides strategies for implementing many of the long-term goals of PlaNYC, such as improving the quality of the city's waterways, increasing access to the waterfront, and restoring coastal ecosystems. Vision 2020 is accompanied by the New York City Waterfront Action Agenda (NYCEDC n.d.), which outlines a number of specific, high-priority projects to be initiated within three years. The Action Agenda organizes each project under one of the eight goals of Vision 2020. Several sites within and surrounding Gateway at both the Staten Island and Jamaica Bay Units are specifically identified as potential sites for habitat restoration, improved water quality, and increased waterfront access.

This ***Hudson–Raritan Estuary Comprehensive Restoration Plan*** (USACE and PA 2009) sets forth a vision and strategy for future ecosystem restoration in the New York/New Jersey

Harbor. It was developed in collaboration with federal, state, municipal, non-government organizations, and other regional stakeholders, and aims to create and restore saltmarshes in Jamaica Bay, establish natural areas as watershed buffers, upgrade technologies at wastewater treatment plants, and manage runoff from impervious surfaces

The ***Jamaica Bay Watershed Protection Plan*** (NYCDEP 2007; 2014) resulted from a bill requiring the New York City Department of Environmental Protection to create a watershed protection plan and stewardship strategy for Jamaica Bay. The plan provides an evaluation of the current and future threats to the bay to ensure that environmental remediation and protection efforts are coordinated in a focused and cost-effective manner. The plan contains two volumes: Volume 1, "Jamaica Bay Watershed Regional Profile,' a comprehensive reference document for Jamaica Bay, provides information about the Jamaica Bay watershed, water quality, and current ecological status; Volume 2, "Jamaica Bay Watershed Protection Plan," contains the vision for the bay and the issues that need to be overcome to achieve the vision. For each of the issues, objectives for the bay were developed and, for each objective, strategies or actions are identified to address the objective. A number of the objectives identified in the plan directly relate to the *General Management Plan* for the Jamaica Bay Unit, particularly ecological restoration and protection of the saltmarsh islands and other natural areas, increasing public access where appropriate, and educating the public on the importance of the Jamaica Bay watershed. Some of the projects include Jamaica Bay wastewater treatment plant upgrades, on-going ecosystem improvements and partnerships, stormwater control structural projects, and pilot projects for various restoration efforts.

SOILS AND SEDIMENTS

AFFECTED ENVIRONMENT

Soils and sediments in Jamaica Bay are underlain by poorly drained glacial outwash soils in the Ipswich series, including organic materials that have accumulated since the retreat of the glaciers. Benthic soils in western Jamaica Bay are more likely fine to medium sands while sediment of the eastern and northern portions of the bay are silty and muddy, fine sand (USFWS 1997; NYCDEP 2007). Jamaica Bay has a long history of alterations by extensive dredging, filling, and development in and around the bay (USFWS 1997; USDA 2001). Over sixty years ago, West Pond and East Pond and other islands within Jamaica Bay were created on the filled lands from Rulers Bar Hassock (USDA 2001). The area was covered with fill material that consisted of natural and human materials, including rubble, fly ash, etc. (NPS 2014a). Point and nonpoint sources of pollution have surrounded Jamaica Bay for a long period of time, including municipal waste water discharges, sewer overflows, stormwater runoff, and leaching of contaminants from closed landfills (USFWS 1997). With time, some soil conditions improved with environmental regulations; however, it does not free the area from a history of contaminated sediments.

The following soils occur around West Pond as defined in the National Soil Survey Handbook (USDA 2001): beaches; Ipswich mucky peat, mud flat, and Pawcatuck mucky peat (tide flooded); Jamaica sand (frequently ponded); barren sand, barren sandy loam, Big Apple coarse sand, and fortress sand (0% - 3% slope); Big Apple coarse sand (3% - 8% slope); and Pavement & Buildings, sandy substratum (0% - 5% slopes). These soils and sediments are susceptible to the effects of climate change by changes in amounts of precipitation, sea level, intensity and amount of runoff, and the intensity and frequency of coastal storms (Nicholls 2004). In the New York City area, heavy downpours are very likely to increase in frequency, intensity, and duration (New York City Panel on Climate Change 2013).

West Pond is located within the Coastal Barrier Resources System. As defined by the Coastal Barrier Resources Act, an "undeveloped coastal barrier" is a “depositional geologic feature that is subject to wave, tidal and wind energies; and protects landward aquatic habitats from direct wave attack”. West Pond is included in the system because it also includes associated “aquatic habitats, including the adjacent wetlands, marshes, estuaries, inlets and nearshore waters, but only if such features and associated habitats contain few man-made structures and these structures, and people's activity associated with them, do not significantly impede geomorphic and ecological processes” (Coastal Barrier Resources Act, Public Law 97-348). The berm surrounding West Pond is composed of sand, soil, and peat and does not have much vertical relief, roughly a 6-7 foot elevation above mean sea level (Nelson 2014).

The sediment budget, how much sediment is import versus exported from the bay, indicates that there is an import of sediment into Jamaica Bay, most substantially as fine-grained sediments through Rockaway Inlet (Renfro 2010). Sediment accretion rates for salt marshes in Jamaica Bay have been reported in the range of 0.25 – 0.41 centimeters per year (Kolker 2005). Research by Renfro (2010) on long-term sediment accumulation and marsh accretion in Jamaica Bay suggests that despite a long history of alterations to the sediment budget and hydrodynamics in the bay, sediment is being deposited on to the marsh islands, but only commensurate with annual sea level rise estimates (0.28 centimeters per year as cited by www.noaa.gov).

Sediments are accumulating within West Pond and certain areas of the pond are becoming increasingly shallow. However, coastal processes are naturally dynamic and strong storm currents would be able to rapidly alter the appearance of the internal/external boundaries and bathymetry of the pond. One storm could swiftly remove what has taken years to build up by redistributing sediments. With the effects of climate change, the intensity, duration, and frequency of storms are predicted to increase, with resulting changes to pond soil and sediment conditions.

The biggest threat under a climate change scenario is sea level rise that would inundate soils and sediments as depicted under varying scenarios in figures 10 and 11. These figures were derived from information available on the National Oceanic and Atmospheric Administration's Sea Level Rise and Coastal Flooding Impacts V2.0 Website. In accordance with information presented there, the basins of West and East Ponds, and an area south of East Pond are considered low-lying hydrologically "unconnected" areas that may flood. A more detailed topographic, hydrologic, and hydraulic analysis of these areas is required to evaluate water surface elevations and flood risk. To reflect this uncertainty, the images depict both the level of potential flooding depicted by the National Oceanic and Atmospheric Administration and the estimated pre-Hurricane Sandy West Pond elevation. Climate change is expected to increase the extent and frequency of coastal flooding (Loehman and Anderson 2009; Titus and Richman 2001) from storm surges and sea level rise. West Pond and the surrounding area are highly susceptible to the impacts of sea level rise, including intensified coastal flood events, increased shore erosion, and inundation of low-lying areas. Even before Hurricane Sandy, soils and sediment in these lower areas could easily succumb to overwash and inundation during storm activity to easily mix Jamaica Bay sediment with upland soils and West Pond sediment. During Hurricane Sandy, the force of the storm surge created a breach in the outer wall of the pond subjecting upland soils and sediments to daily tidal mixing of sediments, shifting sands, and redistribution of sediments. There is not a large difference between low tide and high tide in this area (approximately 4 feet [1.2 m]). As sea levels rise, shorelines would be recontoured under the pressure of new water flows, erosion, and shoaling. Pressures on soils and sediments in this area may create an ever-weakening barrier between the West Pond and Jamaica Bay, which is likely to become progressively more vulnerable to storms. Scouring and soil erosion of the inlet walls is occurring at the breach location and it is widening. Eroding soils and sediments have been transported through the breach into the pond and out into the bay where they are settling and creating shoals.

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FIGURE 10: 2-FOOT SEA LEVEL RISE

Gateway National Recreation Area

United States Department of the Interior / National Park Service

FIGURE 11: 4-FOOT SEA LEVEL RISE

Gateway National Recreation Area

United States Department of the Interior / National Park Service

IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impacts

Under alternative A, no active restoration efforts of West Pond would be pursued. The pond would continue to be exposed to tidally influenced water flows. Since the breach has continued to expand since the hurricane, it is likely it would continue to widen as water flows continue to scour the breach site with tidal fluctuations, high energy storm waves, and storm surge. Additionally, there would be a continued loss of structural integrity at the mouth of the breach as the height and width of the berm are subjected to continual erosion. These erosion impacts would result in long-term slightly adverse impacts on the structural function of soils and sediments of West Pond.

Tidal flow within the pond may create an ever weakening barrier between West Pond and Jamaica Bay, which is likely to become progressively more vulnerable to storms – particularly at the point of the secondary breach. The secondary breach would experience increased pressure from storm waves and storm surge from within the pond boundaries due to additional water forces from the breach. Over the long term, sediments within the pond would continue to accumulate and the pond would become increasingly shallow, with the exception of possible formation of a tidal creek at the primary breach. These impacts from scour, tidal flow, and storm surge would result in slightly adverse impacts on the structural function of soils and sediments of West Pond under alternative A.

Cumulative Impacts

Coastal development, urban development, and hardening of shorelines to accommodate development exacerbates erosion and loss of soils, and pollutant streams from wastewater effluent and other sources continue to contaminate bay sediments and soils. Jamaica Bay receives wastewater, stormwater, and non-point contaminants from the watershed. Additionally, dredging, filling, and hardening of shorelines for development have worsened soil erosion and water quality. These adverse impacts have a substantial historical and current influence on soils and sediment conditions. More recent measures to counter the impacts of development and pollution continue to improve conditions, however past actions still influence the adverse conditions of soil and sediment resources today. A summary of some of the key improvements are provided in the paragraphs that follow. New York Departments of Environment Quality and Environmental Protection have worked together to reduce nitrogen inputs by 2020 from four municipal sewage treatment plants (NYCDEP 2014). These reductions are expected to improve water quality in Jamaica Bay and in turn improve the quality of soils.

The variety of environmental improvements proposed under the 2014 *Gateway National Recreation Area General Management Plan* would have a long-term beneficial impact on coastal soils and sediments most applicable to this resource. These projects include, but are not limited to, invasive species control activities aimed at maintaining and restoring saltmarshes, projects to restore natural sediment transport dynamics or create a positive sediment budget to assist wetlands against erosion and sediment loss, and wetlands creation and restoration (USACE and PA 2009; NYCDEP 2014; NPS 2014a). These trends have a beneficial impact on the soils and sediments in the area by maintaining and restoring stable coastal habitats in the project area, including Jamaica Bay and the larger Hudson–Raritan Estuary.

Actions taken by the New York Regional Transportation Authority immediately after Hurricane Sandy to repair a breach at East Pond and restore rail service enabled the pond to recently return to near freshwater conditions. Additional wetland mitigation and restoration efforts in Jamaica Bay, such as those included in the *Jamaica Bay Watershed Protection Plan* (NYCDEP 2014) and other post-Hurricane Sandy efforts have been focused on ecological restoration and protection of the saltmarsh islands and other natural areas. These efforts have and would continue to have long-term benefits to soils and sediments by improving natural habitats.

Despite the beneficial improvements from recent environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay, the historical impact of environmental degradation associated with coastal and urban development and pollution over time continues to adversely influence soils and sediment conditions. Therefore, past, present, and reasonably foreseeable actions have resulted in primarily negative impacts on soils and sediments. Taken together, these actions would result in substantial long-term adverse impacts to the soils and sediments in and around West Pond due to the level of historical and continued sources of pollution entering the bay.

When the largely adverse impacts on soils and sediments under alternative A are combined with the impacts from past, present, and reasonably foreseeable actions, alternative A would contribute a slight adverse increment to the overall substantially adverse cumulative impact.

Conclusion

Alternative A would not include any active restoration or other construction efforts that would change soil and sediment conditions at West Pond. Adverse impacts to soils and sediments at West Pond would result from continued exposure to tidally influenced water flows and scour and the continued widening and loss of structural integrity at the breach. The secondary breach would continue to experience increased pressure from storm waves and storm surge. Overall, alternative A would have a largely adverse impact on soils and sediments. Alternative A would contribute a slight adverse increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE B: REPAIR THE BREACH AND IMPROVE HABITAT CONDITIONS, THE NPS PREFERRED ALTERNATIVE

Impacts

The analysis of impacts to soils and sediments for alternative B is organized according to phase 1 and future phases of project activity. An analysis of the impacts associated with each of the three options for water supply to West Pond to shift the current salinity in West Pond from an estuarine system (saline) to levels closer to a palustrine system (freshwater) are discussed within the phase 1 analysis, in addition to the impacts associated with the installation of the water control structure. Impacts associated with future phases of work include impacts related to upland habitat restoration at Terrapin Point, shoreline restoration, saltmarsh restoration, and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage). Impacts on soils and sediments that are applicable to phase 1 and future phases of the project are described at the end of the section.

Phase 1. Construction activities during phase 1 would disturb soils and sediments in different ways ranging from direct disturbance at the site of construction (for example, at the primary and secondary breach areas), to movement of construction vehicles and equipment, to soil runoff and sedimentation. Construction activities would involve land-based activities that could create erosion and runoff into West Pond, Jamaica Bay, and adjacent wetlands.

Construction activities would require the use of mechanized equipment and staging for this equipment would be designated in previously disturbed areas to minimize adverse impacts. Construction activities impact soils by disrupting compaction and impervious surfacing. This alters how much water runs through the soil versus running over the soil (runoff). An undisturbed site has approximately 40% - 55% pore space in the soils and 15% surface water runoff (State of Oregon Department of Environmental Quality 2001). After construction, the same site may end up 55% - 70% surface water runoff (State of Oregon Department of Environmental Quality 2001) depending on the type of soils. The pore spaces are responsible for water infiltration and when lost can take decades to replenish (state of Oregon Department of Environmental Quality 2001). Since this site was previously disturbed, it is difficult to determine how long the soils would take to recover. Increases in runoff rates would lead to higher erosion rates with adverse impacts to soils and sediments.

Construction activities and earthmoving equipment accessing the primary and secondary breach areas would adversely impact soils and sediments at several locations around West Pond including uplands (approximately 7.3 acres) along the perimeters of the loop trail; approximately 0.08 acres of upland, intertidal sand, emergent wetland at the secondary breach location; 1.6 miles of trail which would be cleared of stabilizing vegetation to accommodate construction equipment; and two 50 ft^2 areas would be cleared of vegetation for construction vehicle turnarounds. These activities would remove stabilizing vegetation, compact soils, and increase runoff. The loop trail around West Pond would be restored under alternative B and resurfaced with pervious materials such as crushed fines or fine gravel. Heavy construction equipment would use the trail for accessing the primary and secondary breach areas, which would compact soils along the trail and construction footprint. Any damage to soils along the trail would be addressed once construction was completed. Due to the sloping nature at the primary breach site, erosion during any construction would be expected to be high and to create sedimentation. Based on the preliminary engineering design, repair of the primary breach could require importing 110,700 ft^3 fill to repair the berm. Only appropriately sourced fill would be used to minimize contaminants to the area and would be chosen in accordance with regulatory permits. At the secondary breach, construction impacts would be localized to the footprint of the existing weakened area where stabilization measures would be installed. Construction impacts on soils and sediments would be expected to be adverse, limited to the period of construction activities, and localized to the project site. Best management practices would be in place to minimize these impacts (see the “Mitigation Measures” section in chapter 2). With best management practices in place, sedimentation would be localized and dissipate shortly after the completion of construction related activities, with relatively minor adverse impact.

Repair of the primary breach would restore the pond similar to prehurricane conditions. By filling the breach, the pond would no longer be tidally influenced. Filling the breach would stabilize the embankments. The repair work at the breach would result in beneficial impacts on the structural function of sediments of West Pond. Breach repair would also eliminate impacts due to tidal flow from within the pond, which is creating an ever-weakening barrier between West Pond and Jamaica Bay. Repair efforts at the site of the secondary breach would reduce increased pressure from storm waves and storm surge from within the pond boundaries under alternative B. Removing tidal flow would result in beneficial impacts on the structural function of the sediments of West Pond. Filling the breach would strengthen the barrier between West Pond and Jamaica Bay, which has likely become progressively more vulnerable to storms – particularly at the point of the secondary breach. Filling the breach and stabilizing the banks would make reestablishing vegetation successful in this area. As root systems stabilize soils and sediments by anchoring them vertically and laterally in both wetland and upland habitats, soils and sediments would become less vulnerable to erosion and storm impacts because they have been bound and retained within the roots of the vegetation. This would slow the erosion of exposed areas, accelerate the process of soil and sediment recovery, and create a more stable configuration in this location. Because of the stabilizing benefits to soils and sediments, repair of the breaches would provide slightly beneficial impacts on soils and sediments in the area.

Installation of the water control structure would have construction associated impacts at the time the structure was installed over a period of 3 to 5 days. The new water control structure would be installed adjacent to the existing one. The placement of a water control structure would require approximately 0.15 acres of excavation, and then fill would be needed. Construction impacts on soils and sediments would be expected to be adverse, limited to the period of construction activities, and localized to the project site. Best management practices would be in place to minimize these impacts (see the "Mitigation Measures" section in chapter 2). With best management practices in place, sedimentation would be localized and dissipate shortly after the completion of construction related activities, with relatively minor adverse impact.

Groundwater Well –Impacts to soils and sediments associated with the installation of a groundwater well to supplement natural precipitation and runoff as a water supply to the pond would be related to construction and use of the well water. Well installation-related impacts would be similar to the general construction impacts described above, including localized soil and sediment disturbance for installation of the well and the associated pipeline. Well construction activities would disturb soils and sediments in different ways ranging from direct disturbance at the site of construction to movement of the drill rig and equipment, to soil runoff and sedimentation. Construction activities would involve land-based activities that could create erosion and runoff into West Pond or Jamaica Bay. The well site would be located in an area that would avoid wetlands and seasonally flooded areas, avoiding compaction of wetland soils. Best management practices and mitigation measures (see chapter 2) would be used to minimize the effects of erosion and avoid burying sediments. Construction activities would require the use of mechanized equipment and potentially short term staging for this equipment would be designated in previously disturbed areas to minimize adverse impacts. Well installation equipment would impact soils in the immediate vicinity where a groundwater well would be drilled over a very short period of time (estimated 3 to 5 days). Installation of a pipeline for water conveyance would depend upon the location of the well. However, with the use of mitigation measures, adverse impacts would be temporary and negligible. Construction impacts on soils and sediments would be expected to be adverse, limited to the period of construction activities, and localized to the project site. Best management practices would be in place to minimize these impacts (see the "Mitigation Measures" section in chapter 2). With best management practices in place, sedimentation would be localized and dissipate shortly after the completion of construction related activities, with relatively minor adverse impact.

The use of groundwater to supplement West Pond, coupled with seasonal drawdowns and seasonal replenishment would have a negligible beneficial impact on soils and sediments within the pond. Fecally derived bacteria and nutrient loadings would be diluted when the pond was replenished and replenished and water quality conditions may serve to minimize contaminant accumulations in the sediment.

Municipal Water Source – There would be construction impacts to soils and sediments associated with the installation of a pipeline connection to municipal water. With the use of best management practices, the impact to soils and sediment from installation of municipal drinking water source would be similar to those described for the groundwater well. There would be temporary adverse construction impacts localized to the area of the connection to the municipal system and for the conveyance system. Similar to the impacts described for groundwater well installation and piping, the use of best management practices (see "Mitigation Measures" section in chapter 2) would minimize impacts. The conveyance system would be designed and installed to minimize erosion and sedimentation. With best management practices in place, sedimentation and erosion would be localized and dissipate shortly after the completion of construction related activities, with relatively minor adverse impact.

The use of municipal to supplement West Pond, coupled with seasonal drawdowns and seasonal replenishment would have a negligible beneficial impact on soils and sediments within the pond. Fecally derived bacteria and nutrient loadings would be diluted when the pond was replenished and replenished and water quality conditions may serve to minimize contaminant accumulations in the sediment.

Precipitation – An option of this alternative would consider relying solely on freshwater replenishment from precipitation and runoff. There would be no construction-related impacts associated with the option of relying solely on precipitation and runoff as a freshwater source for West Pond. Relying only on natural precipitation and runoff, in combination with management abilities provided by the water control structure, would result in a more gradual transition to freshwater conditions within West Pond. This would have no effect on soils and sediments.

Future Phases. Under future phasing of alternative B, shoreline habitat restoration activities at Terrapin Point would disturb approximately 3.7 acres of soils and sediments during construction. Upland vegetation restoration efforts at Terrapin Point would disturb some soils in the approximate 4.9 acres where invasive plants and thinning of vegetation would occur. Saltmarsh restoration activities would disturb approximately 5 acres of soils and sediment along the southern border of the berm during the timeframe where planting and later monitoring would take place. Details regarding the restoration process of the high marsh restoration (hydrologic restoration, excavation, grading, plantings, etc.) are not available at this conceptual stage of the project. Access to project locations may, however, require national recreation area staff, volunteers, and contractors to traverse existing low saltmarsh, but this pedestrian access is expected to result in only temporary impacts to sediments in these areas. Construction related impacts would be limited to the period of construction, localized to the area of construction, and minimized by the implementation of best management practices (see chapter 2). Overall, with the use of best management practices, and because any impact-related disturbances on sediments in these wetlands areas would be expected to stabilize, any impacts on sediments from construction activities associated with restoration and construction would be considered minimally adverse. With best management practices in place, sedimentation and erosion would be localized and dissipate shortly after the completion of construction related activities, with relatively minor adverse impact.

There would be some adverse impacts to soils during future phases from the installation of boardwalks and observation areas would disturb an estimated 3,000 linear feet of soils at three locations around West Pond. The new trail around Terrapin Point would disturb approximately 1,700 linear feet as shown in figure 5. There would also likely be some soil compaction during the installation process and during use should visitors move off of designated trails. These impacts would be considered relatively slight because of the small area affected and because of outreach efforts to increase visitor awareness about sensitive resources and the need to stay on the trail. With best management practices in place, sedimentation and erosion would be localized and dissipate shortly after the completion of construction related activities, with relatively minor adverse impact.

Construction activity in future phases could have additional impacts to the soils along the trail depending on how construction vehicles access work sites. These types of impacts would include fill, compaction, and disturbance similar to the impacts described above during phase 1 work where approximately 4.1 of upland area along the existing trail would be disturbed to allow for construction vehicular access compacting soils along the construction pathway. However, only a portion of the trail may be impacted because of the location of future amenities may not require disturbing the entire trail distance. This would be determined during detailed design. As described under phase 1, disturbed portions of the loop trail around West Pond would be restored and resurfaced with pervious materials such as crushed fines or fine gravel once construction was completed on future phases of work. Construction impacts on soils and sediments would be expected to be adverse, limited to the period of construction activities, and localized to the project site. Best management practices would be in place to minimize these impacts (see the "Mitigation Measures" section in chapter 2). With best management practices in place, disturbance of soils would be localized and sedimentation would dissipate shortly after the completion of construction related activities, with relatively minor adverse impact.

Common to Phase 1 and Future Phases. Regardless of phase, stabilization through shoreline and saltmarsh restoration efforts and the regrowth of vegetation in the pond and upland areas would have large beneficial impacts because root systems stabilize soils and sediments by anchoring them vertically and laterally in both wetland and upland habitats. These efforts would make soils and sediments less vulnerable to erosion and storm impacts because they have been bound and retained within the roots of the vegetation. Impacts under alternative B phase 1 and future work associated with bank stabilization and restoration efforts would slow the erosion of exposed areas, accelerate the process of soil and sediment recovery, and create a more stable configuration. Because of the long term benefits expected by these stabilizing activities, their impact on soils and sediments over time would be considered largely beneficial.

Foot traffic and visitor use of trails can compact soils by reducing the amount of open pore space. Compaction in general reduces water and air movement through the soil. Compacted soils can create drainage and flooding problems. However, designating trails localizes these impacts to the trail location, creating a beneficial impact to an area where foot traffic is anticipated. In addition, the majority of the trail construction activity is located along the previously disturbed path of the existing trail. Because of the long term benefits expected from redesignating the trail around the pond, designating the trail at Terrapin Point, installing boardwalks and blinds, and increasing outreach, the overall impact on West Pond soils and sediments from these project features would be considered slightly beneficial.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative B would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years has had substantial adverse cumulative impacts on soils and sediment retention, whereas more recent ongoing efforts to restore saltwater wetlands in Jamaica Bay, as well as steps taken to improve watershed conditions would provide beneficial impacts to soils and sediment retention. Collective management actions and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial long-term benefits to sediment accumulation and marsh accretion in Jamaica Bay inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to soils and sediments in and around West Pond due to the level of historical and continued sources of pollution entering the Jamaica Bay estuary.

Under phase 1, the primary and secondary breach would be repaired. Associated construction activities would have a negligible contribution to the existing adverse cumulative impacts on soils and sediments because with best management practices in place, sedimentation would be localized and dissipate shortly after the completion of construction related activities, with relatively minor adverse impact. Repairing the breaches at West Pond and reestablishing freshwater habitat would have a negligible contribution on the existing adverse cumulative impacts on soils and sediments because it would create a closed system and those soils and sediments in the 44-acre pond would no longer interact with the much larger bay's sediment budget. Habitat restoration activities proposed under future phases of alternative B would contribute moderately beneficial cumulative impacts on soils and sediment retention. Past, present, and reasonably foreseeable actions would result in substantial adverse impacts to the soils and sediments in and around West Pond due to the level of historical and continued sources of pollution entering Jamaica Bay. When the impacts on soils and sediments under alternative B are combined with the impacts from past, present, and reasonably foreseeable actions, alternative B would contribute a slight beneficial increment to the overall substantially adverse cumulative impact of soils and sediments.

Conclusion

Under phase 1, construction activities and earthmoving equipment accessing the primary and secondary breach areas would impact soils and sediments at several locations around West Pond including uplands along the perimeters of the loop trail; upland, intertidal sand, emergent wetland at the secondary breach location; areas that would be cleared of stabilizing vegetation to accommodate construction equipment; and two areas that would be cleared of vegetation for construction vehicle turnarounds. Due to the localized nature of the construction activities, the use of best management practices, and soil stabilizing revegetation efforts, long-term consequences to soils and sediments would not be expected to result from construction activities associated with phase 1. Therefore, impacts on soils and sediments from construction associated with implementation of phase 1 would be considered negligible. Over the long-term, repairing the breaches and stabilizing the banks would provide slightly beneficial impacts to soils and sediments by reducing the increased pressure from storm surge and improving the success of reestablished soil-stabilizing vegetation. In addition, the redesignation of the loop trail would localize soil impacts to the trail and further reduce erosion.

Under future phases of construction, habitat restoration activities would contribute largely beneficial long-term impacts to soils and sediments because of the increased soils and sediment stabilization these efforts would afford.

When the largely beneficial impacts on soils and sediments under alternative B are combined with the impacts from past, present, and reasonably foreseeable actions, alternative B would contribute a slight beneficial increment to the overall substantially adverse cumulative impact of soils and sediments.

IMPACTS OF ALTERNATIVE C: CREATE DIFFERENT TYPES OF HABITAT

Impacts

Construction related impacts to soils and sediments would be associated with berm and pond reconfiguration, changes to intertidal conditions near Terrapin Point, installation of a water control structure and a water source, and other actions such as installation of boardwalks and trails. The types of soil and sediment construction related impacts include disturbance, compaction, removal, fill, erosion, and sedimentation. Construction activities would involve land-based activities that would create erosion and runoff into West Pond, Jamaica Bay, and adjacent wetlands. Best management practices would be used to minimize the effects of erosion and avoid burying sediments; however, because of the extent of construction and ground disturbance, some adverse impacts would be expected during and after construction.

It is estimated that it would take up to 3 years to complete construction because of the relatively large scale of the project and seasonal construction windows (roughly November to April). During construction pauses, erosion and sediment controls would require monitoring and maintenance for effectiveness. Construction related impacts to soils and sediments would occur during the construction period and last through a period of recovery while the site stabilizes. An undisturbed site has approximately 40% - 55% pore space in the soils and 15% surface water runoff (state of Oregon Department of Environmental Quality 2001). After construction, the same site may end up 55% - 70% surface water runoff (state of Oregon Department of Environmental Quality 2001) depending on the type of soils. The pore spaces in the soils are responsible for water infiltration and when lost can take decades to replenish (state of Oregon Department of Environmental Quality 2001). Since this site was previously disturbed, it is difficult to determine how long the soils would take to recover.

Construction activities would require the use of mechanized equipment and staging for this equipment would be designated in previously disturbed areas to minimize adverse impacts.

Construction equipment would adversely impact soils and sediment during the installation of the water control structure; however, the impact would be localized to a relatively small area where the structure would be placed and along the access route to the structure. These impacts would be considered slightly adverse. There would also be slightly adverse impacts to soils and sediment in the immediate small area where the groundwater well would be drilled and installed over a few days (estimated at 3 to 5 days). A drill rig and associated equipment would compact and disturb soils while accessing the site where a groundwater well would be drilled. Installation of a pipeline for water conveyance would depend upon the location of the well. However, with the use of mitigation measures (see chapter 2), adverse impacts would be temporary and negligible.

Construction of the berm and reconfiguration of the pond would require substantial earth movement and adverse impacts to soils and sediment in the study area. Temporary impacts during construction would be intensive, including substantial disturbance to the majority of the land surface in and around the previously existing West Pond. Saltmarsh habitat restoration activities between the newly created island and West Pond would disturb approximately 14.3 acres and freshwater wetland restoration activities would disturb 32.3 acres of soils and sediments. Creating vertical relief for the berm would require approximately 1,750,000 ft^3 of fill. These magnitudes of fill and disturbance are preliminary and subject to final design and are provided for purposes of relative comparison. Collectively, reconfiguring the berm and West Pond as a smaller ponded area and reestablishing freshwater wetlands would disturb approximately 36.6 acres (including 32.3 acres of wetlands and 4.3 acres of existing upland habitat) of soil and sediment across the project area causing substantial erosion of soils and sedimentation related adverse impacts during construction. Erosion during construction would be expected to be extremely high during berm construction as fill occurs, and this would cause sedimentation. Because berm construction could require importing fill, only appropriately sourced fill would be used to minimize contaminants to the area and would be chosen in accordance with regulatory permits. Construction impacts on soils and sediments would be expected to be large and adverse and would extend beyond the period of construction activities until vegetation takes root to help stabilize site conditions along the berm. These impacts would be across to the study area in proximity to ground disturbing construction efforts.

Reconfiguration of the berm and the pond would alter freshwater and saltwater conditions across the site. Once established, the reconfigured West Pond would be more buffered by wetlands, which would contribute to stabilized embankments and less tidal scouring of the berm with long term beneficial impacts on the structural function of sediments near the pond. Moving the berm and pond would have beneficial impacts because it would strengthen the barrier between the West Pond and Jamaica Bay, which would likely have become progressively more vulnerable to storms.

Saltmarsh restoration and freshwater wetland restoration efforts would help stabilize soils and sediments once they were established. Stabilization through restoration of saltmarsh and freshwater habitats and growth of native vegetation would have a substantial beneficial impact because root systems stabilize soils and sediments by anchoring them vertically and laterally. These impacts would be beneficial over time; however, due to the substantial area of disturbance, recovery/transition would last longer than the predicted 2 to 3 year construction timeframe, and would likely take multiple growing seasons before soils and sediments would stabilize across the site.

Reconfiguration of the berm and the pond would alter freshwater and saltwater conditions across the site. Once established, West Pond would be more buffered by wetlands, which would contribute to stabilized embankments, and less tidal scouring of the berm, with long term beneficial impacts on the structural function of sediments near the pond. Moving the berm and pond would strengthen the barrier between the West Pond and Jamaica Bay, which would likely become progressively more vulnerable to storms.

Restoring the channelized saltmarsh between Terrapin Point and West Pond would disturb approximately 14.3 acres with substantial adverse construction related impacts that would occur over a 2 to 3 year period or longer. These changes and the newly created berm of West Pond would change sedimentation dynamics due to tidally influenced water flows. Deposition of sediments would also be expected to change with tidal conditions proposed to be altered in the vicinity of a newly created island, Terrapin Point. The potential for erosion would be higher in this area as the island would be subject to an unknown and new tidal regime. The adverse impacts to sediments in the vicinity of Terrapin Point could be severe and long-term over the life of the project.

Under alternative C, a new 1.3-mile trail system would be constructed along the newly constructed berm and around West Pond, and a 0.8-mile loop trail would be constructed at Terrapin Point with adverse impacts such as soil compaction and erosion. Construction equipment could use portions of the existing loop trail around West Pond for access during earth movement activities. Construction access along the loop trail would be similar to that described for alternative B to include vegetation clearing within 15 feet of either side of the centerline of the trail, soil disturbance, and compaction. Any damage to the portions of the trail that would be maintained under alternative C and used by construction vehicles would be repaired upon completion of site work. Although a greater impact would occur during construction, there would be some impacts during trail use. Foot traffic and visitor use of trails can compact soils by reducing the amount of open pore space. Compaction in general reduces water and air movement through the soil. Compacted soils can create drainage and flooding problems. However, designating trails localizes these impacts to the trail location, creating a beneficial impact to an area where foot traffic is anticipated.

Installation of boardwalks and observation areas would disturb an estimated 3,600 linear feet of soils and sediments at four locations around the newly created West Pond as shown in figure 6. These impacts would be considered temporary during construction. Best management practices would be in place to minimize these impacts (see the “Mitigation Measures” section in chapter 2). With best management practices in place, disturbance of soils would be localized and sedimentation would dissipate shortly after the completion of construction related activities, with relatively minor adverse impacts from construction and use.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative C would be similar to those described for alternative A. The past, present, and reasonably foreseeable actions would result in substantial long-term adverse impacts to the soils and sediments in and around West Pond due to the level of historical urbanization and development and continued sources of pollution entering Jamaica Bay. Collective management actions and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial long-term benefits to sediment accumulation and marsh accretion in Jamaica Bay inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to soils and sediments in and around West Pond due to the level of historical and continued sources of pollution entering the Jamaica Bay estuary.

Associated construction activities would have a substantial contribution to the existing adverse cumulative impacts on soils and sediments because even with best management practices in place, the relatively large scale of the project and relatively long construction period (up to 3 years) spread over seasonal windows, there would be adverse impacts including unknown outcomes when a new tidal regime was established. Habitat restoration activities proposed under alternative C would contribute moderate beneficial cumulative impacts on soils and sediment retention once the site was stabilized, yet it is difficult to determine how long the soils would take to become fully functional. Past, present, and reasonably foreseeable actions would result in substantial adverse impacts to the soils and sediments in and around West Pond due to the level of historical and continued sources of pollution entering Jamaica Bay. When the adverse and beneficial impacts on soils and sediments under alternative C are combined with the impacts from past, present, and reasonably foreseeable actions, alternative C would contribute a substantial adverse and minor beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Implementation of alternative C would result in substantial adverse construction-related impacts to soils and sediment because of extensive ground disturbance, compaction, material removal, fill, erosion and sedimentation, and alteration of tidal regimes. Construction activities would involve land-based activities that would create substantial erosion and runoff into West Pond, Jamaica Bay, and adjacent wetlands. Vigilant best management practices (including monitoring and maintenance over the multi-season/multi-year construction period) would be used to reduce the effects of erosion and sedimentation.

The period of construction for alternative C could be up to 3 years because of the magnitude of earthwork required and the environmental and other applied work restrictions. Because of the extent of construction and substantial disturbance across the study area, the timeframe for the area to stabilize after completion would take multiple growing seasons and the timeframe to regain fully functioning soils is unknown.

Over time, beneficial impacts would result from stabilization of site conditions associated with reconfiguring the berm, habitat restoration activities, and establishing a pond that is more buffered from Jamaica Bay. Reestablishing freshwater habitat in the pond through freshwater replenishment by groundwater (aided by natural precipitation) would have no effect on soils and sediments during the initial fill and subsequent replenishments over time.

When the adverse and beneficial impacts on soils and sediments under alternative C are combined with the impacts from past, present, and reasonably foreseeable actions, alternative C would contribute a substantial adverse and minor beneficial increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE D: BRIDGE THE BREACH

Impacts

Under alternative D, the primary breach at West Pond would be bridged, the secondary breach would be stabilized, and West Pond would continue to function as a tidally influenced area. Soils and sediments would be impacted by construction activities associated with bridging the breach, bank stabilization measures, and installation of boardwalks and observation platforms. These activities would impact soils and sediments via disturbance, compaction, fill, erosion, and sedimentation. Land-based construction activities would create erosion and runoff into West Pond, Jamaica Bay, and adjacent wetlands. With best management practices in place (see chapter 2), construction impacts on soils and sediments would be expected to be adverse but limited to the period of construction activities and localized to the project site.

Construction activities would require the use of mechanized equipment and staging for this equipment would be designated in an area of previously disturbed soils to avoid impacts. During construction, up to approximately 4.1 acres (15 feet on either side of the 1.6-mile trail and a 50 foot by 50 foot vehicle turn around) of upland area along the existing trail would be disturbed to allow for construction vehicular access to the primary and secondary breach areas, compacting soils along the construction pathway. Construction equipment would disturb or compact soils within these areas. Up to approximately 4.1 acres of upland soils would be disturbed during construction and a small portion of intertidal sand and mud flat substrate within the breached area could be disturbed during placement of supporting infrastructure on either side of the bridge.

Additional measures to reinforce the secondary breach would involve placing gabion baskets along the pond-side edge and backfilling the eroded embankments on either side of the trail to tie into the adjacent slope, disturbing up to approximately 0.08 acres of upland and intertidal sand and emergent wetland. In addition, installation of boardwalks and observation areas would disturb an estimated 3,300 linear feet of soils and sediments at three locations around West Pond as shown in figure 7.

Stabilization of soils and sediments within and adjacent to the breach would reduce erosion and control erosion/widening of the breach. However, soils and sediments would continue to be subjected to some movement and redistribution from precipitation, runoff, and overbank channel flows during high water. Bridge/culvert and associated bank stabilization related impacts would be long-term, localized, and slight beneficial on soils and sediments at the site of the breach. Stabilization efforts would also occur at the site of the secondary breach and would reduce pressure from tidal waters, storm waves, and storm surge from within the pond boundaries at this weakened location.

Maintaining tidally influenced conditions would subject the pond boundaries to continued scouring. This would create an ever-weakening barrier between the West Pond and Jamaica Bay. Stabilization efforts would occur at the breach and the secondary breach; however, other areas are potentially vulnerable over time and more specifically during storm events. Impacts from tidal flow and storm surge would result in long-term slight adverse impacts on the structural function of soils and sediments of margins of West Pond.

Construction impacts related to the installation of boardwalks and observation areas would be similar to those described for alternative B.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative D would be similar to those described for alternative A. The past, present, and reasonably foreseeable actions would result in substantial long-term adverse impacts to the soils and sediments in and around West Pond due to the level of historical and continued sources of pollution entering Jamaica Bay. When the impacts on soils and sediments under alternative D are combined with the impacts from past, present, and reasonably foreseeable actions, alternative D would contribute a slight beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Under alternative D, construction related activities would impact soils and sediments via disturbance, compaction, fill, erosion, and sedimentation. With best management practices in place, impacts would be expected to be adverse but limited to the period of construction activities and localized to the project site. Maintaining tidally influenced conditions would subject the pond boundaries to continued scouring. This would create an ever-weakening barrier between West Pond and Jamaica Bay. Over time, some slight beneficial impacts would result from the increased structural integrity at the breach and secondary breach. However, other areas of the berm would remain potentially vulnerable over time and more specifically during storm events. Impacts from continued tidal flow and storm surge would result in long-term adverse impacts to the structural function of soils and sediments along the margins of West Pond. The impacts of alternative D would have both slightly beneficial and slightly adverse impacts to soils and sediment.

When the adverse and beneficial impacts on soils and sediments under alternative D are combined with the impacts from past, present, and reasonably foreseeable actions, alternative D would contribute a slight beneficial increment to the overall substantially adverse cumulative impact.

WATER RESOURCES

AFFECTED ENVIRONMENT

West Pond is approximately 44 acres and was 3 to 4 feet deep on average prior to Hurricane Sandy. Reports indicate that water levels in West Pond were historically managed by the NPS through a water control structure (Maillacheruvu and Roy 1999; Ringenary 2014). However, the NPS has indicated that this structure has not been operational for several years and repairs were pending funding at the time that Hurricane Sandy struck (NPS 2014b). At one point, the structure controlled multidirectional flow in order to manage pond water levels (Ringenary 2014) in order to create mudflats along the perimeter of the pond for bird habitat. Since the breach, West Pond has been exposed to the semidiurnal tides of Jamaica Bay. The breach also allowed pond water to be flushed during storms by wave action and high water flowing into the inner pond. Because of the flushing, current water quality reflects the quality of Jamaica Bay (as described later in this section). Some soils and sediments at the primary breach have eroded and been transported through the breachway into the pond and out into the bay. In spite of the movement of sediments, tidal flushing has been shown to maintain water quality by removing organic and inorganic nutrients and coliform organisms in other systems on Long Island (USEPA 1971).

Jamaica Bay is a tidal estuary with an average depth of 13 feet with dredged channels ranging from 30 to 50 feet deep (NYCDEP 2007). Tidal exchange in Jamaica Bay occurs with the Atlantic Ocean through Rockaway Inlet (NYCDEP 2011). Flushing time in a body of water, such as an estuary like Jamaica Bay, is an important factor to consider as it reduces concentrations of pollutants and raises valuable oxygen levels. Flushing time in Jamaica Bay is influenced by tidal currents, natural flows, and freshwater inputs (runoff, wastewater outfalls, rivers, precipitation, etc.). Much of the development around Jamaica Bay, including extensive filling operations, hardening of shorelines, deep channel dredging, and eradication of natural habitats have altered historic flow patterns and increased the historic flushing time in the bay. Flushing times vary across Jamaica Bay and estimates for Grassy Bay in the east (farthest from the inlet) have been measured at one week (GATE and Columbia Earth Institute 2000) for the upper 5 meters of the water.

Wetlands in the refuge and near West Pond play a vital water quality function. Wetlands improve water quality by removing sediments and contaminants (NPS 2014 a). The saltmarshes around the bay store water, transform nutrients, and grow living matter (see the “Wetlands and Floodplains” section for more information).

Coastal flooding is very likely to increase in frequency, extent, and height as a result of increased sea levels (NYCPCC 2013). Therefore, increased shore erosion and inundation of wetlands and low-lying lands are anticipated. The area around West Pond is highly susceptible to all such impacts. According to the scenarios presented in the 2013 report by the New York City Panel of Climate Change, low-lying coastal areas, like West Pond, are at a high risk for rising water (NYCPCC 2013). The impact of sea level rise predicted at West Pond is depicted in figures 10 and 11. As sea levels approximate the 2050 scenario (31 inches), shorelines, including those at West Pond that are exposed to Jamaica Bay, may be recontoured under the pressure of new water flows and erosion leading to localized changes in water quality parameters.

Surface Water Quality

West Pond water levels were historically managed by the NPS through a water control structure (Maillacheruvu and Roy 1999; Ringenary 2014). Structural controls also allowed flushing to prevent nutrient build-up and low oxygen levels (Maillacheruvu and Roy 1999). In addition to inflow/outflow from Jamaica Bay, the pond received input/output from the natural water cycle (precipitation and evaporation) leading to a brackish condition, with salinity levels ranging from 3.58 to 5.20 parts per thousand. These and other historic water quality parameters are summarized in table 5.

As an important bird habitat during spring and fall migration, the pond would accumulate fecally derived bacteria and nutrient loadings because of its small size and its restricted dilution capacity. Nutrient loading from these migratory bird populations would contribute to the process of eutrophication leading to peaks of poor water quality in the spring and the fall (Maillacheruvu and Roy 1999).

Table 5: Historic Water Quality in West Pond

Factor	West Pond (1999)	Jamaica Bay 2012 (Pre- Hurricane Sandy)
Salinity (milligrams per Liter)	3,580 to 5,200	23,000 to 27,000*
Dissolved Oxygen (DO) mg/L	8.42	5.7
Conductivity (mS)	6.84 to 8.I2	-
Turbidity	19.47 to 222.37	-
pH	7.74 to 9.08	-
Nitrate (mM)	0.068 to 0.1	-
Ammonia (mM)	0.01 to 0.8	-
Chlorophyll ‘a’ (µg/L,)	-	18.9
Total suspended solids (TSS)	-	94%
Carbonaceous biochemical oxygen demand (CBOD)	-	96%
Bacteria – Fecal coliform (cells per 100 mL)	-	100.3
Bacteria – Enterococci (cells per 100 mL)	-	3.2

"-" indicates data not available.
Sources: Maillacheruvu and Roy 1999; NYCDEP State of Harbor 2012 (pre-Hurricane Sandy); *NYCDEP 2007

The water quality of West Pond is influenced by conditions in Jamaica Bay and the watershed in which it is located. The Jamaica Bay watershed includes portions of the boroughs of Brooklyn and Queens and Nassau County (NYCDEP 2011). Water quality in Jamaica Bay has been degraded by a variety of human activities across this watershed, including a long history of development, industry, agriculture, dredging, and recreational activities. The largest factors impacting water quality are nutrient inputs from point and nonpoint sources, sedimentation, and loss of water clarity. Development across the watershed also added hardened and impervious surfaces that are causing excess sediment to be conveyed as runoff instead of infiltration and recharge of groundwater aquifers. Point sources such as wastewater pollution control plants, combined sewer overflow pipes, and sewage effluents flow directly into Jamaica Bay providing nitrogen, phosphorous, silica, carbon, pathogens, nickel, zinc, copper, cadmium, and heavy metals inputs (NYCDEP 2007). Landfill leaching is a smaller source of heavy metals, and atmospheric deposition is the most important source of lead contamination (NYCDEP 2007) as well as pharmaceuticals, soaps, floating debris (e.g., trash), and toxic runoff from the John F. Kennedy International Airport (USACE and PA 2009). Benotti et al. (2007) reported a total nitrogen load to Jamaica Bay estimated at 15,785 kilograms per day from wastewater-treatment plants (89%), combined sewer overflow/stormwater discharge during heavy precipitation, and subway dewatering. Excess nitrogen is an increasing problem in Jamaica Bay and can lead to algae growth and low oxygen conditions. Because a major source of excess nitrogen in the bay comes from municipal sewage treatment plants, New York State Department of Environment Quality and New York City Department of Environmental Protection are working together to reduce nitrogen inputs by 2020 from four municipal sewage treatment plants (NYCDEP 2014). These reductions are expected to cut nitrogen loads by 60% by 2020 (over 2010 levels).

The New York City Department of Environmental Protection has operated a water quality monitoring program for over a century. The Department's Harbor Survey Program uses four indicators of water quality in Jamaica Bay– fecal coliform bacteria, dissolved oxygen, chlorophyll 'a' and water clarity (see table 5). Jamaica Bay is classified as 'Impaired' for the following uses: public bathing, aquatic life, recreation, habitat/hydrology, and 'Stressed' for aesthetics and fish consumption under the State's water quality standards (NYCDEP 2012). Increased water temperature, changes in the amounts of precipitation, increase in the intensity and amount of runoff, and the intensity and frequency of coastal storms are climate-related changes (NYCPCC 2013) that could, in turn, affect the water quality of Jamaica Bay and therefore West Pond since the breach. Warmer waters lead to increases in microbial populations and harmful algal blooms. They can also lead to reduced dissolved oxygen, which may more readily mobilize persistent pollutants and mercury. Increased precipitation events would flush contaminants into low-lying waterways impacting water quality by concentrating pollutants in runoff (IPCC 2007).

Groundwater and Hydrogeology

The aquifers below Kings and Queens Counties where West Pond is located have been thoroughly studied. Much hydraulic data from historical studies have been incorporated into various U.S. Geological Survey (USGS) reports including Water Resources Investigations Report (WRIR) 98-4071. Additional background data regarding groundwater and the hydrogeology of the region is provided in appendix C.

The Raritan Formation, consisting of the Lloyd Sand Member and an unnamed clay member, directly overlies the igneous and metamorphic bedrock. Overlying the Raritan Formation is the Magothy Formation and Matawan Group (undifferentiated), the Jameco Gravel, the Gardiners Clay, and upper Pleistocene deposits. Rockaway Peninsula and Coney Island consist of Holocene fluvial deposits. There are four relevant water bearing formations on Long Island: The Upper Glacial, Jameco, Magothy, and Lloyd aquifers. Each of the aquifers located in Queens County (and therefore the West Pond area) are of high transmissivity (except where they thin or pinch out), with hydraulic conductivity values ranging from approximately 20 – 300 feet/minute (ft/min). Using the unit thicknesses below Jamaica Bay, wells completed in the Jameco, Magothy, and Llyod aquifers are expected to have specific capacities ranging from 44 - 135 gallons per minute per foot (gpm/ft) of drawdown (Misut and Monti 1999).

The upper Pleistocene glacial deposits represent the uppermost water-bearing unit and are in contact with saline surface water; therefore, they do not represent a reliable source of freshwater. This conclusion is supported by the U.S. Geological Survey (2002), Barlow (2003, in USGS (n.d.) and NYCDEP 2015). The combined Jameco-Magothy aquifer is reported to be confined to semi-confined below Jamaica Bay; however, chloride concentrations are reported to exceed approximately 3,000 milligrams per liter (mg/L) immediately adjacent to Jamaica Bay on all sides, indicating that a saltwater wedge exists in this aquifer below West Pond. Groundwater in the Lloyd aquifer below West Pond and as far south as Rockaway Island has a low salinity (chloride concentrations of 120 mg/L (0.12 g/L) (or less) and nitrate ranging from below the limit of detection to 0.72 mg/L (Cartwright 2002). The relatively low salinity in the Lloyd aquifer below West Pond is supported by position of the saltwater wedge (see appendix C). Little water quality data apart from chloride and nitrate data are readily available, but the Lloyd aquifer is reported to have a high dissolved iron concentration (USGS 1998; personal communication with American Well and Pump Company 2015). U.S. Environmental Protection Agency Region 2 (1975) reported good water quality of the aquifers with the exception of iron which is two to five times higher than recommended for public water supply. While Raritan clay protects the Lloyd aquifer from contamination from the overlying aquifers, it also inhibits recharge (USGS 2006).

Information regarding groundwater withdrawals proximate to West Pond is summarized in appendix C. Information was obtained from the New York State Department of Environmental Conservation website using Google Earth and includes industrial and municipal wells in the area. There are no groundwater withdrawal wells identified within 3.5 miles of West Pond.

Municipal Drinking Water

An overview of the municipal drinking water supply for the vicinity of West Pond is provided as it relates to potential use of this source as part of alternative B. The New York City Department of Environmental Protection provides high quality, safe drinking water to over 8 million residents of the City of New York. The area around West Pond is included in the distribution area. The water supply originates predominantly from surface water and in 2014 all of New York's water supply came entirely from the Catskill-Delaware Watershed. The Catskill-Delaware supply is treated at the Catskill-Delaware Ultraviolet Water Treatment Facility which came online in October 2013. In May 2015, the Croton filtration plant was commissioned and provides another source of drinking water to the City's residents. The Croton Watershed supplies the filtration plant with an average of 100 million gallons per day and the new plant can treat up to 290 million gallons per day. This additional source will allow necessary repairs to be made to the Catskill-Delaware conveyance system. An overview of the municipal drinking water for the West Pond area is provided in appendix D.

The New York City Department of Environmental Protection disinfects its water with ultraviolet light (UV) and chlorine (elemental or sodium hypochlorite) as a secondary disinfectant. UV treatment is a disinfection process that works by passing the water by special lamps that emit UV light, which can inactivate harmful microorganisms. Chlorine is a common disinfectant added to kill germs and stop bacteria from growing on pipes. The water is also treated with food grade phosphoric acid, sodium hydroxide, and low level of fluoride. The treatment measures that provide water safe for public consumption also render the water unsafe for aquatic use, particularly chlorine (see appendix D for additional background information regarding toxicity to aquatic species). Because treated drinking water can be toxic to aquatic resources, there would be a need to pretreat municipal water source prior to supplementing water for wildlife use.

IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impacts

Under alternative A, West Pond would continue to be influenced by tidal exchange and flushing. Regular tidal flushing would keep the water quality higher than the formerly ponded area (pre-Hurricane Sandy conditions) because the tidal cycles would distribute and dilute potential contaminants, reduce oxygen demand, and flush excess nutrients and organic material. However, water quality would continue to match Jamaica Bay, designated as "impaired/stressed" (NYCDEP 2012), and salinity levels would also remain similar to Jamaica Bay. The majority of water quality parameters would be expected to remain similar to existing conditions and be reflective of Jamaica Bay (see table 5). There would be no changes or impacts to groundwater resources or municipal drinking water under alternative A.

Since the breach has continued to expand since Hurricane Sandy, it is likely it would continue to widen as water flows continue to scour the breach site with tidal fluctuations, high energy storm waves, and storm surge. Additionally, there would be a continued loss of structural integrity at the mouth of the breach and along the secondary breach as the height and width of the berm are subjected to continual erosion. Continued erosion of soils and sediments may lead to increased turbidity in the pond and lead to localized reductions in water quality, especially during storm events. However, suspended sediments would be expected to settle quickly and would not be expected to result in long-term adverse impacts to water resources. Impacts from tidal flow would result in no change to the current water quality of West Pond.

Cumulative Impacts

Coastal development, urban development, and hardening of shorelines to accommodate development exacerbates erosion and loss of soils, and pollutant streams from wastewater effluent and other sources continue to degrade Jamaica Bay water quality. Jamaica Bay receives wastewater, stormwater, and non-point contaminants from the watershed, which has led to poor water quality, with long-term, adverse cumulative impacts that continue to overshadow more recent programs, projects, and actions to improve water quality conditions.

New York State Department of Environment Quality and New York City Department of Environmental Protection are working together to reduce nitrogen inputs by 2020 from four municipal sewage treatment plants (NYCDEP 2014). These reductions are expected to improve water quality in Jamaica Bay by reducing the nitrogen load by 60%, from 2010 levels. This effort alone would provide a considerable benefit to reduce eutrophication in the bay. Combined sewer outflow storage facilities were also constructed and hold excess stormwater and sewage that would otherwise flow untreated into Jamaica Bay.

The variety of environmental improvements proposed/identified under the 2014 *Gateway National Recreation Area General Management Plan* would have a long-term beneficial impact on water quality. These projects include, but are not limited to, invasive species control activities aimed at maintaining and restoring saltmarshes, projects to restore natural sediment transport dynamics or create a positive sediment budget to assist wetlands against erosion and sediment loss, and wetlands creation and restoration (USACE and PA 2009; NYCDEP 2014; NPS 2014a). These trends have a beneficial impact on water quality in the area by maintaining and restoring stable coastal habitats that act as watershed buffers in the project area, including Jamaica Bay and the larger Hudson–Raritan Estuary.

Actions taken by the New York Regional Transportation Authority immediately after Hurricane Sandy to repair a breach at East Pond and restore rail service enabled the pond to recently return to near freshwater conditions. Additional wetland mitigation and restoration efforts in Jamaica Bay, such as those included in the *Jamaica Bay Watershed Protection Plan* (NYCDEP 2014) and other post-Hurricane Sandy efforts have been focused on ecological restoration and protection of the saltmarsh islands and other natural areas. These efforts have and would continue to have long-term benefits to water resources.

These past, present, and reasonably foreseeable actions have resulted in adverse and beneficial impacts on water resources. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to water resources in and around West Pond due to the level of historical and continued sources of pollution entering Jamaica Bay. When the impacts on water resources under alternative A are combined with the impacts from past, present, and reasonably foreseeable actions, alternative A would have no contribution to the overall substantially adverse cumulative impact.

Conclusion

Under alternative A, regular tidal flushing within West Pond would cause water conditions within the pond to remain similar to Jamaica Bay because tidal cycles would distribute and dilute potential contaminants, reduce oxygen demand, and flush excess nutrients and organic material. Water salinity levels and quality would continue to match Jamaica Bay, which is designated as “impaired/stressed” (NYCDEP 2012). It is likely the primary and secondary breaches would continue to erode with tidal fluctuations, high energy storm waves, and storm surge. Because there would be no construction activities and no expected changes to water quality parameters under alternative A, there would be no impacts to water resources. When the impacts on water quality under alternative A are combined with the impacts from past, present, and reasonably foreseeable actions, alternative A would have no contribution to the overall substantially adverse, cumulative impact.

IMPACTS OF ALTERNATIVE B: REPAIR THE BREACH AND IMPROVE HABITAT CONDITIONS, THE NPS PREFERRED ALTERNATIVE

Impacts

The analysis of impacts on water resources for alternative B is organized according to phase 1 and future phases of project activity. An analysis of the impacts associated with each of the three options for water supply to West Pond to shift the current salinity in West Pond from an estuarine system (saline) to levels closer to a palustrine system (freshwater) are discussed within the phase 1 analysis, in addition to the impacts associated with the installation of the water control structure. Impacts associated with future phases of work include impacts related to upland habitat restoration at Terrapin Point, shoreline restoration, saltmarsh restoration, and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage). Impacts on water resources that are applicable to phase 1 and future phases of the project are described at the end of the section.

Phase 1. Under phase 1 of alternative B, the majority of impacts to water resources would be related to construction activities. During repair of the primary and secondary breaches, earthmoving equipment accessing the area would impact upland habitats by causing a physical disturbance along the trail to the breach. Due to the existing disturbance and sloping nature at the primary breach site, erosion from the site would be expected to be high and create sedimentation and turbidity in the pond and bay during construction. Best management practices would be implemented and would be critical to avoid soil and sediment runoff (see the "Mitigation Measures" section in chapter 2) into the waterway. Resulting water resource impacts associated with erosion would be sediment suspension and turbidity. Suspended sediments and turbid water can block sunlight required for aquatic plants to photosynthesize, or lead to inputs of nitrogen and phosphorus which can cause eutrophication and therefore low dissolved oxygen conditions. Sediment suspension and turbidity associated with construction activities would be expected to be temporary and localized to the project site. Suspended sediments would be expected to dissipate shortly after the completion of the construction and are not expected to result in long-term adverse impacts to water quality. Because best management practices would be in place, the localized nature of the construction activities and the recoverability after disturbance, long-term consequences to water resources are not expected to result from construction activities associated with breach repairs. Therefore, impacts from construction associated with the repair of the primary and secondary breaches on water resources would be considered minimally adverse.

A water control structure would be installed adjacent to the existing structure and would have construction associated impacts related to 0.08 acres of excavation, and the placement of fill. The types of temporary sedimentation and turbidity impacts associated with the construction activities during installation of the water control structure would be similar to those physical disturbances caused by earthmoving equipment described above for repair of the breaches, but the level of impact would be less because of the smaller area impacted. Because best management practices would be in place, the localized nature of the construction activities and the recoverability after disturbance, long-term consequences to water resources are not expected to result from construction activities associated with the installation of the water control structure. Therefore, impacts from construction associated with the water control structure on water resources would be considered minimally adverse.

Use of the water control structure for seasonal drawdowns of the pond for wildlife management purposes would release freshwater into Jamaica Bay. The volume of releases would be dependent upon optimum management regimes to be determined based upon future pond management strategies to be developed by the NPS dependent upon final design. Should the NPS release water on a seasonal basis during spring and fall migratory seasons, it is anticipated that only partial drawdowns would occur to expose mudflats for birds. These partial drawdowns would be less than the full volume of West Pond. These seasonal drawdowns would release water into Jamaica Bay that would have lower salinity levels than the bay. High intensity inputs of freshwater (low salinity) into the estuary (higher salinity). NPS would develop management strategies specific to West Pond to address these seasonal freshwater releases and ensure the chosen let down rates are compatible with the flushing rates of the bay (7-days) and peak flows of tidal cycles. These efforts would avoid localized and extreme changes in salinity values in the vicinity of the water control structure outfall. With management efforts in place to reduce high intensity freshwater inputs to the bay, seasonal drawdowns would have negligible impacts on water quality immediately outside of West Pond.

Seasonal drawdowns and replenishments may improve water quality within the pond by removing organic and inorganic nutrients and coliform organisms. Fecally-derived bacteria and nutrient loadings would be diluted when the pond would be replenished. Water quality conditions would be improved during these times, avoiding eutrophication. Overall, this flushing ability of seasonal drawdowns and replenishments would have slightly beneficial impacts on water quality within the pond.

Over the long-term, salt-tolerant plant and animal life that have occupied West Pond since the breach would eventually die during the transition to more freshwater conditions. A period of nutrient loadings would accompany this transition associated with this decaying organic material. The addition of wetland habitats in the interior of the pond would improve water quality once the structure and function of the wetlands were established by removing sediments and contaminants. Impacts on water quality would be adverse during the transition; however, the addition of a freshwater source and replacement of the water control structure would provide large beneficial impacts on water quality in West Pond over the long-term.

Groundwater Well– Installation of a groundwater well would have negligible temporary impacts due to surface disturbance from the drill rig accessing the groundwater well site and physical completion of the well. Piping to the pond to convey groundwater would also cause some temporary impacts because of erosion and sedimentation during construction. Because best management practices would be in place, the localized nature of the construction activities, and the recoverability after disturbance, long-term consequences to water resources are not expected to result from construction activities associated with groundwater well and piping installation. Therefore, impacts from construction associated with groundwater well installation on water resources would be considered negligible.

Changes in water quality and excessive drawdown of the water table are the most significant considerations to groundwater withdrawal given the coastline location of West Pond and the proximity to saline water. Because the Lloyd aquifer contains relatively low salinity it provides the most promising source of groundwater to meet the objectives for freshwater supply to West Pond. Review of readily available literature describing aquifer properties and historical groundwater withdrawals combined with simple quantitative analysis indicates that the impact to local and regional water levels and water quality in the Lloyd aquifer resulting from water withdrawals to replenish West Pond would be negligible (see also appendix C).

The transmissivity (how much water can move horizontally in an aquifer) in the Lloyd aquifer is high and can readily accommodate the relatively small amount of water necessary to fill and maintain West Pond. Saltwater intrusion is caused when pumping groundwater creates a pressure gradient in the aquifer and promotes inland migration (intrusion) of saltwater. In contrast, the overlying aquifers likely have a more significant and widespread saltwater wedge and would not be useful as a supplemental freshwater source for West Pond. The likelihood that saltwater intrusion would occur as a result of pumping 100 gallons per minute (gpm) from the Lloyd aquifer is judged to be negligible because of the relatively small volume requirements, the transmissivity of the aquifer, and the fact that the aquifer is covered by a type of rock and soil that would obstruct the movement of water (including salt water) downward into the Lloyd aquifer.

Because there are no other groundwater wells within 3.5 miles of West Pond, impacts on other water withdrawals would likely be negligible. At a pumping rate of 100 gpm, the expected drawdown at the well would range from 2 to 6 feet. This drawdown is negligible compared to the estimated saturated thickness of the aquifer (120-feet). Pumping from the Lloyd aquifer at 100 gpm would create a large, shallow cone of depression (see appendix C). Historical pumping from upland recharge areas has been reduced; increasing recharge rates USGS (2015). Based on the estimated minimal impact to local and regional water levels in the Lloyd aquifer resulting from water withdrawals to fill West Pond, the potential for the pumping to cause land subsidence (sinking due to groundwater withdrawal) would be negligible.

A preliminary site-specific water balance was developed to estimate (1) the volume of fresh groundwater required to dilute the existing tidally-influenced and saline water to the desired freshwater conditions once the breach was repaired and (2) the time needed to add the required volume of groundwater to West Pond after repair of the breach given an assumed pumping rate (see appendix C for further details on the calculations, target volume = inflow minus outflow).

The calculations were completed for a 44-acre pond having a depth of 4 feet. Inflows (water additions) in the water balance included precipitation falling within the area inside the perimeter walking trail (which includes West Pond and runoff from upland areas) using the low end of the estimated range of yearly mean Long Island precipitation rates for the period 1971 to 2000 (Sanford and Selnick 2013) and additions from groundwater pumping. Outflows (water subtractions) in the water balance were evapotranspiration (Sanford and Selnick 2013), expressed as a percent reduction in precipitation and an assumed 10% seepage rate through the bottom of the pond and the perimeter berm. It was estimated to take 174 days to fill West Pond when considering both natural water inflow from precipitation combined with inflow from groundwater pumping. This is assuming the target salinity (chloride concentration) of the pond is approximately 4,000 mg/L, which is the approximate mid-range reported for West Pond before Hurricane Sandy (Maillacheruvu and Roy 1999) as shown in table 5.

Municipal Water Source – Installation of a pipeline connection to a municipal water source would have negligible temporary impacts associated with ground disturbance during construction. Temporary impacts associated with the installation of a pipeline connection to a municipal water source would be similar to those described above for groundwater well installation. Because best management practices would be in place, the localized nature of the construction activities, and the recoverability after disturbance, long-term consequences to water resources are not expected to result from installation of a pipeline connection to a municipal water source. Therefore, impacts from construction associated with installation of a pipeline connection to a municipal water source on water resources would be considered minimally adverse.

The connection to a municipal water source would shift the current salinity from saline to levels closer to freshwater, aided by precipitation and surface water runoff contributions. This option, in combination with management abilities provided by the water control structure, would result in a quicker transition to freshwater conditions than relying solely on natural precipitation. The transition would be commensurate in duration to the groundwater well transition and could take a similar estimated 174 days to fill West Pond when considering both natural water inflow from precipitation combined with inflow from a municipal water source. The actual number of days to initially fill the pond would be dependent upon pipeline size and pumping rates.

Additional water treatment would be addressed by the NPS prior to discharge to West Pond because municipal drinking water has been treated by chlorine as a secondary disinfectant by the New York City Department of Environmental Protection. Additionally, the New York City Department of Environmental Protection also treats the water with food grade phosphoric acid and sodium hydroxide to reduce the release of metals in pipes and reduce exposure to lead and also adds low levels of fluoride for dental health protection. Though acceptable levels under safe drinking water situations, these levels would not be favorable to water conditions for the support of aquatic life, other wildlife, or vegetation (see appendix D). The treatment of the municipal water source prior to release to West Pond would render the water quality acceptable for aquatic use, with beneficial impacts to West Pond water quality.

Precipitation – There would be no construction-related impacts associated with the option of relying solely on precipitation and runoff as a freshwater source for West Pond. Once the primary and secondary breaches were repaired, relying solely on precipitation and runoff would result in a more gradual transition to freshwater conditions within West Pond when compared to the other water supply options. Based on average precipitation and runoff rates, preliminary estimates indicate that it would take roughly one year to restore West Pond to freshwater conditions when relying solely on natural precipitation and runoff as a freshwater source (see appendix C). Replenishment of water to West Pond subsequent to seasonal drawdowns (via the proposed water control structure) under this option may not be practical for several reasons.

Natural precipitation is a substantial proportion of the water balance developed to estimate volume groundwater required to dilute the pond and time needed to add the required volume of groundwater to West Pond given an assumed pumping rate. Given the anticipated water level management requirements (i.e. seasonal draining and replenishment to support wildlife) it is unlikely that maintenance of the pond could rely solely on precipitation, unless additional engineered diversion of storm drainage into the pond was accomplished to provide more water than assumed by the water balance calculations. The amount of water that would remain in West Pond following seasonal drawdown for wildlife management purposes, and therefore the amount required to replenish the pond at the end of the seasonal drawdown period, has not been determined due to the lack of site-specific bathymetry data and other site-specific information necessary to determine how much water would remain in the pond during seasonal drawdown to expose mudflats. The timeframe estimated to replenish the pond when relying solely on precipitation and runoff could take several months depending on how much water was released during each seasonal drawdown, and conditions at the site (site specific precipitation / runoff conditions, evaporation rates, seepage rates, and other potential site specific parameters that are unknown factors at this time). Due to the level of uncertainty in predicting precipitation rates and other unknowns, the ability of the NPS to manage water levels in the pond would be limited. In addition, from a management perspective, being able to predict how far to drawdown the pond by relying on seasonal weather predictions would involve a high degree of uncertainty. West Pond water levels would rise during the winter and spring and would be lowered to address seasonal wildlife use during migrations for example, as necessary and practical given weather conditions. Over the long-term, freshwater conditions within West Pond would be more susceptible to saltwater inundation during future storms because a reliance on natural precipitation as a freshwater source would result in a more gradual recovery following such an event.

Future Phases. Under future phasing of alternative B, shoreline habitat restoration activities at Terrapin Point would disturb approximately 3.7 acres of soils and sediments during construction. Upland vegetation restoration efforts at Terrapin Point would disturb some soils in the approximate 4.9 acres where invasive plants and thinning of vegetation would occur. Saltmarsh restoration activities would disturb approximately 5 acres of soils and sediment along the southern border of the berm during the timeframe where planting and later monitoring would take place. These ground disturbing activities would cause localized erosion and sedimentation, with resulting increased levels of sediment suspension and turbidity in the bay during construction. Best management practices would be implemented and would be critical to avoid soil and sediment runoff (see the "Mitigation Measures" section in chapter 2) into the bay. Suspended sediments and turbid water can block sunlight required for aquatic plants to photosynthesize, or lead to inputs of nitrogen and phosphorus which can cause eutrophication and therefore low dissolved oxygen conditions. Sediment suspension and turbidity associated with construction activities would be expected to be temporary and localized to the project site. Suspended sediments would be expected to dissipate shortly after the completion of the construction and are not expected to result in long-term adverse impacts to water quality. Because best management practices would be in place, the localized nature of the construction activities, and the recoverability after disturbance, long-term consequences to water resources are not expected to result from future phases of construction. Therefore, impacts from future phases of ground disturbing construction activity would be considered minimally adverse.

Details regarding the restoration process of the high marsh restoration (hydrologic restoration, excavation, grading, plantings, etc.) are not available at this conceptual stage of the project. Access to project locations may, however, require national recreation area staff, volunteers, and contractors to traverse existing low saltmarsh, but this pedestrian access is expected to result in only temporary disturbance to sediments in these areas with negligible impacts to water quality.

Common to Phase 1 and Future Phases. Water resources would be impacted through marsh restoration efforts and the growth of freshwater wetland vegetation. These actions would have a large beneficial impact because root systems stabilize soils and sediments by anchoring them vertically and laterally. These efforts would make soils and sediments less vulnerable to erosion and storm impacts in both upland and wetland habitats with beneficial water quality impacts by reducing sedimentation. Further, as wetland habitats establish and expand, they would improve water quality by removing sediments and contaminants, with beneficial impacts to water quality over the life of the project. In the long-term, phase 1 and future phases would have large beneficial impacts on water resources because of soil and sediment retention and water quality improvements in the vicinity of West Pond.

Cumulative Impacts

Related projects and their impacts to the affected environment for Jamaica Bay, the refuge, and the area surrounding West Pond under alternative B would be similar to those described for alternative A. Alternative B would provide a beneficial contribution to the collaborative efforts identified by Gateway National Recreation Area and other regional plans for habitat restoration and improved surface water quality. The past, present, and reasonably foreseeable actions have resulted in adverse and beneficial impacts on water resources. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to water resources surrounding West Pond due to the level of historical and continued sources of pollution entering Jamaica Bay.

Under alternative B, West Pond would return to a freshwater pond similar to conditions prior to Hurricane Sandy, and the ponded water would no longer mirror conditions in Jamaica Bay. West Pond would have negligible contributions to the overall water quality conditions of Jamaica Bay and refuge water quality conditions associated with inputs from seasonal drawdown of the pond and introduction of freshwater. Freshwater inputs from the pond to the bay would be managed to minimize changes to water quality to the surrounding bay, with resulting negligible cumulative impacts into the future.

The cumulative impact of a freshwater supply under alternative B would depend on the source of freshwater. Freshwater replenishment by groundwater well in the Lloyd aquifer would have a negligible contribution to the existing adverse cumulative impacts on water resources in Jamaica Bay and the refuge because adverse impacts anticipated from construction activities would be temporary, groundwater withdrawal would not change the water quality of the aquifer, it would not cause excessive drawdown of the water table or cause subsidence, nor would it impact other wells in the area. Freshwater replenishment by municipal water source would have a negligible contribution to the existing adverse cumulative impacts on water resources in Jamaica Bay and the refuge because the adverse impacts anticipated with construction activities would only be temporary, and the available volume of municipal drinking water would not be adversely affected into the future. No commensurate impacts would be anticipated if the option for replenishment by precipitation only were selected. Seasonal drawdowns and replenishment would have substantial long-term beneficial impacts on the existing adverse cumulative impacts on water resources by improving water quality within the pond. Habitat restoration activities proposed under future phases of alternative B would contribute moderately beneficial cumulative impacts on water resources in an area that has a history of degradation once the structure and function of these areas have been established.

When the impacts on water resources under alternative B are combined with the impacts from past, present, and reasonably foreseeable actions, alternative B would contribute a beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Under phase 1, temporary construction related adverse impacts would result from disturbances to water resources and increased sedimentation during construction activities. These impacts would be mitigated using best management practices. Freshwater replenishment by a groundwater well in the Lloyd aquifer would have no long-term adverse impacts on water resources in Jamaica Bay and the refuge because construction activities would be temporary, changes in water quality in the aquifer from withdrawal would not be anticipated, excessive drawdown of the water table would not be anticipated, and nearby groundwater withdrawal wells would not be impacted. Freshwater replenishment by municipal water source would have no adverse impacts on water resources in Jamaica Bay and the refuge because there would be no long-term adverse impacts anticipated with construction activities or the available volume of municipal drinking water into the future. No commensurate impacts would be anticipated if the option for replenishment by precipitation only was selected. Seasonal drawdowns through the water control structure could have an adverse impact on water quality outside the water outfall, but it is expected to be negligible because NPS would develop management strategies to address these seasonal freshwater releases to ensure the letdown rates are compatible with the flushing rates and tidal cycles to the extent practicable. Installation of a water control structure would provide additional capacity for national recreation area staff to manage water and salinity levels for purposes of wildlife management, resulting in improved water quality conditions for wildlife. Once the transition to freshwater conditions within West Pond was complete and wetland and vegetation conditions stabilized, phase 1 impacts on West Pond water resources would be beneficial.

Under future phases of work, temporary construction-related minimally adverse and longer term beneficial impacts would result from shoreline and high saltmarsh wetland restoration efforts. Restoring shoreline habitat and saltmarsh would attenuate wave action and storm surges which would control erosion and sedimentation in the water column. The shoreline habitat restoration would also function to trap sediments to aid in the accretion process to further improve water quality.

Alternative B would contribute a beneficial increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE C: CREATE DIFFERENT HABITATS

Impacts

Construction related impacts to water resources would be associated with berm and pond reconfiguration, changes to intertidal conditions near Terrapin Point, habitat restoration efforts, installation of a water control structure and pumping groundwater, and other actions such as installation of boardwalks and trails. Construction activities would involve land-based activities that could create erosion and runoff into West Pond, Jamaica Bay, and adjacent wetlands. Best management practices would be used to reduce the effects of erosion and sedimentation (see the “Mitigation Measures” section in chapter 2). Construction activities would require the use of mechanized equipment and staging for this equipment would be designated in previously disturbed areas to minimize adverse impacts.

A groundwater well would be installed and the water control structure would be replaced to shift the current salinity from saline to levels closer to freshwater, aided by precipitation and surface water runoff contributions from upland. This would provide additional capacity for national recreation area staff to manage water and salinity levels in the pond for purposes of wildlife management. Impacts would be similar to those described under alternative B. The time required to fill a 31.6-acre pond to a depth of 4 feet would be approximately proportional alternative B. Filling the approximately 31.6-acre pond to a depth of 4 feet using similar water balance assumptions would require approximately 20% - 30% less water and would be accomplished approximately 20% - 30% faster than for a 44-acre pond. Therefore, the smaller West Pond under alternative C would be filled in approximately 122 – 139 days of pumping at 100 gpm. Even though the pond would be smaller, the impacts to water quality within the pond, the aquifer, and the likelihood of saltwater intrusion would be similar to those described under alternative B.

Under alternative C, restoring the channelized saltmarsh between Terrapin Point and West Pond would disturb approximately 14.3 acres with substantial adverse construction related impacts that would occur over a 2 to 3 year period. These changes and the reconfigured berm of West Pond would change sedimentation dynamics due to tidally influenced water flows. The potential for erosion would be higher in this area as the island would be subject to an unknown and new tidal regime. The adverse impacts to water quality as the result of sedimentation and turbidity in the vicinity of Terrapin Point could be severe and long-term over the life of the project. Water quality in the saltmarsh channel area would continue to match Jamaica Bay, including the salinity (see table 5) as described under alternative A. Within the proposed channel, increased water flows from storm waves and storm surge would create a very dynamic sediment regime over time. Retaining a channelized water flow through the saltmarsh would improve water quality through filtering and flushing through the wetland, however these improvements would only be recognized once the area was stabilized. With tidal flushing there would be both beneficial and adverse impacts. Adverse impacts are anticipated due to the instability of the newly created site and associated dynamic conditions. High erosion rates would occur and as stated in the “Soil and Sediments” section, it is not known how long it may take for the soils and sediments to become fully functional after construction; this would lead to high sedimentation rates and turbidity during this timeframe. Once habitat conditions become more stable, regular tidal flushing would improve water quality by distributing and diluting potential contaminants, reducing oxygen demand, and flushing excess nutrients and organic material. (Additional impacts related to wetland function and values are discussed in the “Wetlands and Floodplains” section of this chapter).

Collectively, reconfiguring the berm and West Pond as a smaller ponded area and reestablishing freshwater wetlands would disturb approximately 36.6 acres (including 32.3 acres of wetlands and 4.3 acres of existing upland habitat) of soil and sediment across the project area causing erosion and sedimentation related adverse impacts to water quality during this phase of construction. In addition, creating vertical relief for the berm would require approximately 1,750,000 ft^3 of fill. Erosion during this construction effort would be expected to be high during berm construction as fill activities occurred, and this would cause substantial adverse water quality related impacts associated with suspended sediments and turbidity. Vigilant best management practices (see chapter 2) would be in place over the multi-year construction period to reduce and control adverse impacts to water resources, however extensive construction related impacts associated with sedimentation and erosion would be anticipated. These structural changes coupled with water management efforts would result in beneficial impacts on water quality once construction was completed and the area transitioned to freshwater and wetland conditions. Based on conceptual design within the West Pond basin, approximately 32.3 acres of freshwater wetland habitat restoration (to include plantings) would occur along the northern, eastern, and southern perimeters of the pond basin and a small portion of the western perimeter. These plantings would have large beneficial water quality impacts because root systems stabilize soils and sediments making them less vulnerable to erosion and storm impacts because they have been bound and retained within the roots of the vegetation. The addition of wetland habitats would improve water quality once the structure and function of the wetlands were established. Impacts on water quality associated with the restoration of a channelized saltmarsh and freshwater wetland stabilization and restoration (once stabilized and thriving) would be beneficial and long-term.

Impacts to groundwater associated with well installation would be similar to alternative B, with temporary minor adverse impacts during well installation. Impacts related to water withdrawal would be expected to be minimal, and agency coordination would be completed prior to implementation.

Impacts to water resources would be beneficial over time; however, due to the extensive area of disturbance, duration of construction up to 3 years, transition to stable site conditions could take multiple growing seasons over several years. Transition and time for the reconfigured pond and wetland conditions to stabilize would vary according to the phasing of construction and implementation.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative C would be similar to those described for alternative A. The past, present, and reasonably foreseeable actions would result in substantial long-term adverse impacts to water resources in and around West Pond due to the level of historical and continued sources of pollution entering Jamaica Bay. Collective management actions and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial long-term benefits to water resources in Jamaica Bay inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to water resources in and around West Pond due to the level of historical and continued sources of pollution entering the Jamaica Bay estuary.

Associated construction activities would have a substantial contribution to the existing adverse cumulative impacts on water resources because even with best management practices in place, the relatively large scale of the project and relatively long construction period (up to 3 years) spread over multiple seasonal windows, there would be adverse impacts including unknown outcomes when a new tidal regime would be established. Habitat restoration activities proposed under alternative C would contribute moderate beneficial cumulative impacts on soils and sediment retention once the site was stabilized in the future that would improve water quality. Freshwater replenishment by a groundwater well in the Lloyd aquifer would have a negligible contribution to the existing adverse cumulative impacts on water resources in Jamaica Bay and the refuge because there would be no long-term adverse impacts anticipated with construction activities, changes in water quality in the aquifer from withdrawal, excessive drawdown of the water table, or nearby withdrawal wells. When the impacts on water resources under alternative C are combined with the impacts from past, present, and reasonably foreseeable actions, alternative C would contribute a slightly adverse increment to the overall substantially adverse cumulative impact.

Conclusion

Under alternative C, substantial adverse construction related impacts would be anticipated during the entire construction period of up to three years and vigilant best management practices would be in place over the multi-year construction period. The potential for erosion and sedimentation during fill activities associated with reconfiguration of the berm would be expected to be high and cause substantial adverse water quality related impacts associated with suspended sediments and turbidity.

Saltmarsh restoration and opening a channel near Terrapin Point would change sedimentation dynamics due to tidally influenced water flows with substantial adverse impacts to water quality during construction and transition to tidal conditions. Over the long-term, water quality would continue to match Jamaica Bay and retaining a channelized water flow through the area would improve water quality by flushing and wetland filtering once the habitat conditions stabilized after several years. However, tidal conditions would be considered dynamic and would be subject to erosion leading to sedimentation and turbidity.

Freshwater replenishment through a groundwater well in the Lloyd aquifer would not result in any long-term adverse impacts on water resources in Jamaica Bay and the refuge because construction activities would be temporary, changes in water quality in the aquifer from withdrawal would not be anticipated, excessive drawdown of the water table would not be anticipated, and nearby withdrawal wells would not be impacted. Seasonal drawdowns through the water control structure could have an adverse impact on water quality immediately outside the water outfall, but the impact would be expected to be negligible because the NPS would develop management strategies to ensure the letdown rates were compatible with the flushing rates and tidal cycles to the extent practicable.

Over the long-term, once the transition to freshwater conditions within West Pond was complete and wetland and vegetation conditions stabilized, impacts on West Pond water resources would be beneficial. Freshwater quality conditions in West Pond would improve over time due to the installation of a water control structure and management efforts to control water and salinity levels to support wildlife. Reconfiguring the berm, additional stabilization efforts, wetland restoration, and growth of vegetation would attenuate wave action and storm surges and result in beneficial impacts to water resources by reducing erosion and sedimentation in the water column. Wetland construction measures and growth of vegetation would also function to trap sediments to aid in the accretion process to further improve water quality.

Alternative C would contribute a slightly adverse increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE D: BRIDGE THE BREACH

Impacts

Under alternative D, West Pond would continue to be influenced by tidal exchange and flushing. Water quality would be temporarily adversely impacted by construction activities associated with stabilization measures and bridging the breach. With best management practices in place (see chapter 2), construction impacts on water quality would be expected to be adverse but limited to the period of construction activities and localized to the project site.

Under alternative D, the primary breach would remain open and the pond would remain tidally influenced, but the banks near the breach would be stabilized. Stabilization of soils and sediments within and adjacent to the breach would reduce erosion related impacts to water quality; however, soils and sediments would continue to be subjected to movement and redistribution from precipitation, runoff, and overbank channel flows during high water. Stabilization measures would make the embankment and the areas around the primary and secondary breaches less susceptible to erosion and stormwater than under current conditions. Stabilization impacts on water quality would be localized and beneficial once construction was completed.

Construction activities associated with the secondary breach site adjacent to the pond and wetland would also create water quality disturbances through runoff. Best management practices would be implemented and would be critical to avoid soil and sediment runoff (see the “Mitigation Measures” section in chapter 2) into adjacent waters. Suspended sediments would be expected to dissipate shortly after construction activities were completed and turbidity levels would return to existing conditions. Sediment suspension and turbidity associated with construction activities would be expected to be temporary, localized to the project site with minimal, adverse impacts.

Water quality would be expected to remain similar to conditions described under alternative A with some improvement afforded by bank and berm stabilizations measures. There would be no changes to groundwater conditions.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative D would be similar to those described for alternative A. The past, present, and reasonably foreseeable actions would result in substantial long-term adverse impacts to water quality in and around West Pond due to the level of historical and continued sources of pollution entering Jamaica Bay. When the impacts on water quality under alternative D are combined with the impacts from past, present, and reasonably foreseeable actions, alternative D would contribute a very slight beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Under alternative D, continued tidal flushing would maintain water conditions similar to Jamaica Bay because tidal cycles would distribute and dilute potential contaminants, reduce oxygen demand, and flush excess nutrients and organic material. However, salinity levels and water quality would continue to match Jamaica Bay, which is designated as “impaired/stressed” (NYCDEP 2012). Temporary adverse impacts would result from erosion and runoff during construction; however, with best management practices in place, impacts would be limited to the period of construction and localized to the project site. Over the long-term, slight beneficial impacts would result from stabilization of soils and sediments within and adjacent to the primary and secondary breaches, which would reduce erosion over time and improve water quality conditions. Alternative D would contribute a very slight beneficial increment to the overall substantially adverse cumulative impact.

WETLANDS AND FLOODPLAINS

AFFECTED ENVIRONMENT

Jamaica Bay is one of the largest coastal wetland ecosystems in the region and is part of a series of tidal estuaries extending along the Atlantic coast. The rich biodiversity that characterizes the Jamaica Bay ecosystem is derived from a mosaic of estuarine features-- open water, mud flats, low and high saltmarshes, and intertidal beaches with of freshwater wetlands in adjacent upland habitats. These wetlands are interfaces between the open water and land and serve many essential ecological functions such as wave and storm surge protection, wildlife habitat, nutrient cycling, and sediment trapping. Wetlands are areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions (USACE 1987).

Prior to the intensive development of the Jamaica Bay watershed, the bay supported an estimated 16,000 acres of saltmarsh (U.S. Fish and Wildlife Service 1997). Initially, saltmarshes of Jamaica Bay were used by settlers as pastureland, which were later filled for development. Large expanses of saltmarsh were used as landfills, some of which were later converted to parks or commercial and residential uses (NYCDEP 2007). Human disturbances, including these and other historical land uses, dredge and fill activities of the bay (including East and West Ponds) and marshes, hard-edged constructed shorelines, ongoing urban development, sewage and wastewater outflows, and the introduction of nonnative, invasive vegetation species have altered the natural extent, function, and type of wetland habitats at the national recreation area, contributing to the overall “poor” rating of natural resource conditions (NPS 2014a). As of 1971, only 4,000 acres of saltmarsh remained in Jamaica Bay (National Academy of Sciences and National Board of Engineering 1971).

Today, approximately 85% of the estuarine wetlands and 90% of the palustrine (freshwater) wetlands have been lost in the New York-New Jersey Harbor Estuary which includes Jamaica Bay (New York City Wetlands Strategy 2012). Waldman (2008) reported that the freshwater wetlands of Jamaica Bay comprised less than 1% of their historic coverage. The breaching of West Pond added to the loss of the already limited freshwater habitat in the Jamaica Bay system. As shown in table 6, marshes have been declining across the bay. Because of these losses, protection of both freshwater wetland and saltmarshes has become critical. Further, within the recreation area, acreage of freshwater wetlands and ponds are limited considering the surrounding estuarine and marine habitat (NPS 2014a, Edinger et al. 2008).

Table 6: Jamaica Bay Marsh Islands: Marsh Loss Rates

	1951-1974	1974-1989	1989-2003	2003-2008
Average Rate of Loss (acres/year)	17	18	33	19

Sources: NYCDEP 2007; Hartig et al. 2002; M. Christiano (NPS unpublished data).

Adding to the mosaic of wetlands within Jamaica Bay, West Pond was created in the 1950s by excavation and creation of the berm within saltmarsh to provide a freshwater resource for migratory songbirds and waterfowl. The creation of both East and West Ponds represented historical addition of low salinity waters that provided a highly valued ecological resource for spawning, nursery, and other habitat values that were rare in the Jamaica Bay system (Waldman 2008). Additional details regarding background and history of West Pond are summarized in chapter 1. The impoundment was breached in 2012 by Hurricane Sandy, and subsequently transformed the brackish habitat into a tidally influenced area. The NPS, in an effort to inform science-based decision making for the management of the West Pond area, has conducted a wetlands assessment that included a delineation and characterization of the wetlands within the West Pond vicinity, as well as a wetland functional assessment to determine how various wetland functions would be gained or lost from implementing the alternatives discussed in this environmental assessment.

Currently, the interior of West Pond is characterized by mudflats, and slightly more elevated areas that once supported emergent palustrine marsh vegetation, primarily *Phragmites*. Invasive *Phragmites* and Japanese knotweed, for example, formed a dense monoculture in the area surrounding West Pond and threatened native wetland species. The tidal influence of the breached condition at West Pond has reduced the coverage of *Phragmites* in this area.

Wetland functions are defined as processes that take place within a wetland. These include the storage of water, transformation of nutrients, growth of living matter, and diversity of wetland plants, and they have value for the wetland itself, for surrounding ecosystems, and for people. Functions can be grouped broadly as habitat, hydrologic, or water quality, although these distinctions are somewhat arbitrary and simplistic. For example, the value of a wetland for recreation (hunting, fishing, bird watching) is a product of all the processes that work together to create and maintain the wetland. The wetlands within West Pond currently provide functional value of sediment stabilization, water quality, wildlife, fish, and uniqueness/heritage. A wetlands statement of findings included in appendix B includes a detailed description of the current assessment of wetland functions.

Climate projections for the New York City region summarized in several recent reports include the trend of increased frequency, extent, and height of coastal flooding as a result of increased sea level rise (NPS 2014 a; NYCPCC 2013; Horton et al. 2014). Predicted sea level rise would slowly inundate low saltmarshes and mudflats and push the littoral zone farther inland (see figures 10 and 11). Sea level rise in the region is estimated to be from 2 inches to 10 inches in the 2020s and 8 inches to 30 inches by the 2050s (Horton et al. 2014). Figures 10 and 11 depict the area surrounding West Pond, and the possible inundation of low lying wetlands in the vicinity at a predicted 2 foot and 4 foot rise.

In effect, these changes would alter the intricate system of processes that link historic rates of sea-level rise, upward accretion, wave erosion, and sediment deposition (Nuttle et al. 1997). Alterations to this system of processes could adversely affect the stability of saltmarshes. In other saltmarsh locations (e.g., U.S. Gulf coast and non-urbanized watersheds of Atlantic coast saltmarshes), accretion rates have been shown to match or exceed the present rate of sea level rise (Day et al. 2008; New York City Department of Environmental Conservation 2007), but these bay systems, unlike Jamaica Bay, receive an adequate deposition of inorganic sediments from upland drainages (New York City Department of Environmental Conservation 2007). The Jamaica Bay estuary has experienced a deficit in sediment supply resulting in marsh loss (Renfro 2010). In summary, the absence of inorganic sediment deposition from uplands within the Jamaica Bay watershed and other water quality factors would inhibit the natural accretion process of saltmarshes in Jamaica Bay. The lack of accretion prevents marsh formation, causing a reduction in low saltmarsh within Jamaica Bay; a reduction in low saltmarsh within the bay reduces the functionality of the estuary. These functions include prevention of shoreline bank erosion (which was the ultimate cause of the existing breach), sediment stabilization, water quality improvement, and providing wildlife habitat.

Wetlands Delineation and Characterization

In May 2014, wetlands scientists conducted field delineations of wetland features in the interior portions of West Pond, the bayside portion of the berm, and other locations in the study area to characterize the current conditions (see "Appendix B: Wetlands Statement of Findings" for additional details regarding the delineation). A wetlands delineation was conducted in accordance with the U.S. Army Corps of Engineers Wetlands Delineation Manual (USACE 1987), Regional Supplement to the Corps Engineers Wetlands Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0) (USACE 2010), and the NPS Procedural Manual #77-1: *Wetland Protection* (NPS 2012).

Wetland boundaries were identified within West Pond and along the upland-marsh gradient on the western shoreline with Jamaica Bay. Delineated wetlands were grouped in four distinct areas—Wetlands A, B, C, and D, and are shown on figure 12 and described in table 7.

Delineated wetlands were characterized using the Cowardin classification system (Cowardin et al. 1979). Under this classification, wetlands may be generally placed into marine, riverine, estuarine, palustrine, and lacustrine systems. Only estuarine wetlands were delineated within the West Pond vicinity, but freshwater wetlands are found in the East Pond vicinity to the east of Cross Bay Boulevard. These wetlands were largely degraded after Hurricane Sandy, with the overwash of relatively higher salinity water.

Table 7: Delineated Wetlands within the West Pond Area

Designation	Cowardin Classification	Description	Size (Acres)
Wetlands A	E1UBL	Subtidal waters within the berm and channel connecting West Pond with Jamaica Bay	45.00
		Subtidal channel connecting West Pond with Jamaica Bay	1.26
	E2EM1N	Emergent marshes and mudflats within West Pond	33.7
	E2SS6P	Estuarine intertidal shrub scrub	9.26
Wetlands B	E2EM1N	Estuarine intertidal emergent marsh regularly flooded within the South Marsh area	7.07
	E2EM1P	Estuarine intertidal marsh with irregular flooding	10.83
	E2US2N	Intertidal sand and mudflats	0.35
Wetlands C	E1UBL	Subtidal waters around North Marsh	20.85
	E2EM1N	Emergent marshes and mudflats within along the North Marsh shoreline	86.35
	E2SS6P	Estuarine intertidal shrub scrub	8.63
Wetlands D	E2EM1N	Emergent marsh regularly flooded surrounding Terrapin Point periphery	0.91
	E2US2M	Mud and sand deposits around Terrapin area	6.86
Total			***231.07***

Source: Field work and GIS analyses conducted by NPS contractors in May 2014.

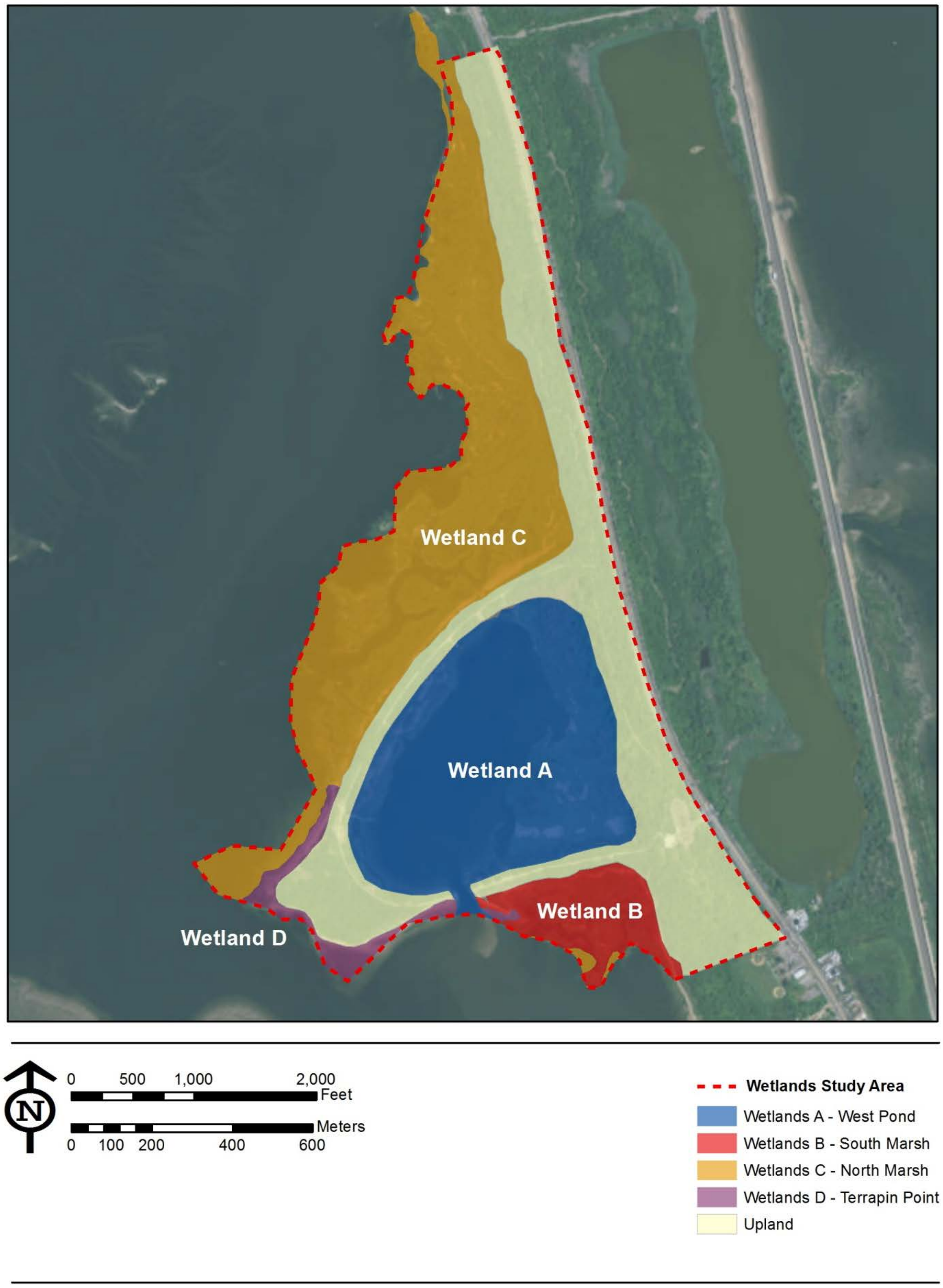


Figure 12: Existing Wetlands Classifications within the West Pond Area

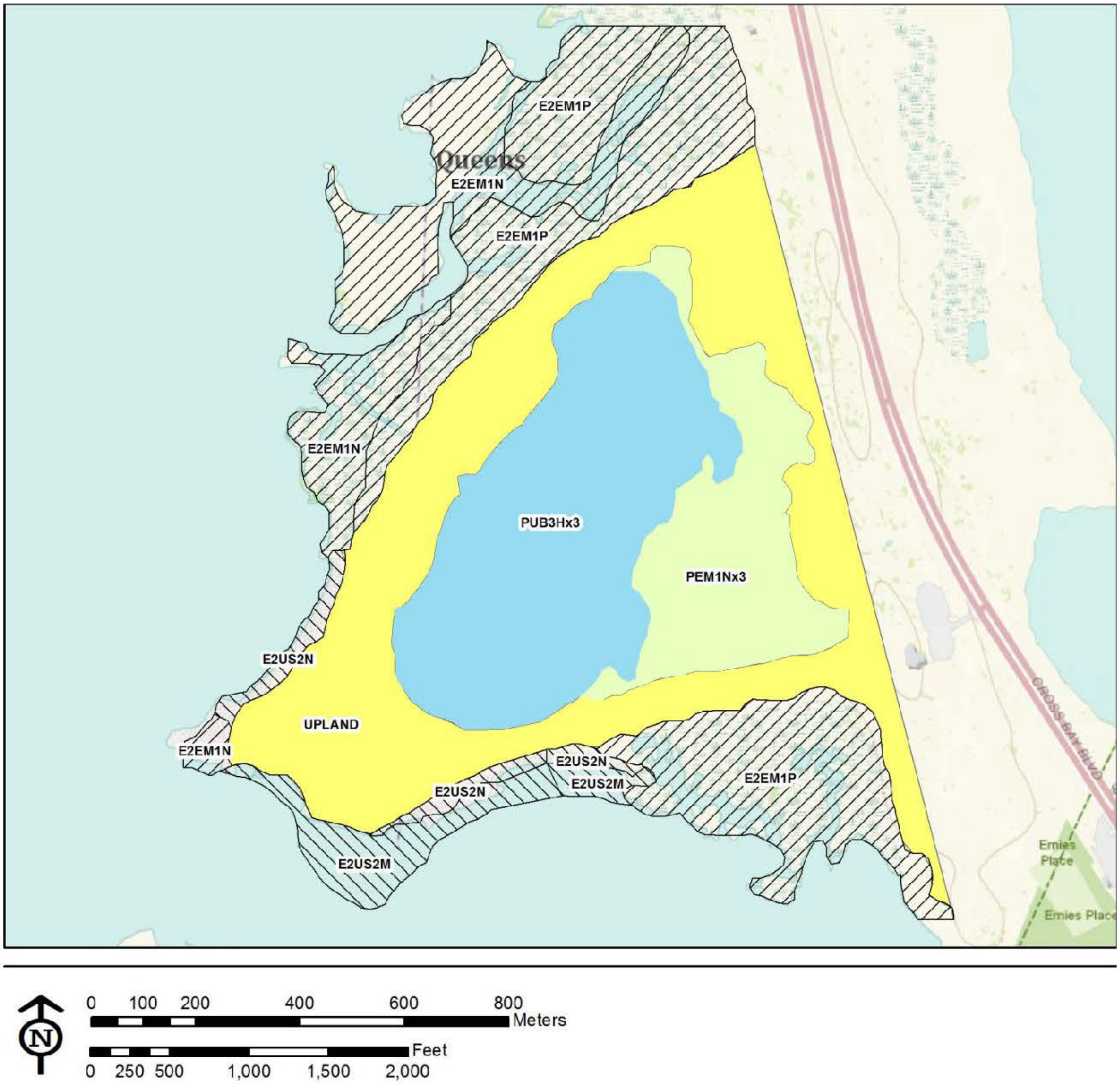


Figure 13: Wetlands Classifications at West Pond Prior to Hurricane Sandy

Wetlands Characterization Prior to Hurricane Sandy

Prior to Hurricane Sandy, no wetlands delineation had been conducted at West Pond. However, wetlands scientists were able to utilize data available in the National Wetlands Inventory (USFWS 1983) and make modifications based on field delineations conducted in May 2014. National Wetlands Inventory data was modified based on the new conditions after the hurricane and the field delineated boundaries (to include changing Cowardin Classifications where applicable, e.g., changing the pond from palustrine to estuarine and using the delineation boundaries inside the pond to define the breach). Figure 13 provides an interpretation by wetland scientists of the wetland communities in and around West Pond prior to the hurricane. Freshwater, or near freshwater, conditions existed in West Pond and palustrine wetlands bordered the interior of the pond. Generally, palustrine (freshwater) wetlands are fed by freshwater sources including precipitation, runoff, and groundwater. It is unknown if West Pond is fed by groundwater (Maillacheruvu and Roy 1999).

Floodplains

The Federal Emergency Management Agency maps flood hazard areas, which are locations on the landscape with a greater than 1% chance of flooding within any given year. After Hurricane Sandy, flood zone maps, known as Flood Insurance Rate Maps were revised and preliminary maps were made available to the public on December 5, 2013. The Federal Emergency Management Agency released revised maps in January 2015. These maps show the entire West Pond study area within the 100-year floodplain, with the exception of an upland area on Terrapin Point and the area along Cross Bay Boulevard encompassing the Jamaica Bay Wildlife Refuge Visitor Center. The outer areas that include low marshes are considered to be within the coastal flood zone with a "wave action velocity hazard." Base flood elevations within these areas range from 12 to 13 feet. Relatively more protected flood zone areas without the velocity hazard have base flood elevations at 11 feet (FEMA 2015). In 2013, the U.S. Fish and Wildlife Service updated maps produced through the Coastal Barrier Resources System, originally produced in the 1980s. The comprehensive revision of maps along the Atlantic coast is intended to assist federal agencies' compliance with the Coastal Barrier Resources Act. West Pond was added to the Coastal Barrier Resources System in 1991 (FEMA 2015).

During Hurricane Sandy, a combination of high tides, wind-blown waves, and the enormous circulation of the superstorm pushed water to a peak surge of nearly 14 feet (NPS 2014a). The berm surrounding West Pond was breached, and a secondary breach is forming on the banks opposite the existing breached portion of the pond. Its amplified wave height and reach, along with strong winds, pushed sand across roads, parking lots, and structures, flooded structures and destroyed machinery, and took beach sands with it as it receded, resulting in a patchwork of coastal erosion and inland areas covered in sand. Although tropical cyclones like Hurricane Sandy primarily flood coastal areas where the storm comes ashore, seasonal storms can cause much wider-ranging damage and major coastal erosion (NPS 2014a).

The former 10-year flood is expected to occur every nine years by the 2020s and as often as once every three years by the 2050s. Therefore, each year between 2020 and 2050, there would be an 11% - 33% chance that a 10-year flood would occur, with this percentage increasing as sea levels rise. The former 100-year flood is expected to occur every 65 to 80 years in the 2020s, with flood height increasing from its current predicted 8.6 feet to 9 feet. Therefore, each year in the 2020s there would be a 1.2% - 1.5% chance of a 100-year flood. The 500-year flood is expected to occur every 382 to 450 years by the 2020s and flood heights are expected to increase from 10.7 feet to up to 11.2 feet. Therefore, each year in the 2020s there would be a 0.22% - 0.26% chance of a 500-year flood (NPS 2014 a; Horton et al. 2014). Damage from these predicted flood heights depends on site specific conditions such as the elevation of the land where the flooding occurs, tidal conditions and tidal range, and winds and wave height.

IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impacts

Under alternative A, natural processes would proceed uninhibited. The existing breach would remain open, continuing the conveyance of tidal ebb and flow through the breach causing erosion of wetland soils and vegetation. The breach would likely continue to erode forming a wider channel and continued alteration of wetland conditions. Other areas of the berm may erode over time, with the sediment transported outward into Jamaica Bay, or captured in tidal and intertidal estuarine mudflats and low marshes interior of the berm. With a high likelihood of a secondary breach forming north of Terrapin Point, a tidal creek system would be formed through low saltmarsh or mudflats established through the accretion of sediments deposited in the interior of the pond. With two breach locations within the existing berm, the peninsula formed by Terrapin Point would become an island separated by a channelized estuarine mudflat or low marsh. There would be localized benefits for saltmarsh wetlands from open mixing with the waters of Jamaica Bay. However, the loss of freshwater influenced wetlands at and surrounding West Pond would result in adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay. Prior to Hurricane Sandy, West Pond provided approximately 44 acres of freshwater habitat. Given the rarity of this type of habitat in the watershed, there would be a continued, substantial reduction in the proportion of available freshwater wetland habitat under alternative A.

The hydroperiod of those areas exposed to bay waters would continue to reflect the daily and monthly tidal cycles and to a lesser extent increases from the effects of storms. The New York area overall experiences moderate precipitation over the entire year and seasonal increases (spring thaw or fall rains) are not expected in a way that would alter the hydroperiod. Currently, the interior of West Pond is characterized by mudflats, and slightly more elevated areas that once supported emergent palustrine marsh vegetation, primarily *Phragmites*. Under alternative A, the wetland vegetation transition within West Pond would continue as less saline-tolerant vegetation was replaced by more saltwater tolerant wetland plants, such as saltmarsh cordgrass.

Because of the position on the landscape, the West Pond area would continue to be within the 100-year floodplain. As natural processes continue, however, protection provided by the berm would be lost. Waves, especially those associated with storms, would likely erode marsh surfaces within the existing pond area at high tide. At lower tides, waves carried through the breached area (which would increase in width over time) from Jamaica Bay would likely erode marsh banks along tidal channels within the pond. In effect, the fetch would increase, allowing larger waves to form. This would likely increase flood elevations farther inland and potentially move the floodplain farther away from the estuary, covering more land. Under alternative A, NPS facilities may be under increased threat of flooding because of the increase in fetch and the loss of the protective function the West Pond berm has provided.

Under alternative A, the NPS would continue to manage wetland resources under existing guidance provided by the national recreation area's legislation, the *General Management Plan* and implementation plans (NPS 2014a) with beneficial impacts to the refuge. The NPS would continue its partnerships and collaboration with other agencies and organizations to protect wetland functions. The national recreation area would continue to collaborate with local, state, and federal officials and work with New York Department of Environmental Conservation to address common management goals concerning wetlands, including saltmarsh restoration projects in Jamaica Bay and the protection of fringe wetlands to improve coastal resiliency. Collectively, these efforts would improve water quality and saltmarsh wetland conditions; however, there would continue to be a loss of freshwater wetlands at West Pond under alternative A.

Cumulative Impacts

The wetlands in the vicinity of West Pond are part of a larger Hudson-Raritan system, and are influenced by conditions in this system; including inputs contributed by the surrounding watershed (see the "Water Resources" section). Adverse cumulative impacts to wetlands have a historical influence from regional urban development, pollution, dredging and filling of bay sediments, and loss of marsh islands in Jamaica Bay. Hydrological changes in Jamaica Bay resulted in altered water volume, flushing time, sediment transport dynamics, and overall decreased water quality that also adversely affects saltmarsh wetlands in the vicinity of West Pond. Other threats to native wetland species include the spread of nonnative species, such as *Phragmites* and Japanese knotweed. Past and present monitoring and treatment of invasive vegetation species in targeted areas would continue as resources and funding allowed, with limited success.

The substantial adverse cumulative impacts to wetlands in the area are partially offset by the collaborative restoration projects between the NPS and other agencies along with management plans, including those listed in the description of cumulative actions at the beginning of this chapter. For example, the variety of environmental improvements proposed/identified under the 2014 *Gateway National Recreation Area General Management Plan* would have a long-term beneficial impact on wetlands. These projects include, but are not limited to, invasive species control activities aimed at maintaining and restoring saltmarshes, projects to restore natural sediment transport dynamics or create a positive sediment budget to assist wetlands against erosion and sediment loss, and wetlands creation and restoration (USACE and PA 2009; NYCDEP 2014; NPS 2014a). These trends have a beneficial impact on water quality in the area by maintaining and restoring stable coastal habitats that act as watershed buffers in Jamaica Bay and the larger Hudson–Raritan Estuary.

The contribution of the national recreation area's actions in restoring saltmarsh through demonstration projects has had a noticeable or even an appreciable beneficial contributing impact to the slowing rate of loss, as the current rate of saltmarsh loss has slowed from 44 acres per year from 1994 to 1999 to 19 acres per year (NPS 2014a). Simultaneously, NPS and partners have restored approximately 140 acres of saltmarsh island habitat. Although there would be substantial efforts to offset bay wetland losses, there would continue to be a lack of freshwater wetlands in the area that previously filled an important role in the Jamaica Bay ecosystem and the New York coast.

Past and future management plans and projects that affect wetlands in proximity to West Pond include the invasive species management plan (2014) and future plans in partnership with The Nature Conservancy and Jamaica Bay-Rockaway Parks Conservancy to restore native vegetation at the North and South Gardens near West Pond. Actions taken by the New York Regional Transportation Authority immediately after Hurricane Sandy to repair the breach at East Pond and restore rail service enabled East Pond to recently return to near freshwater conditions after nearly two years, with resulting beneficial freshwater wetland impacts in the area.

Taken together, past, present, and reasonably foreseeable actions have resulted in primarily adverse impacts on wetlands and floodplains within the greater Jamaica Bay estuary. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to wetlands and floodplains in and around West Pond due to the level of historical and continued sources of pollution entering the Jamaica Bay estuary. When the minimally beneficial and minimally adverse impacts on wetlands and floodplains under alternative A are combined with the impacts from other past, present and future actions, alternative A would continue to contribute a minimally adverse increment to the overall substantially adverse cumulative impact.

Conclusion

Under alternative A, West Pond would continue to function as a tidally influenced area with salinity levels similar to Jamaica Bay. There would be localized benefits for saltmarsh wetlands from continued open mixing with the waters of Jamaica Bay. Wetlands would resemble the current estuarine conditions within West Pond and outside of the berm. The loss of freshwater influenced wetlands at and surrounding West Pond would result in adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay. Given the rarity of this type of habitat in the watershed, alternative A would mean a continued, substantial reduction in the proportion of available freshwater habitat. There would be adverse impacts to floodplains because the continued erosion of the berm would increase fetch and remove a protective barrier against storm surges. This would increase the extent of the floodplain and risk to NPS facilities.

There would be widespread cumulative beneficial improvements in wetland functions and values throughout Gateway National Recreation Area and the refuge from coordinated efforts by the national recreation area with the New York Department of Environmental Conservation and others to restore saltmarsh habitat and improve water quality. However, there remains a history of substantial adverse impacts associated with urbanization, habitat loss, and pollution within the region that has caused degradation of wetland and floodplains. Alternative A would contribute a minimally adverse increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE B: REPAIR THE BREACH AND IMPROVE HABITAT CONDITIONS, THE NPS PREFERRED ALTERNATIVE

Impacts

The analysis of impacts to wetlands and floodplains for alternative B is organized according to phase 1 and future phases of project activity. An analysis of the impacts associated with each of the three options for water supply to West Pond to shift the current salinity in West Pond from an estuarine system (saline) to levels closer to a palustrine system (freshwater) are discussed within the phase 1 analysis, in addition to the impacts associated with the installation of the water control structure. Impacts associated with future phases of work include impacts related to upland habitat restoration at Terrapin Point, shoreline restoration, saltmarsh restoration, and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage). Impacts on wetlands and floodplains that are applicable to phase 1 and future phases of the project are described at the end of the section.

A statement of findings has been prepared in accordance with Executive Order 11988 (Floodplain Management), NPS Director's Order #77-2, and Floodplain Management and Procedural Manual #77-2 and is provided in appendix A. Appendix B provides a wetlands statement of findings in accordance with Executive Order 11990 (Protection of Wetlands) and NPS Director's Order #77-1. This statement of findings provides a detailed description of the assessment of wetland functions and impacts projected for alternative B.

Phase 1. The primary breach would be repaired during phase 1 by filling approximately 0.35 acres of existing tidal conveyance. At the secondary breach location, approximately 0.08 acres of upland, intertidal sand, and emergent wetland would be filled. Replacement of the water control structure would require the use of geo-mats and would adversely impact an area approximately 20 feet by 320 feet of open water/mudflat wetland. Site preparation and earthwork at the primary and secondary breaches would be land-based, along the intact portions of the berm along the West Pond loop trail. Earthmoving equipment accessing the primary and secondary breach areas would impact uplands (approximately 7.3 acres) along the perimeters of the loop trail, and appropriate best management practices (e.g., silt fences, erosion control features, see also chapter 2) would control erosion and runoff impacts to protect adjacent wetlands during construction. These disturbed areas would be revegetated once construction was completed which would also help reduce erosion and runoff thereby avoiding wetland impacts. The period of construction would last approximately one year. Because best management practices would be in place, the localized nature of the construction activities, and the recoverability after disturbance, long-term adverse consequences to wetlands and floodplains are not expected to result from construction activities associated with breach repairs. Therefore, impacts from construction associated with the repair of the primary and secondary breaches on wetlands and floodplains would be considered temporary, and minimally adverse.

Replacing the berm would have beneficial impacts for the quantity of freshwater wetlands in Jamaica Bay as the interior of the pond transitions from estuarine (saline) to more palustrine (freshwater) because of the relatively low amount of freshwater and freshwater wetland habitats compared to the surrounding estuary. Alternative B would have beneficial impacts on floodplains because the repaired berm would provide protection from storm surges, decrease fetch, and better protect facilities and resources. Filling the breach and stabilizing the banks, and restoring vegetation would mitigate flood impacts as root systems stabilize soils and sediments by anchoring them vertically and laterally in both wetland and upland habitats. The growth and stabilization of wetland vegetation would make soils and sediments less vulnerable to erosion and storm impacts because they have been bound and retained within the roots of the vegetation. This would slow the erosion of exposed areas, accelerate the process of soil and sediment recovery, and create a more stable configuration for the floodplain in this location. Because of the benefits to both freshwater wetlands and floodplains, repair of the breaches would provide slightly beneficial impacts on wetlands and floodplains in the area.

Replacement of the water control structure would enable national recreation area staff more control of water and salinity levels that would also benefit freshwater habitat conditions for freshwater wetlands. Installation of the water control structure would have construction associated impacts at the time the structure was installed adjacent to the existing one. The placement of a water control structure would require approximately 0.15 acres of excavation, and then fill would be needed. If the water control structure is placed into the berm at a level below the normal water level, short-term impacts to the wetland would occur due to excavation. Construction activities would follow best management practices as described in chapter 2 to avoid impacts to wetlands. This would lead to disturbance and then recovery of wetland habitat. Because of the recoverability of construction impacts, the localized nature of the impact, the short duration of the construction period, long-term consequences to wetlands are not expected to result from the installation of the water control structure. Therefore, impacts on wetlands from construction of the water control structure would be considered minimally adverse. Because of the small areal extent and its location adjacent to the existing water control structure, no impacts are expected on floodplains from the installation of the water control structure.

Use of the water control structure for seasonal drawdowns of the pond for wildlife management purposes are estimated to release water into Jamaica Bay that would have lower salinity levels than the bay. The volume of releases would be dependent upon optimum management regimes to be determined based upon future pond management strategies to be developed. Should the NPS release water on a seasonal basis during spring and fall migratory seasons, it is anticipated that only partial drawdown would occur to expose mudflats for birds. These partial drawdowns would be less than full volume of West Pond. High intensity inputs of freshwater (low salinity) into the estuary (higher salinity) could have negative impacts on the ecosystem in the area of the water outfall. NPS would develop management strategies specific to West Pond to address these seasonal freshwater releases and ensure the chosen let down rates are compatible with the flushing rates of the bay (7-days) and peak flows of tidal cycles to the extent practicable. These efforts would avoid localized and extreme changes in salinity values and therefore would avoid impacting wetlands dependent on specific salinity ranges in the vicinity of the outfall. With management efforts in place to reduce high intensity freshwater inputs to the bay, seasonal drawdowns would have negligible impacts on estuarine wetland species immediately outside of West Pond.

Over the long-term, reestablishing freshwater wetlands under alternative B would provide beneficial wetland impacts because of the important role freshwater wetland functions and values have in the region. Long-term beneficial impacts would occur because the water control structure would enable park staff additional capacity to manage the hydrology of West Pond to improve wetland function. Managing the hydrology of the wetland would have beneficial impacts because it could allow the recruitment of particular freshwater wetland plants, and provide suitable foraging habitat for shorebirds and wading birds, improving wetland function.

Following repair of the primary breach and a return to freshwater conditions, West Pond would no longer be tidally influenced. The hydroperiod of the interior of the pond would reflect storm events. Seasonal increases (spring thaw or fall rains) would not be expected because the New York City area experiences moderate precipitation over the entire year. The hydroperiod of those areas exposed to Jamaica Bay waters would continue to reflect the daily and monthly tidal cycles and to a lesser extent increases from the effects of storms. Freshwater wetland vegetation within the interior of West Pond would be reestablished through natural recruitment only.

NPS Procedural Manual #77-1: Wetland Protection directs that adverse impacts to wetlands be avoided to the extent practicable, and that unavoidable impacts would be minimized and compensated for with restoration of degraded wetlands. The proposed breach repair and replacement of the water control structure would qualify as an excepted action for a maintenance, repair, or renovation (section 4.2.1 g of the NPS Procedural Manual #77-1: Wetland Protection). Under phase 1 activities, the breach repair would be located in and would be carried out in close proximity to water dependent activities such as wildlife management, education, and viewing. No new permanent wetland disturbances within the breach and water control structure areas would be anticipated. The concept design for the repair of the West Pond breach is intended to result in mostly beneficial impacts on wetlands and the intent of this project is to restore and expand the freshwater wetlands within the interior of West Pond. Mitigation measures and other conditions specifically identified in the procedural manual would be followed and less than 3 acres of existing wetlands would be impacted. Therefore, phase 1 fits within the exception 4.2.1(h) of the procedural manual and wetland compensation is not necessary (see appendix B for detailed descriptions).

Groundwater Well– There would be no water quality impacts on wetlands from utilizing groundwater as a potential source of water supply. The addition of a groundwater well would allow the area to shift from estuarine, tidally influenced habitat to freshwater habitat. It would take an estimated 174 days to fill West Pond when considering both natural water inflow from precipitation combined with inflow from groundwater. The groundwater well would be located outside wetlands and seasonally flooded areas, and the NPS would institute best management practices (see chapter 2) to avoid wetland impacts associated with ground disturbance and use and address all permitting requirements. Therefore, construction associated impacts on wetlands would be avoided due to the small area affected and the use of best management practices.

Municipal Water Source – Municipal water would be treated prior to discharge into the pond, therefore no water quality impacts on wetlands are expected from utilizing this as a potential source of water supply. It would take an estimated 174 days to fill West Pond when considering both natural water inflow from precipitation combined with inflow from the municipal source. The location of a pipeline connection to a municipal source would be determined during final design, and the NPS would avoid wetlands and seasonally flooded areas and institute best management practices (see chapter 2) to avoid impacts associated with pipeline installation and use and address all permitting requirements. Because of the small areal extent, no construction related impacts are expected for wetlands or floodplains from construction activities associated with the installation of a pipeline connection to the municipal water supply to replenish West Pond.

Precipitation – There would be no construction-related impacts associated with implementing the option of relying solely on precipitation and runoff as a freshwater source for West Pond. Once the primary and secondary breaches were repaired, relying solely on precipitation and runoff would result in a more gradual transition to freshwater conditions within West Pond over approximately one year when compared to the other water supply options of 174 days. Immediately prior to Hurricane Sandy, West Pond contained freshwater habitat that was sustained by replenishment from precipitation and runoff alone, without any additional supplemental freshwater input or the ability to conduct seasonal drawdowns. A gradual transition to palustrine (freshwater) conditions would mimic a more natural dynamic, as compared to the groundwater well or a municipal source. However, under this option, replenishment subsequent to seasonal drawdowns may not be practical for several reasons. The timeframe estimated to replenish the pond when relying solely on precipitation and runoff as a freshwater source could take several months depending on how much water was released during each seasonal drawdown and conditions at the site (site specific precipitation / runoff conditions, evaporation rates, seepage rates, and other potential site specific parameters that are unknown factors at this time). Due to the level of uncertainty in predicting precipitation rates and other unknowns, the ability of the national recreation area staff to manage water levels in the pond would be limited. In addition, from a management perspective, being able to predict how far to drawdown the pond by relying on seasonal weather predictions would involve a high degree of uncertainty. Leaving the pond at a lower level due to the lack of precipitation, however, would not have adverse impact on wetland vegetation. Drought conditions, even long-term, can have a renewing impact on wetlands as oxygen is exposed to deeper layers of the pond boundary contacting dormant plant seeds which may germinate. The lower levels would have negative impacts on floodplain values over the short-term if drought condition existed and mudflats were extended along the border where runoff would increase erosion rates. However, over the long-term, if germination were successful, the increase in freshwater wetland plants would increase the softening of the pond boundary. Freshwater conditions within West Pond would be more susceptible to saltwater inundation during future storms because a reliance on natural precipitation as a freshwater source would result in a more gradual recovery following a storm event. Habitats would take longer for freshwater (palustrine) communities to recover within the boundaries of the pond when compared to supplemental replenishment from groundwater or municipal water sources because recovery would be dependent upon site conditions and precipitation levels. Reestablishing freshwater wetland habitats would be beneficial to habitat in the greater region when considering the substantial loss of freshwater wetland in the area over time and the ecological value of these freshwater wetlands in this area. Overall, the use of precipitation as a freshwater source would have a beneficial impact on wetlands and floodplains yet would not be as substantial as groundwater or municipal supplemental replenishment because of the reliance on precipitation and the lack of ability for national recreation area staff to manage water and salinity levels in West Pond. Relying on precipitation as a water source would have no impacts on floodplains.

Future Phases. Under future phases of alternative B, conceptual designs include approximately 650 linear feet of living shoreline along the southern edge of West Pond; and may include approximately 400 linear feet of (i.e. approximately 3.7 acres) armoring and supplemental planting along the berm's toe of slope. The restoration of approximately 5.0 acres of saltmarsh adjacent to the living shoreline would achieve no net loss of wetlands resulting in an overall increase of approximately 1.3 acres of marshland. Placement of the living shoreline would be expected to have some long-term adverse impacts on existing intertidal habitat because this habitat would be converted to marshland. However, restoring shoreline habitat and saltmarsh would attenuate wave action and storm surges to help protect the repaired berm and wetland communities. The shoreline habitat restoration would also function to trap sediments and aid in the accretion process to further stabilize the high saltmarsh. Long-term beneficial effects would occur because there would be an increase (5 acres) in the amount of high saltmarsh along the West Pond area, and the location outside of the repaired berm would protect marsh vegetation by decreasing fetch and decreasing exposure and intensity of storm surges. Transition would occur over multiple growing seasons as saltmarsh species become established, improving sediment trapping and accretion. These restoration efforts would provide beneficial impacts by attenuating wave action, protecting the berm and floodplain, reducing fetch, and providing increased resiliency. Overall, salt marsh restoration activities would have moderately beneficial impacts on wetlands because of the increase in wetland acreage and quality once the structure and function of these areas were established.

Once the installation of living shoreline and saltmarsh efforts outside the berm are completed, established, and are able to function by absorbing storm energy and storing water valuable floodplain protections would have returned. For example, estuarine wetlands along the shoreline provide various functions, such as flood flow storage and sediment retention. These actions would have beneficial impacts on floodplains because the repaired berm would provide protection from storm surges and decrease fetch and better protect facilities (visitor's center) and other infrastructure. Restoration efforts to establish high saltmarsh vegetation (e.g., saltmarsh cordgrass) outside the primary breach location would further protect the berm from future erosion and create a more stable structure for the floodplain in this location. Overall, salt marsh restoration activities would have moderately beneficial impacts on floodplains because of the increase in wetland acreage and floodplain qualities once the structure and function of these areas were established.

Details regarding the restoration process of the high marsh restoration (hydrologic restoration, excavation, grading, plantings, etc.) are not available at this conceptual stage of the project. The anticipated schedule for completion has not been clearly defined and therefore, the anticipated time-frame for full function of the saltmarsh wetlands would be dependent upon final design details. Multiple growing seasons would be anticipated before wetlands would be fully functioning. Monitoring and maintenance requirements and schedule would also be determined in follow-on detailed design. Installation of these resiliency measures would not occur in existing vegetated areas; therefore, no long-term adverse construction impacts to wetland communities are associated with this component of alternative B. Access to project locations may, however, require national recreation area staff, volunteers, and contractors to traverse existing low saltmarsh, but this pedestrian access is expected to result in only temporary impacts. The period of construction would last up to a year depending on environmental and other applied work restrictions. Construction related impacts would be limited to the period of construction, localized to the area of construction, and minimized by the implementation of best management practices (see chapter 2). Overall, with the use of best management practices, and because any impact-related disturbances on wetlands would be expected to recover, any impacts on wetlands from construction activities associated with restoration and construction would be considered minimally adverse. No adverse impacts on floodplains are expected from restoration and construction activities.

Installation of amenities such as boardwalks, gravel trails, observation platforms, and educational signage would have temporary adverse construction related impacts. Once constructed, new visitor amenities would provide dedicated paths for visitor access and protect wetlands from trampling and compaction. Boardwalks and other visitor amenities would be designed at a height to avoid shading aquatic habitats; or to allow the maximum passage of sunlight. Construction of boardwalk trails would require installation of support piers in low saltmarsh and high saltmarsh vegetation communities, with short-term adverse impacts during installation. The construction of these visitor amenities, to the maximum extent practical, would not involve mechanized equipment, would employ best management practices to avoid compaction of substrates, and be timed as to have the least impact possible on wetland vegetation and wildlife. In addition, with increased outreach and education opportunities, there would be increased understanding and awareness of the importance of the mosaic of wetland habitats that the refuge and West Pond provide. These efforts would help build stewardship and aid in the protection of wetland resources. Overall, installation of these amenities would have temporary but recoverable construction impacts, minimal loss of wetland habitat due to shading, and increased awareness of wetland importance due to educational opportunities. Therefore, once construction was completed, the impact of the amenities identified above on wetlands and floodplains would be considered slightly beneficial.

Common to Phase 1 and Future Phases. Regardless of phase, management activities such as routine maintenance, mowing, and invasive vegetation species control activities would be ongoing. There is a reasonable likelihood that returning the pond to freshwater conditions would make the pond more conducive to recolonization of invasive vegetation such as *Phragmites,* as the salinity transitions to near-freshwater conditions. Additional NPS efforts to control invasive vegetation species such as *Phragmites* in the vicinity of West Pond would aid in the recovery of native species along the pond's edges. There would be temporary adverse impacts during the treatment of invasive species, with longer term beneficial impacts to native wetland plants. During earthmoving and excavation activities proposed under phase 1 and future phases of work, prevention of introduction and establishment of invasive species would require intensive monitoring and response plans with beneficial wetland impacts (see the "Mitigation Measures" section in chapter 2). Because of the long term benefits expected by these routine activities, their impact on wetlands and floodplains would be considered slightly beneficial.

A statement of findings has been prepared in accordance with Executive Order 11988 (Floodplain Management), NPS Director's Order #77-2, and Floodplain Management and Procedural Manual #77-2 and is provided in appendix A. Appendix B provides a wetlands statement of findings in accordance with Executive Order 11990 (*Protection of Wetlands*) and NPS Director's Order #77-1. This statement of findings provides a detailed description of the assessment of wetland functions and impact projected for alternative B.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative B would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years has had substantial adverse cumulative impacts, whereas more recent ongoing efforts to restore saltwater wetlands in Jamaica Bay, as well as steps taken to improve watershed conditions would provide beneficial impacts to wetlands and floodplain. There would remain, however, a substantial cumulative loss of freshwater wetlands in the refuge and surrounding Jamaica Bay area. Improved control of invasive vegetation, collective management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial long-term benefits to wetlands and floodplains in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to wetlands and floodplains in and around West Pond due to the level of regional development and historical and continued sources of pollution entering the Jamaica Bay estuary.

Phase 1 breach repair construction activities would have a negligible contribution to the existing adverse cumulative impacts on wetlands and floodplains because they are temporary, limited to the time of breach repair, and localized to the relatively small area compared to the size of the regional area. Repairing the breaches at West Pond and reestablishing freshwater wetland habitat would have a slightly beneficial cumulative impact on freshwater wetlands because of historic degradation of Jamaica Bay and loss of this habitat over the years, particularly because there are few alternative freshwater options in the area. The combination of a potential water supply source and the water control structure to adjust water levels and salinity within West Pond would improve freshwater quality and quantity. Because this feature would improve habitat and water quality in an area that has a history of degradation, it would contribute a slightly beneficial cumulative impact on wetland vegetation species. West Pond reliance on natural precipitation would not be as beneficial as other supplies because it would not be as reliable, but would still contribute a slight cumulative beneficial impact. Habitat restoration activities proposed under future phases of alternative B would contribute moderately beneficial cumulative impacts on wetlands and floodplains in an area that has a history of degradation and habitat loss because of the improvements in habitat quality and quantity once the structure and function of these areas have been established. The impact of other amenities proposed in future phases of alternative B would have only a slight beneficial contribution to the otherwise adverse cumulative impact.

When the beneficial impacts under alternative B are combined with the beneficial and adverse impacts from other past, present, and reasonably foreseeable future actions, alternative B would contribute a minimally beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Under phase 1, slight, adverse impacts would occur during construction because approximately 0.35 acres of tidal conveyance and 0.08 acres of upland, intertidal sand, and emergent wetland would be filled at the primary and secondary breach, respectively. However, adverse impacts during construction activities would be temporary, limited to the time of construction, guided by best management practices, and localized to a relatively small area compared to the surrounding Jamaica Bay estuary. Over the long-term, the phase 1 actions of repairing the West Pond breaches and reestablishing freshwater wetlands under alternative B would provide beneficial wetland impacts because of the important role freshwater wetland functions and values have in the region. Phase 1 would have beneficial impacts on floodplains because once the berm was repaired and the banks were stabilized it would provide protection from storm surges, decrease fetch, and better protect facilities and resources.

Because of the recoverability of construction impacts, the localized nature of the impact, the short duration of the construction period, long-term consequences to wetlands are not expected to result from the installation of the water control structure. Therefore, impacts on wetlands from construction of the water control structure would be considered minimally adverse. Because of the small areal extent and its location adjacent to the existing water control structure, no impacts are expected on floodplains from the installation of the water control structure.

The option of providing a groundwater supply well or a municipal water source would not cause any water quality impacts and the use of best management practices and avoidance of wetland and seasonally flooded areas during site selection and construction would preclude floodplain and wetland impacts. Long-term beneficial impacts would occur because the water control structure would enable park staff additional capacity to manage the hydrology of West Pond to improve wetland function. Regardless of the option of groundwater or municipal or precipitation supply of freshwater, managing the hydrology of the wetland would have beneficial impacts because it could allow the recruitment of particular freshwater wetland plants, and provide suitable foraging habitat for shorebirds and wading birds, improving wetland functions.

Under future phases, installation of amenities would have temporary but recoverable slight adverse construction impacts and minimal loss of wetland habitat due to shading. Habitat restoration activities proposed under future phases would provide improvements in wetland and floodplain quality and quantity once the structure and function of these areas were established. There would be temporary minimal adverse impacts because impacts would be limited to the period of construction, localized to the area of construction, and minimized by the implementation of best management practices. Once the restoration was completed and the area was stabilized, moderately beneficial effects would occur because there would be an increase (5 acres) in the amount of high saltmarsh along the West Pond area, the location outside of the repaired berm would protect marsh vegetation by decreasing fetch and decreasing exposure and intensity of storm surges, and there would be an increase in quantity and quality of freshwater and saltmarsh functions and values and floodplain values of West Pond and environs. These restoration efforts would provide beneficial impacts by attenuating wave action, protecting the berm and floodplain, reducing fetch, and providing increased resiliency. In addition, educational opportunities would result in a slight beneficial impact as a result of increased awareness of wetland importance.

When the beneficial impacts under alternative B are combined with the beneficial and adverse impacts from other past, present, and reasonably foreseeable future actions, alternative B would contribute a minimally beneficial increment to the overall substantially adverse cumulative impact because of the substantial influence from previous development and pollution.bay

IMPACTS OF ALTERNATIVE C: CREATE DIFFERENT TYPES OF HABITAT

Impacts

There would be extensive construction activity and earthwork to create a mosaic of habitats proposed under alternative C. West Pond would be reconfigured and reduced in size to approximately 31.6 water surface acres and approximately 32.3 acres of interior palustrine wetland. A groundwater well would be installed and the water control structure would be installed in the vicinity of the reconfigured West Pond to establish freshwater conditions, aided by precipitation and surface water runoff contributions from upland. This would allow national recreation area staff to manage freshwater levels within West Pond, providing beneficial impacts for purposes of wetlands management once habitat conditions were stabilized after several years. Additionally, the freshwater source and water control structure would enable park staff to manage the hydrology of the wetlands within West Pond providing the opportunity for beneficial impacts to wetland functions. Wetlands and seasonally flooded areas would be avoided during the site selection for the location of the groundwater well. Managing the hydrology of the wetland could allow the recruitment of particular freshwater wetland plants, and provide suitable foraging habitat to shorebirds and wading birds. However, establishing these conditions would cause extensive adverse impacts during several years of construction, as described in the paragraphs that follow. The hydroperiod of the interior of the pond would reflect storm events whereas seasonal increases (spring thaw or fall rains) are not expected because the New York area overall experiences moderate precipitation over the entire year. The hydroperiod of those areas exposed to bay waters would continue to reflect the daily and monthly tidal cycles and to a lesser extent increases from the effects of storms.

Construction activities would have extensive adverse impacts to the existing wetlands, as approximately 22.3 acres would be cleared and recontoured to accommodate the newly created West Pond. Of these 22.3 acres, approximately 14.3 acres of low marsh vegetation would be removed from the interior of West Pond during construction activities to create the intertidal channel, and approximately 8 acres of open water within the existing pond area would be reconfigured as the new West Pond berm. The placement of a water control structure would require approximately 0.15 acres of excavation, and then fill would be needed. If the water control structure is placed into the berm at a level below the normal water level, short-term impacts to the wetland would occur due to excavation. Long-term beneficial impacts would occur as the water control structure would enable park staff to manage the hydrology of the wetlands within West Pond improving wetland function. Managing the hydrology of the wetland could allow the recruitment of particular freshwater wetland plants, and provide suitable foraging habitat to shorebirds and wading birds. Vigilant best management practices would be in place over the multi-year construction period to reduce and control adverse impacts to wetlands, however extensive construction related impacts associated with sedimentation and erosion would be anticipated.

Site preparation and earthwork under alternative C would likely require equipment accessing work sites through tracked vehicles in low saltmarsh and mudflats. Access would disturb saltmarsh vegetation during construction activities by crushing vegetation and compacting subsurface soils from the tracks of the equipment or from extensive excavation activities. The disturbance associated with construction activities would cause moderate adverse impacts to saltmarsh wetlands. The surface of the berm would be revegetated to stabilize the upland portions of the berm upon completion of the multi-year construction period. These plantings, along with other mitigation measures (chapter 2), would result in temporary (at least 2 to 3 year) construction related impacts to vegetation in the vicinity of the berm and longer for disturbed areas to stabilize. Once the area was stabilized and vegetation was established, longer-term beneficial impacts for wetlands would result.

By reconfiguring the berm and a new, smaller West Pond, Terrapin Point would be separated from the berm by tidal creeks and low saltmarshes. This activity would cause extensive disturbance of various wetlands, intertidal emergent marshes, and upland vegetation communities, but would be followed by extensive habitat restoration and rehabilitation activities to establish intertidal estuaries between the new berm alignment and Terrapin Point. Establishment of these wetlands would result in approximately 14.3 acres of low marsh and tidal creeks between the new berm and the island.

Inside of the reconfigured West Pond, planting freshwater wetland species, and stabilization, and natural recovery would occur on the eastern portion of the reconfigured berm and along the eastern bank. Monitoring of the newly established wetland communities over a period of years would be required to ensure that vegetation survives. Areas that were not successful would require additional future planting efforts with resulting site disturbance.

The reconfiguration of the berm and West Pond would decrease the risk associated with flood hazard and adverse impacts to wetlands from flooding, with low marsh buffers on the outside of the berm that would further protect more interior wetlands once site conditions were stabilized. Reconfiguration of the berm and West Pond would decrease fetch and serve to increase resiliency of the berm from storm surge and high winds, improving floodplain values in this area.

Details regarding the restoration process of the high marsh restoration (hydrologic restoration, excavation, grading, plantings, etc.) are not available at this conceptual stage of the project. The anticipated schedule for completion has not been clearly defined and therefore, the anticipated time-frame for full function of the saltmarsh wetlands would be dependent upon final design details. Multiple growing seasons would be anticipated before wetlands would be fully functioning. Monitoring and maintenance requirements and schedule would also be determined in follow-on detailed design.

Management activities and visitor amenities would include routine operation and maintenance activities, invasive vegetation species control activities and installation of visitor facilities such as boardwalks, educational signage, and observation platforms. New visitor amenities would provide dedicated paths for visitor access and protect wetlands from trampling and compaction. During earthmoving and excavation activities, prevention of introduction and establishment of invasive vegetation species would require intensive monitoring and response plans. Construction of boardwalk trails would require installation of support piers in low saltmarsh and high saltmarsh vegetation communities. The construction of these visitor amenities, to the maximum extent practical, would not involve mechanized equipment, would employ best management practices to avoid compaction of substrates, and would be timed to have the least impact possible on vegetation and wildlife that use the wetlands.

In addition, with increased outreach and education opportunities under alternative C, there would be an increased understanding and awareness of the importance of the mosaic of wetland habitats that the refuge and West Pond provide.

Alternative C would have minimally beneficial impacts on floodplains once the installation of living shoreline and saltmarsh efforts outside the berm were completed, established and stabilized, and able to function by absorbing storm energy and storing water. For example, estuarine wetlands along the shoreline provide various functions, such as flood flow storage and sediment retention. These actions would have beneficial impacts on floodplains because the perimeter wetlands would provide protection from storm surges and decrease fetch and better protect facilities (visitor's center) and other infrastructure. Restoration efforts to establish high saltmarsh vegetation (e.g., saltmarsh cordgrass) would reduce erosion and create a more stable structure for the floodplain in this location. Restoring vegetation would mitigate flood impacts as root systems stabilize soils and sediments by anchoring them vertically and laterally in both wetland and upland habitats. These efforts would make soils and sediments less vulnerable to erosion and storm impacts because they have been bound and retained within the roots of the vegetation. This would slow the erosion of exposed areas, accelerate the process of soil and sediment recovery, and create a more stable configuration for the floodplain in this location. Although the long-term benefits of restoration activities under alternative C would be minimally beneficial, adverse impacts during construction would be intensive, including substantial disturbance to the majority of the land surface in and around the previously existing West Pond.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative C would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years has had adverse cumulative impacts, whereas more recent ongoing and future efforts to restore saltwater wetlands in Jamaica Bay, as well as steps taken to improve water quality would provide beneficial impacts to wetlands and floodplains. There would remain, however, a substantial cumulative loss of freshwater wetlands in the refuge and surrounding Jamaica Bay area. Improved control of invasive vegetation, collective management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial long-term benefits to wetlands and floodplains in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to wetlands and floodplains in and around West Pond due to the level of regional development and historical and continued sources of pollution entering the Jamaica Bay estuary.

Associated construction activities would have a substantial contribution to the existing adverse cumulative impacts on wetlands and floodplains because even with best management practices in place, the relatively large scale of the project and relatively long construction period (up to 3 years) spread over multiple seasonal windows, there would be adverse impacts including unknown outcomes when a new tidal regime would be established. Habitat restoration activities proposed under alternative C would contribute moderate beneficial cumulative impacts on wetlands, including sediment retention, and floodplain values once the site was stabilized in the future. The combination of a groundwater source and the water control structure to adjust water levels and salinity within West Pond would improve freshwater quality and quantity. Because this feature would improve habitat and water quality in an area that has a history of degradation, it would contribute a slightly beneficial cumulative impact on wetland vegetation species. The impact of other amenities proposed in alternative C would have only a slight beneficial contribution to the otherwise adverse cumulative impact.

Taken together, these past, present, and reasonably foreseeable actions have resulted in primarily adverse impacts on wetlands and floodplains within the greater Jamaica Bay estuary primarily due to the adverse impacts of historical loss of habitat. Improved control of invasive vegetation, management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial long-term benefits to wetlands and floodplains in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to wetlands and floodplains in and around West Pond due to the level of historical and continued sources of pollution entering the Jamaica Bay estuary.

When the minimally beneficial impacts (once the wetlands were established) and substantially adverse (but temporary) construction impacts under alternative C are combined with the impacts from other past, present and reasonably foreseeable future actions, alternative C would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Under alternative C, temporary, but substantial adverse impacts would result from erosion and runoff and changes in sedimentation dynamics due to tidally influenced water flows near Terrapin Point and across the site during the multi-year construction period. Long-term benefits to wetlands and floodplains would result as a more diverse wetland complex with resilient landscapes at differing elevations was created. Establishment of a variety of wetland features would offer diversity to the greater wetland complex that includes West Pond and surrounding areas within Jamaica Bay. Long-term beneficial impacts would also occur because the water control structure would enable park staff additional capacity to manage the hydrology of West Pond to improve wetland function. Managing the hydrology of the pond would have beneficial impacts because it could allow the recruitment of particular freshwater wetland plants, and provide suitable foraging habitat for shorebirds and wading birds, improving wetland functions.

Reestablishing freshwater habitat from the installation of a groundwater well would result in a beneficial impact to wetland communities by allowing a faster transition (an estimated 122-139 days to fill the pond) from an estuarine system (saline) to levels closer to a palustrine system (freshwater) and providing increased resiliency and recovery of the ecosystem in the event of future storm damage because freshwater could be supplemented to reduce salinity. Seasonal drawdowns through the water control structure could cause changes in salinity outside the water outfall but impacts are expected to be negligible because NPS would develop management strategies to address these seasonal freshwater releases to ensure the letdown rates are compatible with the flushing rates and tidal cycles to the extent practicable.

Although the long-term benefits of restoration activities under alternative C would be beneficial, impacts during construction would be intensive, including substantial disturbance to the majority of the land surface in and around the previously existing West Pond. Vigilant best management practices (including monitoring and maintenance over the multi-season construction period) would be used to minimize the effects of erosion and sedimentation on wetlands. Alternative C would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact to wetlands and floodplains by attenuating wave action, reestablishing freshwater wetland conditions, reducing fetch, and providing increased resiliency.

IMPACTS OF ALTERNATIVE D: BRIDGE THE BREACH

Impacts

Under alternative D, West Pond would continue to function as a tidally influenced area with salinity levels similar to Jamaica Bay. Wetlands would resemble the current estuarine conditions within West Pond and outside of the berm. Impacts to wetlands and floodplains would be similar to those described for alternative A, with additional construction related impacts associated with bridging the breach and stabilizing the banks along the primary and secondary breaches. There would be localized benefits for saltmarsh wetlands from open mixing with the waters of Jamaica Bay. However, the loss of freshwater influenced wetlands at and surrounding West Pond would result in adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay. Prior to Hurricane Sandy, West Pond provided approximately 44 acres of freshwater habitat. Given the rarity of this type of habitat in the watershed, alternative D would mean a continued, substantial reduction in the proportion of available freshwater habitat.

Based on conceptual design, construction activities to install a bridge over the existing breach could require a small portion of intertidal sand and mud flat habitat within the breached area to be filled and recontoured to higher, upland elevations to support infrastructure on either side of the bridge. Strengthening of the secondary breach location would fill approximately 0.08 acres of upland and intertidal sand and emergent wetland. Wetland mitigation measures would be incorporated into construction practices to minimize wetland impacts.

Under alternative D, earthmoving equipment accessing the primary breach area would impact upland habitat along the West Pond loop trail and its perimeters. With appropriate best management practices (e.g., silt fences, erosion control features) runoff into the adjacent wetlands would be controlled. The surface of the berm would be revegetated along with other mitigation measures implemented as described in chapter 2. As a result, construction related impacts would be temporary and longer-term impacts to mudflats and low saltmarsh wetlands interior to the formerly ponded area would be beneficial once the surface vegetation was established, erosion was controlled, and the bridge banks were stabilized.

The hydroperiod of those areas exposed to bay waters would continue to reflect the daily and monthly tidal cycles and to a lesser extent increases from the effects of storms. The New York area overall experiences moderate precipitation over the entire year and seasonal increases (spring thaw or fall rains) are not expected in a way that would alter the hydroperiod.

Because of the position on the landscape, the West Pond area would continue to be within the 100-year floodplain. Although the banks would be stabilized, the primary breach area would remain open and protection provided by the berm would be less than it was before pre-Hurricane Sandy. As described under alternative A, waves, especially those associated with storms, would likely erode marsh surfaces within the existing pond area at high tide. At lower tides, waves carried under the bridge or through the culvert from Jamaica Bay would likely erode marsh banks along tidal channels within the pond. In effect, the fetch would increase, allowing larger waves to form. This could increase flood elevations farther inland and potentially move the floodplain farther away from the estuary, covering more land. Under alternative D, NPS facilities may be under increased threat of flooding because of the increase in fetch and the loss of the protective function the West Pond berm has provided.

Management activities and installation of new visitor use amenities and facilities would include routine operation and maintenance activities (such as mowing and trail maintenance), targeted invasive vegetation species control activities, and installation of facilities such as boardwalks, observation platforms, and educational signage. Impacts of these actions would be similar to alternative B. These facilities would provide dedicated paths for visitor access, and protect wetlands from trampling and compaction. During earthmoving and excavation activities, prevention of introduction and establishment of invasive vegetation species would be monitored. Construction of boardwalk trails would require installation of support piers in low saltmarsh and high saltmarsh vegetation communities. To the maximum extent possible, construction of these visitor amenities would not involve mechanized equipment and would employ best management practices to avoid compaction of substrates. By bridging the primary breach and stabilizing the banks, erosion in the vicinity of both the primary and secondary breaches would be reduced, thereby reducing wetland impacts internal to the formerly ponded area. Wave action, although attenuated, would still influence the former West Pond area. Floodplain impacts from storm surge would be similar to those described for alternative A.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative D would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years have had adverse cumulative impacts, whereas more recent ongoing efforts to restore saltwater wetlands in Jamaica Bay, as well as steps taken to improve watershed conditions would provide beneficial impacts to wetlands and floodplains. Taken together, these past, present, and reasonably foreseeable actions have resulted in primarily adverse impacts on wetlands and floodplains within the greater Jamaica Bay estuary primarily due to the extensive historic impact of habitat loss. Improved control of invasive vegetation, management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial cumulative benefits to wetlands and floodplains in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to wetlands and floodplains in and around West Pond due to the level of historical and continued sources of pollution entering the Jamaica Bay estuary. When the slightly beneficial impact to wetlands and slightly adverse impacts to floodplains under alternative D are combined with the impacts from other past, present and reasonably foreseeable future actions, alternative D would contribute slightly beneficial and slightly adverse increment to the overall substantially adverse cumulative impact.

Conclusion

Under alternative D, West Pond would continue to function as a tidally influenced area with salinity levels similar to Jamaica Bay similar to current conditions. There would be localized benefits for saltmarsh wetlands from open mixing with the waters of Jamaica Bay and wetlands would resemble the current estuarine conditions within West Pond and outside of the berm. The loss of freshwater influenced wetlands at and surrounding West Pond would result in continued adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Given the rarity of this type of habitat in the watershed, alternative D would mean a continued, substantial reduction in the proportion of available freshwater habitat. Alternative D would result in adverse impacts to floodplains because the berm would remain open and therefore would not provide a solid protective barrier from storm surges. Maintaining the breach through the berm would increase fetch, thereby increasing the extent of the floodplain and the risk to NPS facilities.

Depending on final design, construction activities to install a bridge over the existing breach would require a small portion of intertidal sand and mudflat habitat within the breached area to be filled and recontoured to higher, upland elevations. Strengthening of the secondary breach location would impact approximately 0.08 acres of upland and intertidal sand and emergent wetland. Because wetland mitigation measures would be incorporated into construction practices to minimize impacts to wetland, any adverse impacts would be temporary, limited to the time of construction, and localized to a small area when compared to the surrounding Jamaica Bay estuary.

When the slightly beneficial impact to wetlands and slightly adverse impacts to floodplains under alternative D are combined with the impacts from other past, present and reasonably foreseeable future actions, alternative D would contribute slightly beneficial and slightly adverse increment to the overall substantially adverse cumulative impact.

VEGETATION

AFFECTED ENVIRONMENT

The vegetation of Jamaica Bay is mostly successional, reflecting both the history of anthropogenic disturbance and alteration in the bay and natural ecological change. The diversity of vegetation associations is primarily a result of the following four factors (NPS 2008), which are also applicable to the area in the vicinity of West Pond:

- The geologic history of the region, especially the effect of glaciations;
- The national recreation area's position on the northeastern U.S. coastal plain;
- Its proximity to the ocean and maritime ecological processes, such as twice-daily tides, storm overwash, salt spray, and high winds; and
- Its setting within an urban landscape with an intensive human land use history along with its associated problems, such as invasive species, fragmentation, habitat loss, pollution, channel dredging, and the dredge and fill of wetlands.

In addition, future changes associated with climate change that would affect vegetation include higher temperatures, increased precipitation, more frequent and intense heat waves, and heavy downpours that are more likely to become more intense and longer in duration, as well as an increase in the frequency, extent, and height of coastal flooding. These changes are described in the *General Management Plan* (NPS 2014a) and predicted in recent studies (including NYCPCC 2013 and Horton et al. 2014). Of the climate-related changes predicted, sea level rise and the possible increase in frequency and intensity of coastal storms are likely to have the greatest impacts to vegetation. Plant communities and structure may shift as the hydrologic regime and salinity changes. Vegetation within the area of West Pond is at a high risk of these impacts because of its low-lying position. Freshwater and upland habitats would be susceptible to salt stress as a result of tidal inundation due to more frequent and severe storm events. Increases in air and water temperatures may cause die-outs or shifts in the latitudinal range of species or cause an increased potential for disease among species.

Vegetation community types may be broadly categorized as herbaceous communities, shrub communities, and woodland communities. These community types contain both wetlands and uplands. As mentioned previously in the "Wetlands and Floodplains" section, approximately 85% of the estuarine wetlands and 90% of the palustrine (freshwater) wetlands have been lost in the New York-New Jersey Harbor Estuary (New York City Wetlands Strategy 2012) with an associated loss of those vegetation communities. An overview of vegetation communities within the refuge, with emphasis on the area in the vicinity of West Pond is provided, with more detailed descriptions of wetland communities discussed in the Wetlands and Floodplains sections of this environmental assessment.

Herbaceous Community Types

Wetland herbaceous communities include low saltmarsh and high saltmarsh. Prior to the breach of the West Pond berm, West Pond was characterized by deep freshwater emergent marsh and shallow freshwater emergent marsh. As stated in the Wetlands and Floodplains section, a wetland delineation was not conducted on the pond prior to breach. Records from National Wetland Inventory show that freshwater vegetation communities likely present in palustrine emergent and scrub/shrub habitats include cattail (*Typha* spp.), reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), wild rice (*Zizania aquatica*), reed canary grass (*Phalaris arundinacea*), smartweed (*Polygonum* spp.), alder (*Alnus* spp.), buttonbush (*Cephalanthus occidentalis*), and willows (*Salix* spp.) (USFWS 1983).

Since the breach, wetlands interior of the berm have been subjected to increased salinity and tidal ebb and flow, affecting a transition to predominantly mudflats. Saltmarshes occur in sheltered tidal areas that ring the outside of West Pond along the bayside. Upland herbaceous communities consist of mostly maritime grasslands or maintained (mowed) areas.

Low Saltmarsh. The low saltmarsh is one zone within the coastal saltmarsh ecosystem in the vicinity of West Pond; it occurs in a mosaic with several other communities. Low saltmarsh grades into high saltmarsh at slightly higher elevations, and into intertidal mudflats at slightly lower elevations. Saltwater tidal creeks that drain the saltmarsh flow in a sinuous pattern through the marsh, with a narrow band of low marsh lining the banks of the saltwater tidal creeks. Shallow depressions may also occur in the low marsh, which may hold puddles or pools, depending on weather and tides. Low saltmarsh is situated in a zone extending from mean high tide down to 3 to 6 feet below mean high tide. It is regularly flooded by twice-daily tides. The mean tidal range of low saltmarshes on Long Island is about 2-1/2 feet, and they often form in basins with a depth of 5 feet or greater. Vegetation of the low saltmarsh is a nearly monospecific stand of saltmarsh cordgrass, a high vigor *Spartina alterniflora*. This is a coarse grass that grows to about 8 feet in height. Low-vigor *Spartina alterniflora* extend inland from the banks to a point where the elevation is sufficiently high to support high marsh *Spartina patens* (saltmeadow cordgrass). Saltmarshes with large tidal ranges are often dominated by the tall form of saltmarsh cordgrass, while those with more restricted tidal ranges are shorter in stature in the zone that grades into high saltmarsh (Niedowski 2000). A few 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.) can be abundant, especially in early summer. Other plants present in high marsh and the upper end of the low marsh include glassworts (*Salicornia depressa*, *S. bigelovii*), saltmarsh sand-spurry (*Spergularia marina*), and sea blites (*Suaeda* spp.) (New York Natural Heritage Program 2013a).

Tidal wetlands, particularly low saltmarsh, in Jamaica Bay are continuing to decrease at an accelerated rate. From 1989 to 2003, rate of loss on some of the islands within the bay was as high as 33 acres per year, accelerating from an average annual loss of 18 acres per year between 1951 and 1989. Jamaica Bay's marsh islands were projected to disappear between 2012 and 2024 (NYCDEP 2007). Prior to the 1930s, intertidal marsh islands varied in size without significant losses, with natural recovery of marsh islands occurring between large storm events (NYCDEP 2007). Expected sea level rise for the 2020s could range from 2 to 10 inches, and by the 2050s could range from 8 to 30 inches (see figures 10 and 11) (Horton et al. 2014). This rise in sea level would slowly inundate low saltmarshes and mudflats and push the littoral zone (the portion of the water closest to the shore) farther inland (Nicholls 2004). Additional storm activity predicted through climate change models may contribute to existing trends of saltmarsh erosion within Jamaica Bay (Loehman and Anderson 2009; Titus and Richman 2001).

High Saltmarsh. Within the West Pond area, high saltmarsh occupies a narrow band along the bayside of the berm above the low marsh. Salt meadow cordgrass (*Spartina patens*) is the most abundant plant in the high saltmarsh, which occurs above the mean high tide line to the upper limit of the spring high tide. Other common plant species found in the high marsh include black grass (*Juncus gerardii*), salt grass (*Distichilis spicata*), marsh elder (*Iva frutenscens*), and glassworts. Wildflowers are also found within the high saltmarsh, such as saltmarsh aster (*Symphyotrichum tenuifolius*), sea lavender (*Limonium carolinianum*), and seaside goldenrod (*Solidago semervirens*) (NYCDEP 2007).

In recent decades, the amount and quality of high saltmarsh in Jamaica Bay has declined significantly. Dredging and filling of wetlands for airport construction and other urban development activities (NYCDEP 2007) as well as ditching for mosquito control and pollution discharge (New York Natural Heritage Program 2013b) are responsible for a large portion of the decline.

Maritime Grasslands. Maritime grasslands are scattered throughout the West Pond area, particularly in the upland portions of Terrapin Point. These open areas support a high floristic diversity, including beachgrass (*Ammophilia breviligulata*), broomsedge (*Andropogon virginicus*), switchgrass (*Panicum virgatum*), little bluestem (*Schizachyrium scoparium*), and seaside goldenrod (NYCDEP 2007).

The number, extent, and viability of maritime grasslands are suspected to have decreased in the recent past, primarily due to fire suppression, woody species proliferation, and exotic species invasion.

Shrub Community Types

Shrub communities include wetland shrub swamp and upland maritime shrubland and successional shrubland types. Shrub swamp occurs within the West Pond area, inside the breached berm in areas subjected to tidal ebb and flow. Common plants include buttonbush, elderberry, and alder. On Terrapin Point and other shrubby locations along the West Pond trail, maritime shrublands resemble maritime grasslands, except for the inclusion of woody species such as red cedar (*Juniperus virginiana*) and pitch pine (*Prunus serotina*). In previously disturbed areas, successional shrubs include grey birch (*Betula populifolia*), autumn olive (*Elaegnus umbellata*), western hackberry (*Celtis occidentalis*), and black cherry (*Prunus serotina*).

Woodland Community Types

Woodland communities in Jamaica Bay have historically included floodplain forests, red maple swamp communities, Appalachian oak-hickory forest, and upland mesophytic forest and successional mixed hardwood communities (NYCDEP 2007). Within the West Pond area, the woodlands that established on the fill substrate could be described as successional mixed hardwood communities. Many of these trees, such as various oak species (*Quercus* spp.) and pine species (*Pinus* spp.) are unable to tolerate the increased salinity inside of the berm after the 2012 breach, and show a considerable amount of dieback or stress. Previously, ornamental tree species were planted in North and South Gardens and along each side of Cross Bay Boulevard. Aside from these plantings, these areas support hardwood groves and other vegetation associated with riparian systems (moist soils at low salinities), but show extensive damage from storm surge from Jamaica Bay. Since Hurricane Sandy these areas have become stressed by high salinity levels.

Invasive Plant Species

Invasive plants are those that outcompete native species, often taking over their habitats and replacing them. Most invasive plants (and animals) are exotic. Most exotic plants either require human assistance to survive in a region new to them, or become naturalized and integrate themselves unobtrusively into native plant communities. Exotic plants that behave invasively threaten native species and ecosystems.

The most prominent invasive plant species found in wetland communities and mesic uplands is *Phragmites australis*. This species produces large quantities of seeds and also spreads by sprouting new growth from rhizomes. *Phragmites* is an aggressive invader of disturbed wet areas and can commonly be seen in degraded wetlands, roadside ditches, and dredge spoils. Thick monocultural stands form in low saline environments or freshwater. Within the West Pond area, *Phragmites* is present in small areas and intermittently along the West Pond trail and Terrapin Point, as well as in mesic upland and intertidal areas north of West Pond. Expanses of *Phragmites* once dominated the emergent marsh areas of the West Pond prior to the breach in 2012. The subsequent rapid rise in salinity in the pond caused a die off of *Phragmites*. Purple loosestrife (*Lythrum salicaria*) was also common within the freshwater emergent marsh, but has a low tolerance for salinity and is now found only intermittently throughout the West Pond area.

Shrub and woodland communities within the West Pond area have been invaded by a number of invasive trees and shrubs. Tree of heaven (*Ailanthus altissima*), Oriental bittersweet (*Celastrus orbiculatus*), Japanese knotweed (*Polugonum cuspidatum*), Japanese barberry (*Berberis thunbergii*), and autumn olive (*Eleagnus umbellata*) are all readily seen from the West Pond loop trail in shrublands and woodlands, along with Japanese honeysuckle (*Lonicera japonica*) and garlic mustard (*Alliaria petiolata*).

The NPS issued a “Strategic Plan for Managing Invasive Non-native Plants on National Park System Lands” in 1996 (NPS 1996). This document describes the impacts of invasive plants on natural resources, and presents strategies and tactics for preventing their invasion and spread, and for inventorying, monitoring, and managing them on national recreation area lands. In response to this directive, the national recreation area is developing an invasive species management plan that prescribes management actions for all units. Within the refuge, the plan targets a wet meadow near the west bank of East Pond and *Phragmite*s, Oriental bittersweet, Japanese honeysuckle, alder buckthorn, and tree of heaven treatments along the West Pond loop trail (NPS 2014c).

The anticipated rise in temperatures associated with other effects of climate change could likely shift the composition of the communities described above, which may in turn facilitate the establishment and spread of invasive species. The ecological shift over the coming decades may reduce the ability for landscapes in the vicinity of West Pond to resist invasive species.

IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impacts

Under alternative A, natural processes would proceed uninhibited. The existing breach would remain open, continuing the conveyance of tidal ebb and flow through the breach and causing erosion of soils and loss of vegetation. The breach would likely continue to erode forming a wider channel and more loss of soils and vegetation in the vicinity of the breach. Other areas of the berm may erode over time, with the sediment transported outward into Jamaica Bay, or captured in tidal and intertidal estuarine mudflats and low marshes interior of the berm. With a high likelihood of a secondary breach forming north of Terrapin Point, a tidal creek system would be formed through low marsh vegetation or mudflats established through the accretion of sediments deposited in the interior of the pond. With two breach locations within the existing berm, the peninsula formed by Terrapin Point would become an island separated by a channelized estuarine mudflat or low marsh.

Vegetation communities within West Pond that had established under pre-Hurricane Sandy conditions (vegetation adapted to freshwater or low salinity conditions) would continue to shift in composition and structure, resembling low saltmarsh and mudflats in the lower elevations grading to upland shrub scrub in the upland locations. Wetlands and adjacent hardwood communities would die off due to increased salinity from tides. After the damage sustained by Hurricane Sandy, upland vegetation, such as hardwood trees common along riparian zones in other locations would likely continue to be stressed and eventually be replaced with a shrub-scrub community composed of plants more tolerant to seaspray and brackish water. The loss of freshwater vegetation would have an adverse affect for individual plants, in addition to a regional impact since freshwater habitat is rare in this region and has been largely replaced in the Jamaica Bay watershed by urban development. Many of the plant species found in these habitats cannot tolerate saline conditions found in estuaries. The loss of freshwater influenced wetlands at and surrounding West Pond would result in adverse effects primarily due to the species diversity that these habitats provide in the overall ecosystem within Jamaica Bay. Prior to Hurricane Sandy, West Pond provided approximately 44 acres of freshwater vegetation communities. Given their rarity in the watershed, alternative A would mean a continued substantial reduction in the proportion of available freshwater habitat.

The NPS would continue to monitor invasive plant species and control measures would be similar to existing levels with targeted reduction efforts for select species. Invasive plant species would be expected to continue to be a problem in the wildlife refuge, with adverse effects to the regional community of native species. Given the saline levels within West Pond, there would be a decreased need to control *Phragmites* and purple loose-strife (invasive plants that thrived in the low salinity conditions before Hurricane Sandy). Routine mowing near the trail at West Pond would continue to occur, along with other routine maintenance activities near the refuge visitor center, consistent with existing conditions, and with no adverse effect. The NPS would continue targeted invasive plant species monitoring and control in the North and South Gardens. These efforts would improve vegetation in these areas at the community level.

Cumulative Impacts

The presence and spread of invasive plant infestations within the national recreation area and the refuge has adversely impacted native vegetation and species diversity. The NPS manages the impacts of these and similar conditions through the development of management plans and by implementing subsequent actions to improve resource conditions. Past and future management plans that affect vegetation within the vicinity of West Pond and the refuge include the invasive species management plan (NPS 2014c), and plans in partnership with the Nature Conservancy and Jamaica Bay-Rockaway Parks Conservancy to restore native vegetation at the North and South Garden near West Pond. These plans and actions altered or would alter conditions, with adverse effects on vegetation during implementation of the plans as treatment applications take place and invasive species are removed and landscape plans for North and South Gardens are implemented. However, over the long-term these plans would have beneficial effects on vegetation by restoring native habitat and attracting wildlife.

Actions taken by the New York Regional Transportation Authority immediately after Hurricane Sandy to repair a breach at East Pond and restore rail service enabled the pond to recently return to near freshwater conditions, reestablishing one of the remaining freshwater wetland habitats within East Pond and surrounding areas. Additional wetland mitigation and restoration efforts in Jamaica Bay, such as those included in the *Jamaica Bay Watershed Protection Plan* (NYCDEP 2007), those identified in the national recreation area's general management plan

(NPS 2014a), and other post-Hurricane Sandy efforts have been focused on ecological restoration and protection of the saltmarsh islands and other natural areas, in addition to public education about the importance of the Jamaica Bay watershed. Collectively, these efforts have and would continue to have direct and indirect benefits to vegetation by improving natural habitats and the species that depend on them, improving the body of knowledge of the resources, and improving wildlife conditions within the national recreation area including areas in proximity to the refuge and West Pond.

Taken together, these past actions have resulted in primarily beneficial impacts on vegetation. Improved control of invasive species, collective management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay would result in substantial benefits to vegetation in the region inclusive of the refuge. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to vegetation in and around West Pond due to the level of historical and continued sources of pollution entering Jamaica Bay.

When the impacts on vegetation under alternative A are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative A would contribute a slightly adverse increment to the overall substantially adverse cumulative impact.

Conclusion

Under alternative A, West Pond would continue to function as a tidally influenced area with salinity levels similar to Jamaica Bay. There would be localized benefits for saltmarsh wetland species from open mixing with the waters of Jamaica Bay and wetland vegetation would resemble the current estuarine conditions within West Pond and outside of the berm. The loss of freshwater influenced wetland species at and surrounding West Pond would result in adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay. The sustained loss of freshwater vegetation would have an adverse affect for individual plants, in addition to a regional adverse impact because freshwater habitat is rare in this region and has been largely replaced in the Jamaica Bay watershed by urban development. Alternative A would result in adverse impacts to vegetation because overall diversity of plant species within West Pond would continue to decline as the habitat continues to shift from freshwater to saltmarsh. Adverse impacts would include decreases in upland vegetation that have developed under the influence of low saline conditions in place prior to the breaching of the pond. The breach would likely continue to erode forming a wider channel leading to more loss of soils and vegetation in the vicinity of the breach, with resulting adverse impacts. Additionally, adverse impacts to upland vegetation communities would continue because the breach would remain and therefore would not provide a solid protective barrier from storm surges and fetch through the breach. Prior to Hurricane Sandy, West Pond provided approximately 44 acres of freshwater habitat. Given the rarity of this type of habitat in the watershed, alternative A would mean a continued, substantial reduction in the proportion of available freshwater habitat. Alternative A would contribute slightly adverse increment to the overall substantially adverse cumulative impact from a continued reduction in biodiversity of native plant communities.

IMPACTS OF ALTERNATIVE B: REPAIR THE BREACH AND IMPROVE HABITAT CONDITIONS, THE NPS PREFERRED ALTERNATIVE

Impacts

The analysis of impacts to vegetation for alternative B is organized according to phase 1 and future phases of project activity. An analysis of the impacts associated with each of the three options for water supply to West Pond to shift the current salinity in West Pond from an estuarine system (saline) to levels closer to a palustrine system (freshwater) are discussed within the phase 1 analysis, in addition to the impacts associated with the installation of the water control structure. Impacts associated with future phases of work include impacts related to upland habitat restoration at Terrapin Point, shoreline restoration, saltmarsh restoration, and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage). Impacts on vegetation that are applicable to phase 1 and future phases of the project are described at the end of the section. Impacts associated with wetland vegetation are addressed in the “Wetlands and Floodplains” section of this chapter.

Phase 1. Site preparation and earthwork would occur during phase 1 at the primary and secondary breaches. Access to the breached areas would be along the intact portions of the berm along the West Pond loop trail. Earthmoving equipment accessing the primary and secondary breach areas would impact uplands (approximately 7.3 acres) along the perimeters of the loop trail. At the secondary breach location, approximately 0.08 acres of upland and intertidal sand and emergent wetland would be filled (see Wetlands Floodplains and Wetland and Floodplains section for discussion of wetland impacts). Construction equipment would need clearance to pass along the trail and to accommodate this, 15 feet on each side of the centerline (i.e., 30-feet total) for the length of the trail (1.6 miles) would be cleared of vegetation as needed, including tree trimming with clear height of approximately 16 feet. In addition, vegetation would be cleared in a 50 foot by 50 foot area so that vehicles could turn around near the breach and the water control structure. Vegetation in these areas is largely composed of turf grasses and is maintained through periodic mowing. The banks along the breach are void of vegetation because of the continued erosion associated with the tidal flow. Turf grasses that would be disturbed by construction vehicles would be replanted once construction was completed and other vegetation that would be trimmed would be allowed to recover naturally; therefore, construction within the area of the breach would not result in impacts to vegetation. Appropriate best management practices (e.g., silt fences, erosion control features, see also chapter 2) would control erosion and runoff impacts that may impact vegetation during construction. The disturbed areas along the trail and construction pathways described would be revegetated once construction was completed which would also help reduce erosion and runoff. Because best management practices would be in place, the localized nature of the construction activities, and the recoverability after disturbance due to revegetation efforts, long-term consequences to vegetation are not expected to result from construction activities associated with breach repairs. Therefore, impacts on vegetation from construction associated with the repair of the primary and secondary breaches would be considered negligible.

Replacement of the water control structure would also have temporary, but recoverable impacts associated with construction which would be localized in mudflats. Construction activities would structure would require the use of geo-mats and would adversely impact an area approximately 20 feet by 320 feet of open water/mudflat wetland. Impacts would be minimally adverse because of the use of best management practices, the localized nature of the construction activities, and the recoverability after disturbance due to revegetation efforts.

Use of the water control structure for seasonal drawdowns of the pond for wildlife management purposes are estimated to release water into Jamaica Bay that would have lower salinity levels than the bay. The volume of releases would be dependent upon optimum management regimes to be determined based upon future pond management strategies to be developed. Should the NPS release water on a seasonal basis during spring and fall migratory seasons, it is anticipated that only partial drawdown would occur to expose mudflats for birds. These partial drawdowns would be less than full volume of West Pond. High intensity inputs of freshwater (low salinity) into the estuary (higher salinity) could have negative impacts on the vegetation in the area of the water outfall. NPS would develop management strategies specific to West Pond to address these seasonal freshwater releases and ensure the chosen let down rates are compatible with the flushing rates of the bay (7-days) and peak flows of tidal cycles to the extent practicable. These efforts would avoid localized and extreme changes in salinity values and therefore would avoid impacting vegetation dependent on specific salinity ranges in the vicinity of the outfall. With management efforts in place to reduce high intensity freshwater inputs to the bay, seasonal drawdowns would have negligible impacts on estuarine vegetation species immediately outside of West Pond.

By actively managing salinity and water levels, the die off of hardwoods and other vegetation adapted to freshwater and near freshwater conditions would likely slow to a halt. Trees and shrubs already stressed by high salinity levels along West Pond would likely not survive; however, moderately stressed trees and shrubs may recover. Limited recovery of upland habitats that thrived under conditions prior to Hurricane Sandy would likely occur, thereby increasing biodiversity. Within the pond, mudflats would likely be recolonized by invasives such as *Phragmites,* as the salinity transitioned to near-freshwater conditions. Additional NPS efforts to control invasives such as *Phragmites* in the vicinity of West Pond would aid in the recovery of native species along the pond's edges. There would be beneficial impacts associated with the natural regeneration of native vegetation in proximity and interior to West Pond.

Over the long-term, the improvements implemented under phase 1, along with the introduction of freshwater habitat, would have beneficial impacts to vegetation and the species that depend on these habitat conditions. These freshwater communities have largely been lost within Jamaica Bay and are therefore unique in the area. Reestablishing freshwater influenced wetland vegetation at West Pond would have beneficial effects primarily due to the species diversity that these habitats provide in the overall ecosystem within Jamaica Bay.

Groundwater Well –The location of the groundwater well would be determined during final design, however, it is assumed it would be placed in upland habitat. Vegetation would be removed or compacted at the well site during well installation. A drill rig would require access to the well site that could require clearing or trimming of a limited pathway. Disturbed areas would be revegetated or allowed to recover naturally. The area of impact would be limited to the immediate well site. Best management practices and standard well installation protocols would be followed to minimize impacts to vegetation. Construction associated impacts on vegetation would be limited due to the small area affected (likely occur within an area of approximately 25 square feet and the drill rig or trailer would remain on the existing trail) and the use of best management practices. Any impact-related disturbances on vegetation would be expected to recover. Considering the potential for temporary but recoverable impacts from construction, installation of a groundwater well as an option for a source of water would have only slight adverse impacts on vegetation.

Municipal Water Source – Municipal water would be treated prior to discharge into the pond; therefore no impacts on vegetation are expected from utilizing this as a potential source of water supply. The location of a pipeline connection to a municipal source would be determined during final design. Construction associated impacts on vegetation would be limited due to the small area affected and the use of best management practices. Any impact-related disturbances on vegetation would be expected to recover. Therefore, any impacts on vegetation from construction activities associated with the installation of a pipeline connection to municipal water would be considered minimally adverse. Considering the potential for temporary but recoverable impacts from construction, the use of municipal water as an option for a source of water would have an overall slightly adverse impact on vegetation.

Precipitation – There would be no construction-related impacts associated with the option of relying solely on precipitation and runoff as a freshwater source for West Pond. Once the primary and secondary breaches were repaired, relying solely on precipitation and runoff would result in a more gradual transition to freshwater conditions within West Pond when compared to the other water supply options. The more gradual addition of freshwater to West Pond would mean that vegetation in West Pond may take longer to recover and be weather dependent. Immediately prior to Hurricane Sandy, West Pond contained freshwater habitat that was sustained by replenishment from precipitation and runoff alone, without any additional supplemental freshwater input or the ability to conduct seasonal drawdowns. A gradual transition to palustrine (freshwater) conditions would mimic a more natural dynamic, as compared to the groundwater well or a municipal source. The national recreation area staff would use the water control structure to seasonally adjust water levels and manage salinity levels within West Pond. However, under this option, replenishment subsequent to seasonal drawdowns may not be practical for several reasons. The timeframe estimated to replenish the pond when relying solely on precipitation and runoff as a freshwater source could take several months depending on how much water was released during each seasonal drawdown and conditions at the site (site specific precipitation / runoff conditions, evaporation rates, seepage rates, and other potential site specific parameters that are unknown factors at this time). Due to the level of uncertainty in predicting precipitation rates and other unknowns, the ability of the national recreation area staff to manage water levels in the pond would be limited. In addition, from a management perspective, being able to predict how far to drawdown the pond by relying on seasonal weather predictions would involve a high degree of uncertainty. Over the long-term, freshwater conditions within West Pond would be more susceptible to saltwater inundation during future storms because a reliance on natural precipitation as a freshwater source would result in a more gradual recovery following a storm event. Freshwater vegetation communities would take longer to establish within the boundaries of the pond. The conditions would mimic how the pond was functioning before Hurricane Sandy. However, reestablishing freshwater habitats would be beneficial considering how much has been lost in this region and how little this community type is represented in the region. Considering the benefits of improved water quality from seasonal replenishments and drawdowns, the reestablishment of freshwater habitat in an area that has seen losses of this type, and the limited ability of national recreation area staff to manage water levels, the use of precipitation as a freshwater source would have an overall minimally beneficial impact on vegetation.

Future Phases. Under future phasing of alternative B, conceptual designs for shoreline habitat restoration and high saltmarsh (primarily species of *Spartina*) restoration would occur on the bayside of the repaired primary breach. Restoring shoreline habitat and saltmarsh would attenuate wave action and storm surges to help protect the repaired berm and vegetation communities in the surrounding area, with beneficial impacts. The shoreline habitat restoration impacts to wetland vegetation are described under the Wetlands and Floodplains section. Overall, salt marsh restoration activities would have moderately beneficial impacts on other vegetation communities in the West Pond area because once the structure and function of the saltmarsh was established, other vegetation communities would benefit from the storm protection and buffering qualities.

Installation of these resiliency measures would not occur in existing vegetated areas; therefore, no long-term adverse construction impacts to vegetation communities are associated with this component of alternative B. Access to project locations may, however, require national recreation area staff, volunteers, and contractors to traverse existing low saltmarsh, or other vegetated areas, but this pedestrian access is expected to result in only temporary impacts. Construction related impacts would be limited to the period of construction, localized to the area of construction, and minimized by the implementation of best management practices (see chapter 2). Overall, with the use of best management practices, and because any impact-related disturbances on vegetation would be expected to recover, any impacts on vegetation from construction activities associated with restoration and construction would be considered minimally adverse.

Future phases would include improvements at Terrapin Point for invasive vegetation species control and thinning of shrubland vegetation to restore diamond-backed terrapin and bird nesting habitat. It is anticipated that this would provide a beneficial effect for vegetation by promoting native maritime grasslands. Approximately 4.9 acres of upland habitat at Terrapin Point would be targeted for restoration. Overall, improvements at Terrapin Point would have moderately beneficial impacts on vegetation because of the improvements in habitat quality (control of invasive species and promoting native maritime grasslands) once the structure and function of these areas was established.

Installation of amenities such as boardwalks, gravel trails, observation platforms, and educational signage would have temporary adverse construction related impacts. Once constructed, new visitor amenities would provide dedicated paths for visitor access and protect vegetation from trampling and compaction. Boardwalks and other visitor amenities would be designed at a height to avoid shading aquatic habitats; or to allow the maximum passage of sunlight. Construction of boardwalk trails would require installation of support piers in low saltmarsh and high saltmarsh vegetation communities, with short-term adverse impacts during installation. The construction of these visitor amenities, to the maximum extent practical, would not involve mechanized equipment, would employ best management practices to avoid compaction of substrates, and be timed as to have the least impact possible on wetland vegetation and wildlife. In addition, with increased outreach and education opportunities, there would be increased understanding and awareness of the importance of the mosaic of ecosystems that the refuge and West Pond provide. These efforts would help build stewardship and aid in the protection of vegetation communities. Overall, installation of these amenities would have temporary but recoverable construction impacts, minimal loss of vegetation communities due to shading, and increased awareness of vegetation importance due to educational opportunities. Therefore, the impact on vegetation would be considered slightly beneficial.

Common to Phase 1 and Future Phases. Regardless of phase, management activities such as routine maintenance, mowing, and invasive vegetation species control activities would be ongoing. There is a reasonable likelihood that returning the pond to freshwater conditions would make the pond more conducive to recolonization of invasive vegetation such as *Phragmites,* as the salinity transitions to near-freshwater conditions. Additional NPS efforts to control invasive vegetation species such as *Phragmites* in the vicinity of West Pond would aid in the recovery of native species along the pond's edges. There would be temporary adverse impacts during the treatment of invasive species, with longer term beneficial impacts to native plants. During earthmoving and excavation activities proposed under phase 1 and future phases of work, prevention of introduction and establishment of invasive species would require intensive monitoring and response activities with beneficial vegetation impacts (see the "Mitigation Measures" section in chapter 2). Because of the long term benefits expected by these routine activities, the impact on vegetation communities would be considered slightly beneficial.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative B would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years has had substantial adverse cumulative impacts, whereas more recent ongoing efforts to restore saltwater wetlands in Jamaica Bay, as well as steps taken to improve watershed conditions would provide beneficial impacts to vegetation communities. There would remain, however, a substantial cumulative loss of freshwater vegetation in the refuge and surrounding Jamaica Bay area. Improved control of invasive vegetation, collective management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial long-term benefits to freshwater vegetation in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to natural resources in and around West Pond due to the level of regional development and historical and continued sources of pollution entering the Jamaica Bay estuary.

Phase 1 breach repair construction activities would have a negligible contribution to the existing adverse cumulative impacts on vegetation communities because they are temporary, limited to the time of breach repair, and localized to the relatively small area compared to the size of the regional area. Repairing the breaches at West Pond and reestablishing freshwater wetland habitat would have a slightly beneficial cumulative impact on freshwater vegetation because of historic degradation of Jamaica Bay and loss of this habitat over the years, particularly because there are few alternative freshwater options in the area. The combination of a potential water supply source and the water control structure to adjust water levels and salinity within West Pond would improve freshwater quality and quantity. Because this feature would improve habitat and water quality in an area that has a history of degradation, it would contribute a slightly beneficial cumulative impact on vegetation species. West Pond reliance on natural precipitation would not be as beneficial as other supplies because it would not be as reliable, but would still contribute a slight cumulative beneficial impact.

Habitat restoration activities proposed under future phases of alternative B would contribute moderately beneficial cumulative impacts on vegetation in an area that has a history of degradation and habitat loss because vegetation communities would benefit from the storm protection and buffering qualities of these improvements in habitat quality and quantity once the structure and function of these areas have been established. The impact of other amenities proposed in future phases of alternative B would have only a slight beneficial contribution to the otherwise adverse cumulative impact.

When the beneficial impacts under alternative B are combined with the beneficial and adverse impacts from other past, present, and reasonably foreseeable future actions, alternative B would contribute a minimally beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

The phase 1 actions of repairing the West Pond breaches and reestablishing freshwater wetlands under alternative B would provide beneficial impacts on freshwater vegetation communities because of the important role these communities have in the region. The majority of impact to vegetation would occur during construction activities when earthmoving equipment would be accessing the primary and secondary breach areas. Construction equipment would impact vegetation at several locations around West Pond including uplands (approximately 7.3 acres) along the perimeters of the loop trail; approximately 0.08 acres of upland, intertidal sand, emergent wetland at the secondary breach location; 1.6 miles of trail which would be cleared of vegetation to accommodate construction equipment; trees along the trail would be trimmed to a height of approximately 16 feet to accommodate construction equipment; and two 50 ft^2 areas would be cleared of vegetation for construction vehicle turnarounds. Because best management practices would be in place, the localized nature of the construction activities, and the recoverability after disturbance due to revegetation efforts, long-term consequences to vegetation are not expected to result from construction activities associated with breach repairs. Therefore, impacts on vegetation from construction associated with the repair of the primary and secondary breaches would be considered negligible.

Because of the recoverability of construction impacts, the localized nature of the impact, the short duration of the construction period, only minimally adverse consequences to wetland vegetation are expected to result from the installation of the water control structure. In addition, regardless of the option of freshwater supply from groundwater, municipal or precipitation, management of the hydrology and salinity of the pond would have beneficial impacts for vegetation because it would allow for the recruitment of particular freshwater vegetation that is unique to the region.

Habitat restoration activities proposed under future phases would provide improvements on vegetation in an area that has a history of degradation and habitat loss because vegetation communities would benefit from the storm protection and buffering qualities of these improvements in habitat quality and quantity once the structure and function of these areas have been established. There would be temporary minimal adverse impacts because impacts would be limited to the period of construction, localized to the area of construction, and minimized by the implementation of best management practices. Overall, moderately beneficial effects would occur because there would be an increase (5 acres) in the amount of high saltmarsh vegetation along the West Pond area, and the location outside of the repaired berm would protect marsh vegetation by decreasing fetch and decreasing exposure and intensity of storm surges, protecting upland vegetation. These restoration efforts would provide beneficial vegetation impacts by attenuating wave action, protecting the berm, and providing increased resiliency.

IMPACTS OF ALTERNATIVE C: CREATE DIFFERENT TYPES OF HABITAT

Impacts

Alternative C would involve extensive clearing of vegetation and earthwork to establish a mosaic of habitats across the study area. Alternative C would reduce vegetated uplands, create a smaller freshwater pond, and increase low-marsh and estuarine wetland vegetation. A variety of vegetation community types would be established including upland maritime forests, shrubland communities, grasslands, and palustrine marsh within the newly configured West Pond. In addition, estuarine low and high saltmarsh mudflats would be targeted for restoration outside of the reconfigured berm. The pond would be reduced in size to approximately 31.6 acres with an additional approximate 32.3 acres of interior freshwater wetland vegetation. A groundwater well would be installed to supplement freshwater to the pond, and the water control structure would be replaced to shift the current salinity from an estuarine system (saline) to levels closer to a palustrine system (freshwater), aided by precipitation and surface water runoff contributions from upland. This would allow national recreation area staff to manage freshwater levels within West Pond and in turn, provide conditions conducive for the establishment of freshwater vegetation.

Construction activities would have an extensive impact to the existing vegetation, as the reconfiguration would convert approximately 8.0 acres of subtidal channel and estuarine intertidal emergent marsh into upland habitat and 4.3 acres of existing upland habitat would be converted into estuarine intertidal marsh. Vigilant best management practices would be in place over the construction period which may last up to 3 years to reduce impacts to vegetation, including maintenance and monitoring during seasonal construction pauses and subsequent to completion of construction.

The types of impacts associated with construction access such as clearing and trimming vegetation along portions of the existing trail, as well as vehicle turn around space would be similar to alternative B, but to a greater adverse degree due to the greater disturbance of the landscape and vegetation across the study area. Revegetating the trail in portions that would not be rerouted, along with best management practices and other mitigation measures described in chapter 2, would result in temporary adverse construction related impacts to vegetation in the vicinity of the reconfigured berm and trail.

Due to the extent of construction and substantial disturbance across the geographic study area, the timeframe for vegetation stabilization and root establishment would be expected to extend over multiple years and growing seasons. Some species, like hardwoods, may take up to 20 years to reestablish if disturbed. Monitoring and management efforts would be required to ensure success and would include additional site disturbance in localized areas for follow-on work.

The reconfiguration of the berm and West Pond, restoration of freshwater wetland vegetation, and supply and control of water and salinity levels in West Pond would have beneficial impacts to vegetation once the area was stabilized and fully established. Inside of the reconfigured West Pond, revegetation, stabilization, and natural recovery would occur on the eastern portion of the reconfigured berm and along the eastern shore. Reestablishing freshwater vegetation communities would have a regional beneficial impact since freshwater habitats are rare in this region and have been largely replaced in the Jamaica Bay watershed by urban development. Additionally, retention of freshwater influenced wetlands at West Pond would have beneficial effects primarily due to the species diversity that these habitats provide in the overall ecosystem within Jamaica Bay.

The reconfiguration of the berm and West Pond would decrease the risk associated with flood hazard and adverse impacts to vegetation from flooding, with low marsh buffers on the outside of the berm that would further protect vegetation. Reconfiguration of the berm and West Pond would decrease fetch and serve to increase resiliency of the berm from storm surge and high winds, with resulting beneficial impacts to vegetation within the reconfigured berm.

Under the new configuration, Terrapin Point would be separated from West Pond by tidal creeks and low saltmarshes. Earthwork to reconfigure the site would cause substantial disturbance of various wetlands and upland vegetation communities, and once construction was completed, would be followed by extensive habitat restoration and rehabilitation activities to establish a mosaic of habitats (freshwater, estuarine, and uplands). Establishment of intertidal emergent marshes would result in approximately 14.3 acres of low marsh and tidal creeks between the new berm and the island. Monitoring of the newly established saltmarsh communities would be required to ensure that vegetation survives. Areas that were not successful would require additional disturbance for maintenance plantings.

Other habitat improvements at Terrapin Point would include invasive plant species control and thinning of shrubland vegetation to restore diamond-backed terrapin and bird nesting habitat. These actions would provide a beneficial effect for vegetation by promoting native maritime grasslands. Approximately 8.6 acres of upland habitat at Terrapin Point would be targeted for restoration under alternative C. Details regarding the restoration process of the high marsh restoration (hydrologic restoration, excavation, grading, plantings, etc.) are not available at this conceptual stage of the project. The anticipated schedule for completion has not been clearly defined and therefore, the anticipated time-frame for full function of the saltmarsh wetlands and other vegetation would be dependent upon final design details. Multiple growing seasons would be anticipated before vegetation and habitats would be fully functioning. Monitoring and maintenance requirements and schedule would also be determined in follow-on detailed design.

Additional NPS efforts to control invasives such as *Phragmites* in the vicinity of West Pond and vicinity would aid in the recovery of native species along the pond's edges. Management activities and visitor amenities would include routine operation and maintenance activities, invasive plant species control activities, and installation of educational signage, boardwalks and observation platforms that could alter vegetation in localized areas where activity would take place. These facilities would provide dedicated paths for visitor access and protect vegetation from trampling and compaction. During earthmoving and excavation activities, prevention of introduction and establishment of invasive vegetation species would require intensive monitoring and response plans. After the multi-year construction was complete, routine operation and maintenance activities would primarily focus on maintaining operability of the water control structure and removing debris in the reconfigured West Pond. These activities would have temporary impacts when vegetation must be removed to maintain and/or access the water control structure or cleared from visitor use facilities. Construction of boardwalks, trails would require installation of support piers in estuarine wetlands. To the maximum extent practical, the construction of these visitor amenities would not involve mechanized equipment, would employ best management practices to avoid compaction of substrates, and would be timed to have the least impact possible on vegetation and wildlife that use the wetlands. Seasonal drawdowns of the pond are estimated to release freshwater into Jamaica Bay. High intensity inputs of freshwater (low salinity) into the estuary (higher salinity) could have negative impacts on the ecosystem in the area of the water outfall. NPS would develop management strategies specific to West Pond to address these seasonal freshwater releases and ensure the chosen let down rates are compatible with the flushing rates of the bay (7-days) and peak flows of tidal cycles. These efforts would avoid localized and extreme changes in salinity values and therefore would avoid impacting vegetation and wildlife which may be dependent on specific salinity ranges in the vicinity of the outfall.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative C would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years have had adverse cumulative impacts, whereas more recent ongoing and future efforts to improve watershed conditions and natural resources would provide beneficial impacts to vegetation in the area. There would remain, however, a substantial cumulative loss of freshwater wetland vegetation in the refuge and surrounding Jamaica Bay area and reduction of vegetation coverage in the area because of previous urban development. Improved control of invasive vegetation, collective management actions, and efforts to improve and restore natural resource conditions and watershed conditions around Jamaica Bay would result in substantial long-term benefits to vegetation in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to vegetation in and around West Pond due to the level of regional development and overall loss of vegetation communities.

Associated construction activities would have a substantial contribution to the existing adverse cumulative impacts on vegetation and vegetation communities because even with best management practices in place, the relatively large scale of the project and relatively long construction period (up to 3 years) spread over multiple growing seasons. Habitat restoration activities proposed under alternative C would contribute moderate beneficial cumulative impacts on vegetation and vegetation communities once the site was stabilized in the future. The combination of a groundwater source and the water control structure to adjust water levels and salinity within West Pond would improve freshwater quality and quantity for freshwater vegetation communities. Because this feature would improve habitat and water quality in an area that has a history of degradation, it would contribute a moderately beneficial cumulative impact on freshwater vegetation species. The impact of other amenities proposed in alternative C would have only a slight beneficial contribution to the otherwise adverse cumulative impact.

Taken together, the past actions have resulted in primarily adverse cumulative impacts on vegetation. Improved control of invasive species, collective management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay would result in substantial benefits to vegetation in the region inclusive of the refuge. When the impacts on vegetation under alternative C are combined with the impacts from other past, present and reasonably foreseeable actions, alternative C, once fully implemented and recovered, would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Alternative C would result in extensive, adverse impacts that would last through the multi-year construction phase and extend through multiple growing seasons until the study area was stabilized and vegetation became established. Alternative C would contribute to vegetative and ecosystem diversity in the immediate area and within the region, however the benefits of the proposed mosaic of habitats would only occur once the extensive site reconfiguration, planting, stabilization and recovery occurred.

Construction activities would have an extensive, adverse impact to the existing vegetation because the reconfiguration would convert approximately 8.0 acres of subtidal channel and estuarine intertidal emergent marsh into upland habitat and 4.3 acres of existing upland habitat would be converted into estuarine intertidal marsh. Vigilant best management practices (including monitoring and maintenance over the up to 3 year construction period) would be required to reduce the effects of erosion and sedimentation; however some moderate adverse impacts would be likely.

Establishment of a mosaic of upland habitats (native maritime grassland, shrubland, and woodland communities) would increase biodiversity beyond conditions that exist currently or that existed prior to Hurricane Sandy. Upland vegetation influenced by the proximity to freshwater would eventually recover, which would bolster native plant diversity within upland vegetation communities. Alternative C would contribute a beneficial impact over time as the function and structure of the mosaic of vegetation communities became established

Establishing freshwater habitat from the installation of a groundwater well to supplement natural precipitation and runoff at the reconfigured West Pond would result in a beneficial impact to freshwater communities by allowing for a faster transition (estimated 122-139 days) from an estuarine system (saline) to levels closer to a palustrine system (freshwater). Installation of a well would also provide increased resiliency and recovery of the ecosystem in the event of future storm damage since freshwater could be quickly added to reduce salinity. Managing the hydrology of the wetland would have beneficial impacts because it could allow the recruitment of particular freshwater vegetation. Seasonal drawdowns could have an adverse impact on water quality outside the water outfall, however, is the impact would be expected to be negligible because NPS would develop management strategies to address these seasonal freshwater releases to ensure the drawdown rates are compatible with Jamaica Bay flushing rates and tidal cycles to the extent practicable.

Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the cumulative adverse impacts to vegetation in and around West Pond due to the level of regional development and overall loss of vegetation communities. When the impacts on vegetation under alternative C are combined with other past, present and future impacts, alternative C would contribute a slight beneficial increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE D: BRIDGE THE BREACH

Impacts

Under alternative D, the West Pond area would continue to function as a tidally influenced area with salinity levels similar to Jamaica Bay, which would result in vegetation conditions similar to those that are currently present. With the stabilization of the primary and secondary breach locations, vegetation communities would resemble the current assemblage within West Pond and outside of the berm. Vegetation within the primary breach location and the secondary location would be subject to temporary impacts during construction of the bridge and stabilization activities. Around the primary breach, intertidal sand and mud flat habitat would be replaced by supporting infrastructure on both sides of the bridge. At the secondary breach, low marsh vegetation and some upland maritime grassland vegetation (approximately 0.08 acres total) would be replaced with gabion baskets and backfill for stabilization. This area would rely on natural recruitment only and no vegetation plantings would occur.

The loss of freshwater vegetation communities at and surrounding West Pond would result in adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay. Prior to Hurricane Sandy, West Pond provided approximately 44 acres of freshwater habitat. Given the rarity of this type of habitat in the watershed, alternative D would mean a continued, substantial reduction in the proportion of available freshwater vegetation.

Under alternative D, vegetation communities within West Pond that had established under pre-Hurricane Sandy conditions (vegetation adapted to freshwater or low salinity conditions) would continue to shift in composition and structure, to resemble low saltmarsh and mudflats in the lower elevations grading to upland shrub scrub in the upland locations. Precipitation and sheet flow would be the only freshwater sources into West Pond. After the damage sustained by Hurricane Sandy, upland vegetation, such as hardwood trees common along riparian zones in other locations, would likely continue to be stressed and eventually be replaced with a shrub-scrub community composed of plants more tolerant to seaspray and brackish water. The NPS would continue to monitor invasive plant species with control measures and targeted reduction efforts. Given the saline levels within West Pond, there would be a decreased need to control *Phragmites* and purple loose-strife (invasive plants that thrived in the low salinity conditions before Hurricane Sandy).

Management activities and installation of new visitor use amenities and facilities would include routine operation and maintenance activities (such as mowing and trail maintenance), targeted invasive vegetation species control activities, and installation of facilities such as boardwalks, observation platforms, and educational signage. Impacts of these actions would be similar to alternative B. These facilities would provide dedicated paths for visitor access, and protect vegetation and wetlands from trampling and compaction. During earthmoving and excavation activities, prevention of introduction and establishment of invasive vegetation species would be monitored. Construction of boardwalk trails would require installation of support piers in low saltmarsh and high saltmarsh vegetation communities. To the maximum extent possible, construction of these visitor amenities would not involve mechanized equipment and would employ best management practices to avoid compaction of substrates.

There would be localized benefits for saltmarsh wetlands from open mixing with the waters of Jamaica Bay. However, the loss of freshwater influenced wetlands at and surrounding West Pond would result in adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay. The loss of freshwater vegetation would have an adverse affect for individual plants, in addition to a regional impact since freshwater habitat is rare in this region and has been largely replaced in the Jamaica Bay watershed by urban development. The loss of freshwater influenced wetland vegetation at and surrounding West Pond would result in slightly adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative D would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years has had adverse cumulative impacts, whereas more recent ongoing efforts to restore natural resources in Jamaica Bay, as well as steps taken to improve watershed conditions would provide beneficial impacts to vegetation. Taken together, these past, present, and reasonably foreseeable actions have resulted in primarily adverse impacts on vegetation within the greater Jamaica Bay estuary primarily due to the extensive historic impact of habitat loss. Improved control of invasive plants, management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial cumulative benefits to vegetation in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to vegetation in and around West Pond due to the level of historical and continued sources of pollution entering the Jamaica Bay estuary. When the impacts on vegetation under alternative D are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative D would contribute a slightly adverse increment to the overall substantially adverse cumulative impact because of a continued reduction of biodiversity in plant communities.

Conclusion

Under alternative D, wetland vegetation would continue to resemble current estuarine conditions both within West Pond and outside of the berm. There would be localized benefits for saltmarsh wetland vegetation from open mixing with the waters of Jamaica Bay and wetland vegetation would resemble the current estuarine conditions within West Pond and outside of the berm. The loss of freshwater influenced wetland species at and surrounding West Pond would result in adverse effects primarily due to the important role that these habitats provide in the overall ecosystem within Jamaica Bay. The sustained loss of freshwater vegetation would have an adverse effect for individual plants, in addition to a regional adverse impact because freshwater habitat is rare in this region and has been largely replaced in the Jamaica Bay watershed by urban development. Although the surface area of low saltmarsh within the West Pond area would likely increase over time, the trends would decrease vegetation diversity as freshwater (palustrine) species are lost and overall diversity of plant species within West Pond would continue to decline. Adverse impacts would also include a decrease in upland vegetation that had developed under the influence of low saline conditions prior to the breaching of the pond. In addition, alternative D would result in adverse impacts to vegetation communities because of the absence of a solid protective barrier against storm surges and the potential for increased fetch through the breach as a result of keeping the berm open. Alternative D would contribute an adverse increment to the overall substantially adverse cumulative impact because of a continued reduction of biodiversity in plant communities.

WILDLIFE AND SPECIAL STATUS SPECIES

AFFECTED ENVIRONMENT

Despite the intensive and long history of development within the Jamaica Bay watershed, the Jamaica Bay estuary is rich in fish and wildlife communities with large and diverse populations of resident and migratory species. The bay is recognized by the U.S. Fish and Wildlife Service as a regionally valuable habitat for migrating birds along the Atlantic Flyway and the National Marine Fisheries Service has designated areas of the Jamaica Bay as essential fish habitat for several marine, estuarine, migratory, and anadromous fish species. The West Pond area supports varied wildlife communities of marine invertebrates (macroinvertebrates and shellfish), fish, birds, mammals, and reptiles, and amphibians. Some of these species have special regulatory protections under the Endangered Species Act, Migratory Bird Treaty Act, and state-level protections. This section summarizes existing conditions, including information reported prior to Hurricane Sandy. Additional wildlife information for the larger region comprising the national recreation area, Jamaica Bay Unit and other park units is provided in the *General Management Plan* (NPS 2014a).

Marine Invertebrates

The subtidal and intertidal substrates of Jamaica Bay support a large and diverse macroinvertebrate community. This community of species, as a whole, is an important indicator of site-specific health and water quality impairment. Marine invertebrate habitats are highly vulnerable to flooding, sea level rise, temperature increase, and storm frequency and duration anticipated with climate change. In addition, within Jamaica Bay, the fluctuations in the total number of macroinvertebrates species can be an indicator of excessive organic loading from sewage and sediment contamination (see also the "Water Resources" section). Oyster reefs provide shelter for juvenile and smaller macroinvertebrates, including forage, and soft bottom habitats provide macroinvertebrate prey for predators using the reef for shelter. Farther up the elevation gradient, the marsh fringe is an alternate habitat for predators (such as crabs), that visit the oyster reef to prey on small oysters. Some common macroinvertebrates within Jamaica Bay include the polycheate worm (*Streblospio benedicti*), amphipod (*Ampelisca abdita*), mud crab (*Xanthidae*) mud snail (*Nassarius obsoletus*) slipper limpet (*Crepidula fornicate*s) and shrimp (*Crangon septemspinosus*), and gen clam (*Cyllopsis gemma gemma*) (Iocco et al. 2000; Franz and Friedman 2004). Common shellfish include hard-shelled clam (*Mercenaria mercenaria*), soft clam (*Mya arenaria*), blue mussel (*Mytilus edulis*), blue crab (*Callinectes sapidus*), horseshoe crab (*Limulus polyphemus*), and Atlantic ribbed mussel (*Geukensia demissa*).

Atlantic ribbed mussels are often found in high densities in saltmarshes and mudflats (USACE 2005), which facilitate the creation of wetlands and their stabilization (NPS 2014b). Horseshoe crabs are found in high abundance within Jamaica Bay (USACE 2002). Horseshoe crab nesting occurs in the vicinity of West Pond and Rulers Bar Hassock (NPS 2013). Peak horseshoe crab spawning occurs throughout May and June. Spawning is highest during lunar high tides; however, in Jamaica Bay, spawning activity occurs during daytime and evening high tides (James and Rafferty *in preparation*; McGowan et al. 2011). As sea level rise accelerates over time (as depicted in figures 10 and 11), areas of shallow water covering deeper sandy beaches that are needed for horseshoe crab spawning are quickly disappearing under deeper water, with potential adverse impacts across Jamaica Bay including the study area (NPS 2014a).

Fish

Jamaica Bay is a highly productive estuary and provides important nursery areas and feeding grounds for marine, estuarine, migratory, and anadromous fish species (NPS 2014b). The area supports some of the greatest numbers of fish species in the New York estuary system, with up to 82% of individual species coming from the Atlantic to utilize the estuary for feeding, breeding, and nursery habitat (Woodhead 1991). Saltmarsh fringes and nearshore areas of higher turbidity provide cover from predators and nursery habitat. The breach of West Pond created more nursery habitat available for fish that utilize Jamaica Bay. Winter flounder (*Pleuronectes americanus*) occurs in great numbers during all life stages within Jamaica Bay and the shallow estuarine areas are believed to be a significant breeding area for this species (USFWS 1997). Forage fish species with high abundances, including Atlantic silverside (*Menidia menidia*), bay anchovy (*Anchoa mitchilli*), mummichog *(Fundulus heteroclitus*), Atlantic menhaden (*Brevoortia tyrannus*), and striped killifish *(Fundulus majalis*), form a prey base for other fish and birds that also use Jamaica Bay. Some of the other common species found in surveys and recreational landings include scup (*Stenotomus chrysops*), bluefish *(Pomatomus saltatrix*), windowpane (*Scophthalmus aquosus*), tautog (*Tautoga onitis*), weakfish (*Cynoscion regalis*), black sea bass (*Centropristis striata*), summer flounder (*Paralichthys dentatus*), American eel (*Anguilla rostrata*), and searobin (*Prionotus* spp.). Anadromous fish known to use Jamaica Bay include blueback herring *(Alosa aestivalis*), Atlantic sturgeon (*Acipenser oxyrhynchus*), alewife (*Alosa pseudoharengus*), American shad (*Alosa sapidissima*), and striped bass (*Morone saxatilis*) (USFWS 1997; NYCDEP 2007; NPS 2013). The inland silverside (*Menidia beryllina*) is a native species that inhabits estuarine and freshwater marshes, and was known to occur within East Pond prior to the damage sustained by Hurricane Sandy (NPS 2013). The current status of this species within West Pond or East Pond is unknown.

The Atlantic sturgeon is the only federally listed fish species that may use Jamaica Bay, but breeding occurs primarily up the reaches of large rivers along the Atlantic Coast (NMFS 2014). Larvae float downstream of spawning rivers and settle into benthic habitats of estuaries. No rivers used for spawning flow into Jamaica Bay. Juveniles and adults are known to migrate into estuarine bays, but are associated with depths no less than approximately 30 feet (NMFS 2014). The subtidal and intertidal marshes and mudflats in the West Pond vicinity are too shallow for this species (see the "Special Status Species" section for further discussion).

The National Marine Fisheries Service has designated essential fish habitat for various life stages of fish and marine invertebrates in the study area which highlight the importance of protecting habitat for commercial fisheries by protecting habitats of marine and estuarine finfish, mollusks, and crustaceans. Essential fish habitats are those habitats required to support a sustainable commercial fishery and the species' influence on a healthy ecosystem. Not all 22 species listed in the 10 x 10 minute squares which include Jamaica Bay are appropriate for consideration in this assessment because essential fish habitat was not designated for them in an estuary like Jamaica Bay based on their life histories versus the type of habitat in the bay. For example, the shallow, higher temperature, and low salinity estuarine waters of Jamaica Bay, as described in the "Water Resources" section of this chapter, may not be suitable habitat for any life stages of deep-water ocean species listed in the links above and therefore, essential fish habitat was not designated for them in the estuary.

The shallow-water, subtidal estuarine habitats within Jamaica Bay are designated as essential fish habitat for six species (table 8). For waters in and around the tidally-influenced West Pond, these species include summer flounder (larvae, juveniles and adults), winter flounder (all life stages), windowpane flounder, (all life stages), red hake (eggs, larvae, and juveniles), Atlantic butterfish (all life stages), and scup (all life stages) (NOAA 2011). Applicable water column parameters referenced in essential fish habitat descriptions (NOAA 2011) for these species include estuarine waters, temperature, and salinity zones which correlated to what has been described for Jamaica Bay (see "Water Resources" section). Most of these life stages prefer the mud, sand, or soft bottom sediments which are present near West Pond so their presence would be likely (NOAA 1999a; NOAA 1999b; NOAA 1999c; NOAA 1999d; NOAA 1999e; NOAA 1999f). The Magnuson-Stevens Act requires that Fishery Management Councils identify habitat areas of particular concern. For an essential fish habitat to be identified as a habitat area of particular concern, it must meet the following criteria: (1) the importance of the ecological function provided by the habitat; (2) the extent to which the habitat is sensitive to human-induced environmental degradation; and (3) whether, and to what extent, development activities are, or will be, causing stress to the habitat type (NEFMC 1998). The only habitat area of particular concern identified in the study area (NOAA 2011) is for summer flounder (see table 8). This designation does not provide added protections or restrictions; instead it simply serves as a priority for habitat conservation, management, and research.

Table 8: Species with Identified Essential Fish Habitat within the Project Area

Species	Life Stage				Habitat Area of Particular Concern
	Eggs	Larvae	Juveniles	Adults	
Atlantic butterfish (*Peprilus triacanthus*)	T	T	T	T	None
Red hake *(Urophycis chuss)*	M,S	M,S	M,S		None
Windowpane flounder (*Scophthalmus aquosus*)	M,S	M,S	M,S	M,S	None
Winter flounder (*Pleuronectes americanus*)	M,S	M,S	M,S	M,S	None
Summer flounder *(Paralicthys dentatus)*		M	M,S	M,S	All native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, plus loose aggregations, within adult and juvenile summer flounder essential fish habitat.
Scup (Stenotomus chrysops)	M,S	M,S	M,S	M,S	None

Source: NOAA 2011
Key:
S =The Essential Fish Habitat designation for this species includes the seawater salinity zone of this bay or estuary (salinity > 25.0‰).
M = The Essential Fish Habitat designation for this species includes the mixing water / brackish salinity zone of this bay or estuary (0.5 < salinity < 25.0‰).
T= water column temperatures are 6.5-21.5°C.

Birds

Jamaica Bay is situated on the confluence of two migratory pathways for waterfowl, which are strands of the larger Atlantic Flyway system. The U.S. Fish and Wildlife Service estimates that nearly 20% of North America's bird species migrate through, or breed in, the Jamaica Bay area (USACE 2005). Habitats within Jamaica Bay form a complex of critical feeding, resting, and breeding grounds for migrating species during the spring and fall. An avian abundance study prior to Hurricane Sandy, found 326 species of birds using the refuge, including confirmed breeding by 62 species (NPS 2014b; U.S. Fish and Wildlife Service 1997). The refuge provides nesting habitat for colonial nesting waterbirds, including herons, ibis, and egrets, as well as shorebirds like common terns, and the only nesting colony of laughing gulls in the state of New York (NPS 2014a). Common bird species found at Jamaica Bay include the killdeer (*Charadrius vociferus*), greater yellowlegs (*Tringa melanoleuca*), osprey (*Pandion haligetus*), American brant

(*Branta bernicla*), herring gull (*Larus argentatus*), great blue heron (*Ardea herodias*), and barn swallow (*Hirundo rustica*).

Some man-made disturbances within the Jamaica Bay watershed have shifted bird populations. Migratory bird and resident bird populations have suffered impacts within Jamaica Bay from habitat destruction and degradation attributed to water pollution, noise, boat traffic, nutrient loading, and petrochemical releases. An increase in the herring gull population, however, is likely due to the numerous landfills within the area (NYCDEP 2007). Climate change is believed to be shifting migratory bird patterns, temporally and spatially. Migratory birds in the Atlantic flyway have been delaying their southward departure with some species changing routes (United Nations Environment Programme 2009). This has adverse consequences for many species of migratory shorebirds that time their arrival along a migration route with prey availability. A notable example for the West Pond area is that the red knot has been shown to have decreased fitness rates associated with late arrival to mid-Atlantic foraging locations (Baker et al. 2004; McGowan et al. 2011).

Within West Pond environs, the most significant habitat alteration occurred in 2012 from a natural event—Hurricane Sandy. The subsequent breach of the berm surrounding West Pond removed a near freshwater feature that has subsequently transitioned to mudflats and emergent tidal marsh. Although the West Pond area continues to provide excellent habitat for shorebirds, waterbirds with freshwater associations have apparently declined in relative abundance. The national wildlife refuge has conducted bird surveys at count stations dating back to 2006, with data available since 2009. In addition, the Queens County Bird Club compiled data from "eBird," a real-time online checklist program managed by the National Audubon Society and the Cornell Lab of Ornithology, that covers a similar time span from 2011 through 2014 (Tognan 2012). Both data sets show substantial changes in the species assemblage at West Pond prior and subsequent to the damage sustained at West Pond. Table 9 summarizes the change in average counts of the pied-billed grebe (*Podilymbus podiceps*), snowy goose (*Chen caerulescens*), northern shoveler (*Anas clypeata*), canvasback duck (*Aythya valisineria*), ring-necked duck (*Aythya collaris*), greater scraup (*Aythya marila*), common goldeneye (*Bucephala clangula*), red-breasted merganser (*Mergus serrator*), ruddy duck (*Oxyura jamaicensis*), American coot (*Fulica americana*), and greater yellowlegs (*Tringa melanoleuca*). These species are representative of the declines of waterfowl observed at West Pond that show strong affinity for freshwater sources. Declines reported in table 9 reference average counts of birds seen on checklists with a positive observation for the species within a specified date range and region.

Much of the shoreline in the area surrounding West Pond and within the refuge is considered to be highly or very highly vulnerable to flooding and loss from climate change. Inundation as the sea level rises (depicted on figures 10 and 11) over time could affect low marshland habitat, with impacts on shorebirds and waterfowl and the species on which they depend, including fish and some reptiles.

Table 9: Representative List of Birds Showing Declines at West Pond after Hurricane Sandy

Scientific Name	Common Name	Status Observations at West Pond (Before & After Hurricane Sandy)
Podilymbus podiceps	Pied-billed Grebe	After showing high numbers in 2011 and 2012, no observations in 2014
Chen caerulescens	Snow Goose	Approximate 75% decline from 2011 to 2014
Anas clypeata	Northern Shoveler	Approximate 85% decline from 2011 to 2014
Aythya valisineria	Canvasback	13 observed in 2011, 2 observed in 2013, no observations in 2014
Aythya collaris	Ring-necked duck	12 observed in 2011, 4 in 2012, no observations in 2013 or 2014
Aythya marila	Greater Scraup	No observations in 2014, found in high numbers at East Pond
Bucephala clangula	Common Goldeneye	Approximate 95% decline from 2011 to 2014
Mergus serrator	Red-breasted Merganser	Approximate 95% decline from 2011 to 2014
Oxyura jamaicensis	Ruddy Duck	No observations in 2014, found in high numbers at East Pond
Fulica americana	American Coot	No observations in 2013 or 2014
Tringa melanoleuca	Greater Yellowlegs	Approximate 50% decline from 2011 to 2014

Sources: NPS 2014a; Tognan 2012

Mammals

Species such as elk, deer, and bear were once common within the Jamaica Bay watershed, but with the extensive development over the centuries, these species have been extirpated (Black 1983). Today, the muskrat (*Odantra zibethicus*) is the only mammalian species within Jamaica Bay that regularly inhabits saltmarsh environments and their presence is generally associated with healthy marsh ecosystems (NYCDEP 2007). Most mammals within the West Pond area include feral dogs (*Canis familiaris*), feral cats (*Felis silvestris*), rats (*Rattus rattus*), and other small rodents. Raccoons (*Procyon lotor*) are common, and cottontail rabbits and grey squirrels (*Sciurus carolinensis*) were observed during wetlands surveys conducted in May 2014.

During summer and fall of 2014, Long Island Century Bat Surveys were conducted at Floyd Bennett Field about three miles from West Pond (Fishman 2014). Six species were found and included the big brown bat (*Eptcsicus fuscus*), little brown bat (*Myotis lucifugus*), eastern pipistrelle or tri-colored bat (*Perimyotis subflavus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionyctcris noctivagans*). Marine mammals are also known to occasionally visit Jamaica Bay. These species include the bottlenose dolphin (*Tursiops truncates*) and harbor seal (*Phoca vitulina*) (NYCDEP 2007).

Reptiles/Amphibians

With the large reduction in freshwater wetlands in the area over the past century, over 90% (New York City Wetlands Strategy 2012), comes a large impact to reptiles and amphibians because of the reliance on this habitat. The extensive development of the Jamaica Bay watershed and portions within the estuary has greatly reduced diversity and abundance of reptiles and amphibians (Cook 2008). Freshwater habitat was largely lost after the breach of the berm forming West Pond. Freshwater wetlands surrounded by uplands provide the main source of freshwater habitat in the immediate vicinity of West Pond, as well as the freshwater of nearby Big John Pond and East Pond (figure 3). A literature search of amphibians and reptiles was conducted in 2008 for the area within the refuge Rulers Bar Hassock (closest location to West Pond) at the time of establishment of the wildlife refuge (Cook 2008). This area supported populations of Fowler's toad (*Bufo fowleri*), common garter snake (*Thamnosphis sirtalis*), and terrapins, with individual sightings of common snapping turtle (*Chelydra serpentina*), yellow-bellied slider (*Trachemys scripta*), and Carolina box turtle (*Terrapene carolina*). Reintroductions of various turtle species in the 1990s and early 2000s increased the diversity of native herpetofauna, along with efforts to stabilize declining native populations within the national recreation area. The successful reintroductions tended to be turtles that were generalists in habitat and diet (Cook 2008). Prior to Hurricane Sandy, the NPS noted introduced species such as the eastern box turtle, eastern hognose snake (*Hetreodon platyrhinos*), Eastern Painted Turtle (*Chrysemys picta picta*), Red-eared Slider (*Chrysemys scripta elegans*), Smooth Green Snake (*Opheodrys vernalis vernalis*), snapping turtle, and yellow-bellied slider. All reintroductions of amphibians were compromised following the breaching of West Pond (NPS 2013) and surveys have not been completed following Hurricane Sandy. Because Big John Pond and the surrounding uplands survived the hurricane largely intact, it is believed that a few survivors of most resident species remain within the refuge (Frame, personal communication 2015). Terrapin nesting, however, continues on Terrapin Point, and a vigorous terrapin conservation program is managed by NPS staff, which includes nest protection (prevention of egg predation) and protection of juveniles and hatchlings that overwinter near nest sites. The northern diamondback terrapin is extremely vulnerable to warmer temperatures because drier summers reduce nesting success. Temperature shifts are anticipated as a result of climate change and could impact terrapins (NPS 2014a). Jamaica Bay is part of the northernmost portion of the diamond-backed terrapin's range, with Rulers Bar Hassock as the largest breeding location for terrapins in New York (Muldoon and Burke 2012). Sea level rise and impacts associated with increased storm frequency/intensity could inundate reptile and amphibian nests, adversely affecting populations in the refuge and areas surrounding West Pond.

Special Status Species

Habitats within the West Pond area support a number of species with either federal protection under the federal Endangered Species Act or state protections specified under the New York Endangered Species Act. These species are considered to have special regulatory status. Special status species by major taxonomic group found within the West Pond area are shown in appendix E. These protected species are described based on information provided in the *Gateway National Recreation Area General Management Plan* (NPS 2014a), the U.S. Fish and Wildlife Service Office of Ecological Services, and the New York State Natural Heritage Program.

The northern long-eared bat, red-knot, and roseate tern are federally listed species that may occur within the West Pond area. Although the Atlantic sturgeon is federally listed and likely occurs within Jamaica Bay, the subtidal and intertidal marshes and mudflats in the West Pond vicinity are too shallow for this species and therefore, this species is not analyzed further. Special status species are described in more detail below.

Northern Long-eared Bat. Northern long-eared bats (*Myotis septentrionalis*) were recently listed as threatened under the Endangered Species Act. This species declined approximately 98% since white-nose syndrome began in New York in 2006 (USFWS 2013). In the colder months, they will be found in their hibernacula which include caves or mines. They are frequently found in forested areas during the warmer months roosting underneath bark, in cavities or crevices in live or dead trees in areas proximate to ponds, wetlands, streams, and other aquatic habitats. However, they are typically associated with mature interior forests and avoid the forest edge habitat (Yates and Muzika 2006). Their presence at West Pond would be considered rare. The recent Long Island Century Bat Surveys conducted at Floyd Bennett Field three miles from West Pond (Fishman 2014) did not locate any of these species, however, they have been found during surveys in the Central Pine Barrens on Long Island (Fishman 2013).

Red Knot. The red knot (*Calidris canutus*) is a migratory species listed as threatened under the Endangered Species Act and listed by the state of New York. Migrating red knots typically arrive in mid-May, timed to coincide with horseshoe crab spawning that occurs throughout May and into early June. The critical feeding time for red knot in Jamaica Bay is late May. Horseshoe crabs spawn within the sandy shorelines of the West Pond area, and red knots have been noted to forage in the area as well (Frame, personal communication 2015).

Roseate Tern. Roseate terns (*Sterna dougallii*) are listed as endangered under the federal Endangered Species Act and by the state of New York. This species nests almost exclusively on rocky or saltmarsh islands where predation pressure is lower than on mainland sites. Colonies are often located close to shallow-water locations where the terns can fish. Roseate terns are threatened by the loss of breeding habitat to development, rising sea level and related storm surge, human disturbance, and predation. The only record for roseate tern nesting in the national recreation area is one or two pairs nesting on the ocean beach at Breezy Point (approximately 8 miles [12.9 k,] from West Pond), but none have been reported since 1999. Breeding numbers have always been low, peaking in 1998 at six individuals (NPS 2014a). Their presence at West Pond would be considered rare.

State-listed Species. Forty-two bird species and 3 reptilian species have been listed by the state of New York and may appear in the project area (see table in appendix E). Of the 42 bird species, 15 are passerines, 11 are grouped as raptors, falcons, and owls, and 16 are shorebirds and waders. Passerines are songbirds, either migratory or breeding in the West Pond area, typically in upland habitats. Raptors, falcons, and owls are predatory birds, either migratory or breeding in the West Pond area, that use estuarine habitats (such as the osprey) and upland habitats. Shorebirds and waders are a general classification of birds that migrate or breed in the West Pond area that are typically found along shorelines and shallow waters.

Climate change has affected habitat for wildlife as previously described, and for listed species that have become rare over time because they are specialized. Climate change can mean substantial loss of individuals as conditions are too quickly altered for these species to relocate. Impacts from many climate change factors are not just historical, but are ongoing and likely to worsen in the future with adverse impacts to species already in jeopardy.

Invasive Species

NPS staff at Gateway National Recreation Area maintain an annotated list of species of management concern, which includes invasive species and management actions (NPS 2013). This document identifies 17 undesirable species targeted for management because of their impacts to native species and habitats. Feral cats can be regularly seen throughout the West Pond area, with rarer sightings of feral dogs that have dispersed from adjacent urban areas. The house mouse (*Mus musculus*) and Norway rat (*Rattus norvegicus*) are also common in the area. Raccoons, a native species, are managed within the recreation area to control their predation on piping plovers and to minimize interaction with visitors. Invasive bird species include European starlings (*Sturnus vulgaris*), house sparrows (*Passer domesticus*), and rock pigeons (*Columba livia*), which outcompete and crowd out other native upland birds. The Asian shore crab (*Hemigrapsis sanguineus*) is an introduced invasive crab that outcompetes and preys on other marine invertebrates. The green crab (*Carcinus maenas*), an earlier introduction, also outcompetes other native crab species; however, this species is also being replaced by the Asian shore crab. Natural resource managers at the national recreation area also must contend with two species of disease-bearing mosquitoes—the Asian rock pool mosquito (*Ochlerotat* spp.) and the Asian tiger mosquito (*Aedes albopidtus*). Both of these species harbor and spread West Nile Virus, which is harmful to both humans and wildlife species. Anticipated rise in temperatures associated with climate change would likely shift the composition of upland wildlife communities through habitat changes or degradation from the establishment and spread of invasive species. The ecological shift over the coming decades may reduce the ability for wildlife communities within West Pond to resist invasive species.

IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impacts

Under alternative A, natural processes would proceed uninhibited and habitat conditions would continue to change resulting in impacts to wildlife due to the continuing conveyance of tidal ebb and flow through the primary breach. The primary breach would likely continue to erode forming a wider channel. Other areas of the berm may erode over time, with the sediment transported outward into Jamaica Bay, or captured in tidal and intertidal estuarine mudflats and low marshes interior off the berm. With a high likelihood of a secondary breach forming north of Terrapin Point, a tidal creek system would be formed through low marsh vegetation or mudflats established through the accretion of sediments deposited in the interior of the pond. With two breach locations within the existing berm, the peninsula formed by Terrapin Point would become an island separated by the channelized estuarine mudflat or low marsh.

Habitat for marine invertebrates and shellfish would likely increase under alternative A since the primary breach would remain open and resemble other productive shallow water habitats of Jamaica Bay. About 0.3% more spawning and feeding habitats would be available for fishes within the Jamaica Bay Unit.

Although alternative A may increase prey availability for shorebirds and other birds (e.g., ospreys), the area surrounding the existing West Pond would continue to exhibit a decreased avian diversity. Birds that show an affinity for freshwater resources would not use the area as indicated in table 9 (representative list of birds showing declines at West Pond).

Upland habitats such as the riparian hardwood woodlands around North and South Gardens would likely transition to a shrub community more tolerant of salt spray and overwash from storm surges. These habitats would degrade as upland bird habitat with the expected loss of hardwoods and freshwater riparian vegetation. This would reduce habitat availability for various migratory passerines. Habitat for state-listed passerines and waterfowl would continue to degrade, decreasing recovery opportunities within the West Pond area for special status species.

Under alternative A, the amphibian and reptile communities would not recover to pre-Hurricane Sandy conditions since freshwater habitat within West Pond would not be available and wetlands would continue to degrade. An absence of freshwater wetlands near West Pond would result in a lack of vital habitat that once provided breeding grounds for amphibians.

Continued saltwater influence at West Pond would continue to have substantial adverse impacts on freshwater wetland-dependent species.

Special status species that use estuarine habitats, such as shorebirds and ospreys, may benefit from increased estuarine habitat that would likely form over time as the secondary breach widened and a tidal conveyance was created between the primary and secondary breaches. These species include the federally listed red knot and several state-listed shorebird species that have a high dependence on estuarine foraging environments. Tidal conveyance through the West Pond area could create additional sandy beach habitat for horseshoe crab spawning. Because horseshoe crab spawning areas may be a limiting factor for red knot use of the West Pond area, alternative A may benefit the red knot. Diamond-backed terrapins may benefit from the eventual isolation of Terrapin Point by a tidal conveyance formed between the primary breach and the secondary breach. Terrapin nests and juveniles on the island may be subject to decreased trampling and disturbance since the point would become more isolated from visitors and not connected via landmass. As upland habitats that established under the influence of freshwater availability prior to Hurricane Sandy continue to degrade, the number and diversity of passerine, raptor, and waterfowl special status species (listed in appendix E) may continue to decrease or cease to use the area. In summary, some special status species may benefit from alternative A, while others that have used freshwater and freshwater-influenced habitats would likely continue to decline. Pursuant to section 7 of the Endangered Species Act, the NPS would make a finding that alternative A may affect, but not likely adversely affect, the red knot. Because alternative A would not alter any habitats, and because of the unlikelihood of their presence in the area, pursuant to section 7 of the Endangered Species Act, alternative A would have no effect on the northern long-eared bat or the roseate tern.

Pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, alternative A would have no adverse effect on essential fish habitat because no construction activities would occur. Therefore, it would not include any activities that would disturb the water column that constitutes essential fish habitat, impact the listed forage species, or reduce the quality or quantity of soft bottom substrates that constitute essential fish habitat for any of the life stages for any of the species listed in table 8.

Under alternative A, a more complex shoreline with more estuarine environments is expected to form as natural processes create a tidal conveyance between the primary and secondary breach locations. These processes may form more horseshoe spawning areas, which would benefit the red knot. Because horseshoe crab spawning areas may be a limiting factor for red knot use of the West Pond area, alternative A may benefit the red knot. Pursuant to section 7 of the Endangered Species Act, the NPS would make a finding that alternative A would have no effect on the red knot. Because alternative A would not alter any habitats, and because of the unlikelihood of their presence in the area, pursuant to section 7 of the Endangered Species Act, alternative A would have no effect on the northern long-eared bat or the roseate tern.

Cumulative Impacts

Cumulative adverse impacts to wildlife and special status species would result from habitat losses, whether through direct development or through alteration by pollutants, invasive species, dredging or filling, recreation or other human uses, and/or increases in feral predators like dogs or cats (NPS 2014a). Cumulative beneficial impacts on wildlife and special status species within the vicinity of West Pond from past, present, and reasonably foreseeable projects would result from restoration projects that improve or restore wildlife habitats locally and within the national recreation area and from local natural habitat restoration projects within Jamaica Bay. These actions include wetland restoration projects in Jamaica Bay that are addressed in the wetlands and floodplains sections in more detail. Continued efforts to build marsh islands in Jamaica Bay would have potential substantial and widespread benefits for saltmarsh vegetation and the species that depend on it. These islands support populations of marine invertebrates, including shellfish, waterfowl, and seabirds and provide important stopover habitat for migratory shorebirds, which feed in the saltmarsh, on mudflats at low tide, at East and West Ponds, and on beaches.

The national recreation area has also established several objectives for clean-up of Jamaica Bay in partnership with the New York Department of Environmental Conservation that would result in improved water quality and aquatic habitat conditions for fish and other species (NPS 2014a). Other beneficial cumulative actions affecting wildlife by improving habitat conditions include multiphased programs to address the impacts of wastewater and combined sewer/stormwater flows into Jamaica Bay, landfill closures, and other watershed management measures underway by the New York City Department of Environmental Protection and other agencies (see also the "Water Resources" section) (NPS 2014a).

The presence and spread of invasive plant infestations within the national recreation area and the refuge has adversely impacted native vegetation and species diversity. The NPS manages the impacts of these and similar conditions through the development of management plans and by implementing subsequent actions to improve resource conditions. Past and future management plans that affect wildlife and special status species within the vicinity of West Pond and the refuge include the invasive species management plan (2014) and future plans in partnership with the Nature Conservancy and Jamaica Bay-Rockaway Parks Conservancy to restore native vegetation at the North and South Gardens near West Pond. These plans and actions have altered or would alter conditions, with temporary, adverse effects on wildlife during implementation of the plans as applications take place and species are removed. However, these plans would have longer beneficial effects on wildlife by restoring native habitat and attracting wildlife.

Increased saltmarsh within the West Pond area may benefit a number of special status species, but anticipated decreases in wildlife diversity may decrease the overall diversity within Jamaica Bay by stressing the carrying capacity of other freshwater habitats (e.g., East Pond). Amphibian and reptile introduction projects that have occurred over the past few decades would no longer be possible at West Pond, and the freshwater dependent species would no longer be present. Actions taken by the New York Regional Transportation Authority immediately after Hurricane Sandy to repair the three breaches at East Pond and restore rail service enabled the pond to recently return to near freshwater conditions. Additional wetland mitigation and restoration efforts in Jamaica Bay, such as those included in the *Jamaica Bay Watershed Protection Plan* (NYCDEP 2007) and other post-Hurricane Sandy efforts have been focused on ecological restoration and protection of the saltmarsh islands and other natural areas, in addition to public education about the importance of the Jamaica Bay watershed. Collectively, these efforts have and would continue to have indirect benefits by improving natural habitats, knowledge, and wildlife conditions within the national recreation area and areas in proximity to the refuge and West Pond.

Implementing alternative A would contribute some adverse cumulative impacts on wildlife and some species of concern from continued visitor use and other activities that disturb wildlife, including recreational trail use in the vicinity of nesting species, visitors going off trail, kayakers venturing onto beach areas during nesting, and violations of closures by visitors, including those with dogs.

Taken together, the past, present, and reasonably foreseeable actions identified in the previous paragraphs have resulted in primarily beneficial impacts on wildlife and special status species. Improved control of invasive species, management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay would result in substantial beneficial impacts to wildlife in the region inclusive of the refuge. However, despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the substantial, adverse impacts to wildlife and special status species in and around West Pond due to the level of historical development and continued sources of pollution entering Jamaica Bay.

When the impacts on wildlife and special status species under alternative A are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative A would contribute a minimally adverse increment to the overall substantially adverse cumulative impact.

Conclusion

Alternative A would result in adverse impacts to wildlife because overall diversity of fauna and habitats they inhabit within West Pond would continue to decline as habitats continue to shift from freshwater to saltmarsh. Although the surface area of estuarine habitats within the West Pond area would likely increase over time, the habitat trends would result in a decrease in wildlife diversity. Adverse impacts to wildlife and special status species would also result because of saltwater inundation and the resulting continued decline of upland habitat that once supported a diverse assemblage of migratory passerines, amphibians, and reptiles.

Because there would be no construction activities, pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, there would be no adverse effects on habitats designated as essential fish habitat.

Under alternative A, over time additional horseshoe spawning habitat may form within the West Pond area as a result of tidal conveyance between the primary and secondary breaches, which would benefit the red knot. Pursuant to section 7 of the Endangered Species Act, the NPS would make a finding that alternative A may affect, but not likely adversely affect the red knot. Because alternative A would not alter any habitats, and because of the unlikelihood of their presence in the area, pursuant to section 7 of the Endangered Species Act, alternative A would have no effect on the northern long-eared bat or the roseate tern.

Cumulative impacts on wildlife and listed species would be substantial and adverse because of habitat loss, pollution, feral predators, and recreation/visitor use. However, beneficial cumulative impacts would also result from management actions, improved control of invasive species, and efforts to improve and restore natural resource conditions around Jamaica Bay. Alternative A would contribute a slight adverse increment to the overall substantially adverse cumulative from the continued decline of wildlife diversity.

IMPACTS OF ALTERNATIVE B: REPAIR THE BREACH AND IMPROVE HABITAT CONDITIONS, THE NPS PREFERRED ALTERNATIVE

Impacts

The analysis for alternative B is organized according to phase 1 and future phases of project activity. An analysis of the impacts associated with each of the three options for water supply to West Pond to shift the current salinity in West Pond from an estuarine system (saline) to levels closer to a palustrine system (freshwater) are discussed within the phase 1 analysis, in addition to the impacts associated with the installation of the water control structure. Impacts associated with future phases of work include impacts related to upland habitat restoration at Terrapin

Point, shoreline restoration, saltmarsh restoration, and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage). Impacts that are applicable to phase 1 and future phases of the project are described at the end of the section.

Phase 1. During repair of the primary and secondary breaches, earthmoving equipment accessing the area would impact upland habitats by causing a physical disturbance along the trail to the breach. This would cause some disturbance to wildlife species in the vicinity of these portions of the trail. Impacts associated with the breach repair would be limited to the construction period of up to one year. These impacts would be limited due to the relatively small area being affected when compared to the adjacent available habitat and the low likelihood of wildlife or special status species being present within the area at the time of construction. There would be some damage to individual macroinvertebrates and shellfish within the immediate area of sand and mud flats where filling and breach repair activities would occur. However, the loss of these individual organisms would be minimal due to the conditions created by ongoing erosion at the breach site that has degraded macroinvertebrate and shellfish habitat and therefore, impacts would not be expected at the population level. The mobility of fish species would allow them to avoid disturbed areas (in-water noise and turbidity) during construction activities and fish would likely reestablish in the area surrounding West Pond once construction was completed. Additionally, construction activities would follow best management practices and seasonal constraints, as described in chapter 2, to avoid and minimize impacts to wildlife habitat and special status species. For these reasons, long-term consequences to individuals or populations of wildlife and special status species would not be expected to result from the construction activities associated with repair of the primary and secondary breaches.

In addition to physical disturbances, there would be construction related noise during repair of the primary and secondary breaches. Noise related impacts would be associated with the operation of construction equipment. Use of such equipment (e.g., excavators, bull dozers, etc.) could result in wildlife behavioral effects such as startling and auditory masking of calls, which could lead to nest abandonment or reduced mating success. As with most anthropogenic (human-caused) sounds, auditory masking can effectively limit the distance over which wildlife species can communicate and also detect biologically relevant sounds. Species' responses to new sounds in their environment, as well as individual responses, could differ. As a new sound begins, some animals could flush/flee or not respond at all. Once a sound was established or discontinued, animals could return to their previous activities once they feel the threat is gone (Beale 2007). The type and level of noise anticipated with construction equipment in use during phase 1 would fall within current background noise levels at the site when you consider the traffic sounds coming from Cross Bay Boulevard and the sounds of aircraft taking off and arriving at John F. Kennedy Airport, which is located just 1.5 miles from West Pond. Because of the low intensity of the construction noise, the localized nature of the noise source, the short duration of the construction period, and the availability of suitable adjacent habitat for retreat for most species, long-term consequences to individuals or populations of wildlife and special status species are not expected to result from the noise generated by construction activities associated with repair of the primary and secondary breaches. Therefore, noise impacts would be considered negligible. Overall, impacts from construction associated with the repair of the primary and secondary breaches on wildlife and special status species would be considered minimally adverse.

Under phase 1, the water control structure would be replaced to allow NPS staff to seasonally lower water levels within West Pond. The new water control structure would be installed adjacent to the existing one. Installation of the water control structure would have temporary impacts associated with habitat disturbance during its installation (estimated 3 to 5 days). Similar to temporary impacts associated with repair of the breach, these impacts would be limited due to the small area that would be affected and the low likelihood of wildlife or special status species to be present within the location at the time of construction. Additionally, construction activities would follow best management practices as described in chapter 2 to avoid impacts to wildlife habitat. Because of the recoverability of construction impacts, the localized nature of the impact, the short duration of the construction period, and the availability of suitable adjacent habitat for retreat, impacts would be considered minimally adverse and long-term consequences to populations of wildlife and special status species would not be expected from the installation of the water control structure.

Temporary impacts associated with the construction noise during installation of the water control structure would be similar to those described above for repair of the primary and secondary breaches. Because of the low intensity of the noise, the localized nature of the noise source, the short duration of the construction period, and the availability of suitable adjacent habitat for retreat, impacts would be considered negligible and long-term consequences to individuals or populations of wildlife and special status species would not be expected to result from the noise generated during installation of the water control structure.

Use of the water control structure for seasonal drawdowns of the pond for wildlife management purposes would release water into Jamaica Bay that would have lower salinity levels than the bay. The volume of the release would be dependent upon optimum management regimes that would be determined based on NPS developed pond management strategies. Should national recreation area staff release water on a seasonal basis during spring and fall migratory seasons, it is anticipated that only partial drawdowns would occur to expose mudflats for birds. These partial drawdowns would be less than the full volume of West Pond. High intensity inputs of freshwater (low salinity) into the estuary (higher salinity) could have negative impacts on the ecosystem in the area of the water outfall. National recreation area staff would develop management strategies specific to West Pond to address these seasonal freshwater releases and ensure the chosen drawdown rates were compatible with the flushing rates of the bay (7-days) and peak flows of tidal cycles, to the extent practicable. These efforts would avoid localized and extreme changes in salinity values and therefore would avoid impacting habitats dependent on specific salinity ranges within the vicinity of the water control structure outfall. With management efforts in place to reduce high intensity freshwater inputs to the bay, seasonal drawdowns would have negligible impacts on wildlife and wildlife habitats immediately outside of West Pond.

Over the long-term, the improvements implemented under phase 1, along with the introduction of freshwater habitat, would encourage utilization of West Pond by waterfowl and shorebirds with strong affinities for freshwater habitat, particularly during seasonal migrations. By actively managing water and salinity levels, the die off of nearby vegetation adapted to freshwater and near freshwater conditions would likely slow to a halt. These conditions would maintain and improve wetland habitats for various amphibians and reptile species within the West Pond area. Freshwater wetlands near West Pond would return to conditions that historically provided breeding grounds for amphibians. Freshwater influence at West Pond would have substantial beneficial impacts on freshwater wetland-dependent species.

Special status species and other species that utilize estuarine habitats, such as shorebirds and ospreys, would not likely be impacted by the transition of West Pond from estuarine conditions back to freshwater habitat under alternative B due to the availability of adjacent estuarine habitat. These species include the federally listed red knot and several state-listed shorebird species that depend on estuarine foraging habitats (see appendix E). The amount and availability of suitable adjacent habitats would reduce the level of adverse impact to negligible. During the return to freshwater conditions, upland habitats would continue to recover from damages incurred because of the breach and the resulting increased salinity and the number and diversity of passerine, raptor, and waterfowl special status species (appendix E) could continue to improve and return to use the area. State-listed reptiles that have utilized freshwater and brackish water habitats within West Pond would likely benefit as these habitats recovered under alternative B. Overall, returning West Pond to a palustrine (freshwater) condition would have substantial beneficial impacts on those species that require freshwater habitat conditions. However, impacts on species that rely on estuarine habitats would be negligible and adverse due to the availability of adjacent habitats.

Phase 1 construction activities may disturb soils and sediments which may have an adverse effect on water column essential fish habitat by disturbing soft bottom substrates around the construction areas. These adverse effects would be minimal with a short duration, limited to the period of construction. These activities could also have a minimal and temporary adverse effect on the water column essential fish habitat when substrates are disturbed. All life stages for the species listed in table 8 occupy the water column. Adult and juvenile Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup would retreat from the area when water-column disturbing construction activities began; however, less mobile life stages (eggs and larvae) of Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup, if present at the time of construction activities, would be adversely impacted by activities because of short-term changes to water quality including the re-suspension of sediments in the water column and changes to the quality or quantity of soft bottom substrates, as discussed in the "Soils and Sediments" section. However, given the use of best management practices to control sedimentation and erosion; and given the large extent of Jamaica Bay compared to the small construction footprint; this adverse impact on the overall population of eggs and larvae for Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup would be negligible. As previously stated, if present at the time of construction, adult and juvenile life stages would be able to retreat from the area once construction activities began without any adverse affects, as would forage species. This impact is expected to be negligible given the temporary nature of the disturbance, the availability of suitable adjacent habitat for these life stages, and availability of suitable adjacent habitat for the prey species. Adult and juvenile life stages and their prey species would likely reestablish in the area surrounding West Pond once construction was completed. Pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, construction activities may have an adverse effect on essential fish habitat. Because the adverse effects to essential fish habitat would be minimal, localized to the area of construction, and temporary to the timeframe of construction activities, it is anticipated that phase 1 of alternative B would have no more than a minimal impact on habitats designated as essential fish habitat for Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup. There would be de minimis impacts relative to the available habitat within Jamaica Bay.

Following repair of the primary breach and a return to freshwater conditions, the interior of West Pond would no longer serve as a potential spawning area for horseshoe crabs; however, there would be an overall increase in potential spawning area for horseshoe crabs under future phases when shoreline habitat would be restored along the southern edge of the point. Because horseshoe crab spawning habitat may be a limiting factor for red knot use of the West Pond area, implementing phase 1 of alternative B may affect this species. Construction activities would be avoided or restricted during May or early June when the presence of red knot would be expected to coincide with horseshoe crab spawning events.

Because phase 1 of alternative B would alter potential spawning area for horseshoe crabs, pursuant to section 7 of the Endangered Species Act, phase 1 of alternative B may affect, but not likely adversely affect, the red knot. Construction activities associated with breach repairs could cause some disturbance if these activities were to co-occur with roseate tern presence; therefore, pursuant to section 7 of the Endangered Species Act, phase 1 of alternative B may affect, but not likely adversely affect, the roseate tern. Because alternative B would not alter any habitats for the northern long-eared bat and because of the unlikelihood of their presence in the area during construction activities, pursuant to section 7 of the Endangered Species Act, phase 1 of alternative B would have no effect on the northern long-eared bat. State-listed passerine species (see appendix E) that are dependent on woodlands influenced by freshwater would likely benefit over time as upland habitats recovered under phase 1 of alternative B.

Groundwater Well– Installation of a groundwater well would have negligible temporary impacts associated with habitat disturbance during well installation (estimated at 3 to 5 days). Similar to temporary impacts associated with repair of the breaches and installation of the water control structure, these impacts would be limited due to the small area that would be affected and the low likelihood of wildlife or special status species to be present within the location at the time of construction. Additionally, construction activities would follow best management practices as described in chapter 2 to avoid impacts to wildlife habitat. Because of the recoverability of construction impacts, the localized nature of the impact, the short duration of the construction period, and the availability of suitable adjacent habitat for retreat, impacts would be considered minimally adverse and long-term consequences to populations of wildlife and special status species would not be expected from the installation of a groundwater well.

Temporary impacts associated with the construction noise during installation of a groundwater well would be similar to those described above for repair of the breaches and installation of the water control structure. In addition, there would be some minor noise intrusions associated with periods of pumping well water for replenishment. Because of the low intensity of the noise, the localized nature of the noise source, the short duration of the construction period and/or pumping periods, and the availability of suitable adjacent habitat for retreat, impacts would be considered negligible and long-term consequences to individuals or populations of wildlife and special status species would not be expected to result from the noise generated during installation and/or pumping periods of a groundwater well.

The use of groundwater to supplement the water in West Pond, coupled with seasonal drawdowns and seasonal replenishment could have a slightly beneficial impact on water quality within the pond by diluting organic and inorganic nutrients and coliform organisms. Fecally derived bacteria and nutrient loadings would be diluted when the pond was replenished and replenished and water quality conditions would be improved during these times by avoiding eutrophication. Removal of nutrients and the maintenance of freshwater conditions would be beneficial to wildlife and special status species by improving aquatic habitat conditions and for those species that may rely on this location as a freshwater source.

It would take an estimated 174 days to fill West Pond when considering natural water inflow from precipitation combined with inflow from groundwater pumping, however, many freshwater species are able to tolerate higher salinity levels and may establish earlier. This method of replenishing would be quicker than relying on precipitation only. Seasonal replenishment would also occur more quickly. The reduced time to replenish the pond would have a beneficial impact on wildlife and special status species by providing access to higher water quality in a shorter duration. There would also be beneficial impacts because t of the reliability of replenishment during drought periods compared to precipitation only. In general, seasonal replenishment would have moderately beneficial impacts on wildlife and special status species because of the improvements in water quality and reliability of freshwater supply.

The national recreation area staff would use the combination of the groundwater supply well and the water control structure to adjust water and salinity levels within West Pond. These features would have considerable beneficial impacts for migrating shorebirds and waders by allowing for the seasonal exposure of mudflats for foraging along the perimeter of the pond.

Considering the temporary impacts from construction, noise impacts from pump operation, benefits of improved water quality from seasonal replenishments and drawdowns, benefits from increased foraging habitat for shorebirds and waders, the use of groundwater as an option for a source of water would have an overall moderately beneficial impact on wildlife and special status species.

Municipal Water Source – Installation of a pipeline connection to a municipal water source would have negligible temporary impacts associated with habitat disturbance during construction and installation of a pipeline. Similar to temporary impacts associated with repair of the breaches and installation of the water control structure, these impacts would be limited due to the small area that would be affected and the low likelihood of wildlife or special status species to be present within the location at the time of construction. Additionally, construction activities would follow best management practices as described in chapter 2 to avoid impacts to wildlife habitat. Because of the recoverability of construction impacts, the localized nature of the impact, the short duration of the construction period, and the availability of suitable adjacent habitat for retreat, impacts would be considered minimally adverse and long-term consequences to populations of wildlife and special status species would not be expected from the installation of a pipeline connection to a municipal water source.

Temporary impacts associated with the construction noise during installation of a pipeline connection to a municipal water source would be similar to those described above for repair of the breaches and installation of the water control structure. In addition, there could be some minor noise intrusions associated with periods of pumping municipal water for replenishment. Because of the low intensity of the noise, the localized nature of the noise source, the short duration of the construction period and/or pumping periods, and the availability of suitable adjacent habitat for retreat, impacts would be considered negligible and long-term consequences to individuals or populations of wildlife and special status species would not be expected to result from the noise generated during installation and/or pumping periods of a municipal water source.

Municipal water would be treated prior to discharge into the pond, therefore no impacts to wildlife and special status species would be expected due to water quality issues from utilizing a municipal water source. Use of a municipal water source for seasonal replenishment would have the same beneficial impacts as described above for a groundwater source by improving water quality conditions and providing a reliable water source.

It would take an estimated 174 days to fill West Pond when considering both natural water inflow from precipitation combined with inflow from a municipal source. This method of replenishing would be quicker than relying on precipitation only. Seasonal replenishment would also occur more quickly. The reduced time to replenish the pond would have a beneficial impact on wildlife and special status species by providing access to higher water quality in a shorter duration and as a result of the reliability of replenishment during drought periods. In general, seasonal replenishment would have moderately beneficial impacts on wildlife and special status species because of the improvements in water quality and the reliability of the water source.

Similar to the groundwater supply freshwater source described above, national recreation area staff would use the combination of the municipal water and the water control structure to adjust water levels and salinity within West Pond. These features would have considerable beneficial impacts for migrating shorebirds and waders by allowing for the seasonal exposure of mudflats for foraging along the perimeter of the pond.

Considering the temporary impacts from construction, noise impacts during operation, benefits of improved water quality from seasonal replenishments and drawdowns, benefits from increased foraging habitat for shorebirds and waders, use of a municipal freshwater source would have an overall moderately beneficial impact on wildlife and special status species.

Precipitation – There would be no construction-related impacts associated with the option of relying solely on precipitation and runoff as a freshwater source for West Pond. Once the primary and secondary breaches were repaired, relying solely on precipitation and runoff would result in a more gradual transition to freshwater conditions within West Pond when compared to the other water supply options. Immediately prior to Hurricane Sandy, West Pond contained freshwater habitat that was sustained by replenishment from precipitation and runoff alone, without any additional supplemental freshwater input or the ability to conduct seasonal drawdowns for wildlife management purposes. A gradual transition to palustrine (freshwater) conditions would mimic a more natural dynamic, as compared to the groundwater well or a municipal source. For those individual wildlife species that would inhabit the pond before and after repair of the primary breach, a gradual transition would be beneficial because it would allow them time to adapt. Therefore, impacts on wildlife and special status species from replenishing West Pond with via precipitation and runoff would be minimally beneficial.

The national recreation area staff would use the water control structure to seasonally adjust water levels and manage salinity levels within West Pond. This feature would have beneficial impacts for migrating shorebirds and waders by allowing for the seasonal exposure of mudflats for foraging along the perimeter of the pond. However, under this option, replenishment subsequent to seasonal drawdowns may not be practical for several reasons. The timeframe estimated to replenish the pond when relying solely on precipitation and runoff as a freshwater source could take several months depending on how much water was released during each seasonal drawdown and conditions at the site (site specific precipitation / runoff conditions, evaporation rates, seepage rates, and other potential site specific parameters that are unknown factors at this time). Due to the level of uncertainty in predicting precipitation rates and other unknowns, the ability of the national recreation area staff to manage water levels in the pond would be limited. In addition, from a management perspective, being able to predict how far to drawdown the pond by relying on seasonal weather predictions would involve a high degree of uncertainty. These uncertainties could lead to adverse impacts on wildlife and special status species who would utilize the aquatic habitat. Over the long-term, freshwater conditions within West Pond would be more susceptible to saltwater inundation during future storms because a reliance on natural precipitation as a freshwater source would result in a more gradual recovery following a storm event. Habitats would take longer for freshwater (palustrine) communities to reestablish within the boundaries of the pond. The conditions would mimic how the pond was functioning before Hurricane Sandy. Due to the importance of freshwater in this region, the impacts to wildlife from replenishment by precipitation to a freshwater habitat within West Pond would be beneficial.

Considering the benefits of improved water quality from seasonal replenishments and drawdowns, the limited ability of national recreation area staff to manage water levels, increased foraging habitat for shorebirds, the use of precipitation as a freshwater source would have an overall beneficial impact on wildlife and special status species when compared to current conditions.

Future Phases. Under future phases of alternative B, saltmarsh restoration would take place on the bayside of the repaired primary breach. These efforts would include restoration efforts to establish approximately 5 acres of high saltmarsh outside and south of the primary breach location and 3.7 acres of shoreline habitat restoration. The restored shoreline would likely provide additional benthic habitat for macroinvertebrates, shellfish, and fish species within Jamaica Bay and would also attenuate wave action and storm surges to protect the berm repairs and freshwater habitat within West Pond, with resulting beneficial impacts. High saltmarsh restoration would also increase bird nesting and foraging habitat in the area. Temporary adverse impacts on wildlife would be associated with construction activities. The period of construction would last up to a year depending on environmental and other applied work restrictions. Construction related impacts would be limited to the period of construction, localized to the area of construction, and minimized by the implementation of best management practices (see chapter 2). Therefore, impacts on wildlife species would not be expected at the population level. Because of the location of this restoration, the installation would likely be water-based and therefore, turbidity issues could be of concern. However, exact details with regard to the final engineering design and construction plans would be completed prior to any site work. Project work elements could be completed consecutively or simultaneously with any of the future phase components discussed in this section. Overall, salt marsh restoration on the bayside of the primary breach would have moderately beneficial impacts on wildlife and special status species because of the improvements in habitat quality once the structure and function of these areas were established.

Habitat improvements to 4.9 acres at Terrapin Point would include invasive plant species control, removal of shrubland vegetation to restore diamond-backed terrapin habitat, and a reduction of turf/grass cover to create potential tern and other bird nesting habitat. It is anticipated these actions would provide a beneficial impact for wildlife by promoting native maritime grasslands. The areas on both sides of the trail include terrapin nesting habitat and construction activities would need to be restricted and/or conducted outside of the summer months (see the "Mitigation Measures" section in chapter 2) in order to avoid crushing nests and hatchlings. The period of construction would last up to a year depending on environmental and other applied work restrictions. Temporary impacts associated with this construction noise from equipment operation during habitat restoration at Terrapin Point would be similar to those described above for repair of the primary and secondary breaches. However, these impacts would be expected to be temporary and minimal. Because of the low intensity of the noise, the localized nature of the noise source, the short duration of the work period, and the availability of suitable adjacent habitat for retreat, impacts would be considered negligible and long-term consequences to individuals or populations of wildlife and special status species would not be expected to result from the noise generated during habitat restoration at Terrapin Point. Overall, habitat improvements at Terrapin Point would have moderately beneficial impacts on wildlife and special status species because of the improvements in habitat quality once the structure and function of these areas were established.

Construction of boardwalk trails could require the installation of support piers in low saltmarsh and high saltmarsh vegetation communities, with minimal localized adverse impacts (e.g., loss of vegetation due to the pier/boardwalk footprint and shading due to the presence of the boardwalk/pier itself). To the maximum extent practical the construction of these visitor amenities would not involve mechanized equipment, would employ best management practices to avoid the compaction of substrates, would avoid the shading of aquatic habitats, would allow for the maximum amount of sunlight passage, and would be timed to have the least impact possible on vegetation and wildlife that use these wetland areas. The period of construction would last up to a year depending on environmental and other applied work restrictions. Overall, with the use of best management practices, the installation and use of these improvements would have negligible impacts on wildlife and special status species.

Following the establishment of freshwater conditions in West Pond, freshwater wetlands that would establish within West Pond would offer foraging habitat for special status shorebird species, although these species would likely favor estuarine habitats on the outside of the pond. Waterfowl, passerines, upland raptor species, and reptiles and amphibians with freshwater associations would likely benefit under alternative B because more habitat would be available. Diamond-backed terrapins would still be exposed to predation at Terrapin Point, but ongoing invasive species management interventions would continue. In summary, future phases under alternative B would provide unique habitats (freshwater and freshwater influenced habitats) for wildlife and special status species and improve habitat conditions for these species thereby providing beneficial impacts.

Construction activities under future phases could disturb soils and sediments which could have an adverse effect on water column essential fish habitat by disturbing soft bottom substrates around the construction area. These adverse effects would be minimal with a short duration, limited to the period of construction. These activities may also have a minimal and temporary adverse effect on the water column essential fish habitat when substrates are disturbed. All life stages for the species listed in table 8 occupy the water column. Adult and juvenile Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup would retreat from the area when water-column disturbing construction activities began, however, less mobile life stages (eggs and larvae) of Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup, if present at the time of construction activities, would be adversely impacted by activities because of short-term changes to water quality including the re-suspension of sediments in the water column and changes to the quality or quantity of soft bottom substrates, as discussed in the Soils and Sediments section. However, given the use of best management practices to control sedimentation and erosion; and given the large extent of Jamaica Bay compared to the small construction footprint; this adverse impact on the overall population of eggs and larvae for Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup would be negligible. As previously stated, if present at the time of construction, adult and juvenile life stages would be able to retreat from the area once construction activities began without any adverse affects, as would forage species. This impact is expected to be negligible given the temporary nature of the disturbance, the availability of suitable adjacent habitat for these life stages, and availability of suitable adjacent habitat for the prey species. Adult and juvenile life stages and their prey species would likely reestablish in the area surrounding West Pond once construction was completed. Pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, construction activities may have an adverse effect on essential fish habitat. Because the adverse effects to essential fish habitat would be minimal, localized to the area of construction, and temporary to the timeframe of construction activities, it is anticipated that future phases of construction under alternative B would have no more than a minimal impact on habitats designated as essential fish habitat. There would be *de minimis* impacts relative to the available habitat for Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup within Jamaica Bay.

Following repair of the primary and secondary breaches and a return to freshwater conditions, West Pond would no longer serve as a potential spawning area for horseshoe crabs. However, under future phases, enhancements outside of West Pond could provide additional spawning habitat. Because horseshoe crab spawning habitat may be a limiting factor for red knot use of the West Pond area, implementing future phases of alternative B may affect this species. Construction activities would be avoided or restricted during May or early June when the presence of red knot would be expected to coincide with horseshoe crab spawning events. Because future phases of alternative B would alter potential spawning area for horseshoe crabs, pursuant to section 7 of the Endangered Species Act, alternative B may affect, but are not likely adversely affect the red knot. Future phases would restore nesting habitat for the roseate tern; therefore, pursuant to section 7 of the Endangered Species Act, future phases of alternative B may affect, but are not likely to adversely affect the roseate tern. Because alternative B would not alter any habitats for the northern long-eared bat and because of the unlikelihood of their presence in the area during construction activities, pursuant to section 7 of the Endangered Species Act, future phases of alternative B would have no effect on the northern long-eared bat. State-listed passerine species (see appendix E) that are dependent on woodlands influenced by freshwater would likely benefit over time as upland habitats recover under future phases.

Common to Phase 1 and Future Phases. Some minimally adverse impacts on wildlife and some species of concern would result from continued visitor use and other activities that disturb wildlife, including recreational trail use in the vicinity of nesting species, visitors going off trail, kayakers venturing onto beach areas during nesting, and violations of closures by visitors, including those with dogs. Increased outreach and education efforts proposed under future phases would help to counter some of these impacts and provide for increased sensitivity for the need to protect sensitive species. Seasonal closures may be enforced as necessary to protect vulnerable species. Predation of birds is best reduced by protecting nesting areas from human disturbance so that parent birds can better protect their young. These protective measures by national recreation area staff would help alleviate the adverse impact of human disturbance thereby improving conditions for nesting species.

Cumulative Impacts

Related projects and their impacts to the affected environment described under alternative B would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years has had substantial adverse cumulative impacts, whereas more recent ongoing efforts to restore natural resources in Jamaica Bay, as well as steps taken to improve watershed conditions have had beneficial impacts to wildlife. Improved control of invasive plants, collective management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay and the refuge have had substantial long-term benefits to wildlife in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements do not offset the long-term adverse impacts to wildlife in and around West Pond due to the level of historical and continued development and sources of pollution entering the Jamaica Bay estuary. Taken together, these past, present, and reasonably foreseeable actions have resulted in primarily adverse impacts on wildlife and special status species.

Under phase 1, the primary and secondary breach would be repaired. Associated construction activities would have a negligible contribution to the existing adverse cumulative impacts on wildlife and special status species because they are temporary, limited to the time of breach repair, and localized to the relatively small area compared to the size of the regional area. Closing West Pond and reestablishing freshwater habitat within it would have a slightly beneficial cumulative impact on those wildlife and special status species that rely on this type of habitat because of historic degradation to and loss of habitat within the area over the years and because of the limited availability of this type of habitat in the area. For those wildlife and special status species that do not rely on freshwater habitats, repairing the berm and eliminating access to 44-acres of estuarine habitat within West Pond would have a negligible cumulative impact because suitable habitat can be found in the larger 16,000-acre estuary of Jamaica Bay. Installation of a water source and the water control structure that would enable NPS staff to manage and adjust water and salinity levels within West Pond would allow for the seasonal exposure of mudflats in a freshwater habitat and improve freshwater quality. This exposure would allow for foraging by migrating shorebirds along the perimeter of the pond. Because these features would allow for additional management and control of improved habitat and water quality in an area that has a history of degradation and habitat loss, it would contribute a slightly beneficial cumulative impact on wildlife and special status species. Habitat restoration activities proposed under future phases of alternative B have been established, they would contribute moderately beneficial cumulative impacts on wildlife and special status species in an area that has a history of degradation and habitat loss because of the improvements in habitat quality and quantity once the structure and function of these areas have been established. When the impacts on wildlife and special status species under alternative B are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative B would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Phase 1 activities, such as repairing the breaches and reestablishing freshwater habitat, would improve conditions with resulting beneficial impacts for those wildlife and special status species that rely on this type of habitat. Freshwater habitat has important wildlife value because of the historical elimination of these conditions over the surrounding Jamaica Bay region. There would be minimally adverse impacts to wildlife individuals that do not rely on freshwater habitats because of the availability of suitable habitat in the surrounding estuary of Jamaica Bay. Long-term consequences to individuals or populations of wildlife and special status species would not be expected to result from the construction activities associated with repair of the primary and secondary breaches.

The combination of the phase 1 municipal or groundwater water supply and the water control structure would provide the national recreation area staff with additional capacity to manage water and salinity levels in West Pond than reliance solely on natural replenishment by precipitation and runoff. The ability to manage water levels would allow NPS staff to improve water quality by managing water levels and to seasonally expose mudflats for foraging by migrating shorebirds and waders along the perimeter of the pond, which would result in beneficial impacts for wildlife. Because of the recoverability of construction impacts, the localized nature of the impact, the short duration of the construction period, and the availability of suitable adjacent habitat for retreat, impacts from the installation of these features would be considered minimally adverse and long-term consequences to populations of wildlife and special status species would not be expected.

Habitat restoration activities proposed under future phases would have long term beneficial impacts for wildlife because these activities would result in improvements to habitat quality and quantity, in an area that has a history of degradation and habitat loss, once the structure and function of these areas has been established. Adverse impacts from construction activities associated with future phases would be minimal because they would be temporary, limited to the time of construction, and localized to relatively small areas.

Because the adverse effects to essential fish habitat would be minimal, localized to the area of construction, and temporary to the timeframe of construction activities, pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, it is anticipated that phase 1 and future phases of alternative B would have no more than a minimal impact (*de minimis* impacts) on habitats designated as essential fish habitat.

Future phases of work may have a beneficial impact on the red knot because additional spawning habitat for horseshoe crabs could be provided with habitat restoration activities. There could be beneficial impacts for the roseate tern because potential nesting habitat would be restored. There would not be any impacts to the northern long-eared bat because habitat for this species is not likely to occur at the site. State-listed passerine species would likely benefit over time because upland habitat conditions would improve. Pursuant to section 7 of the Endangered Species Act, activities under alternative B may affect, but not likely adversely affect the red knot and roseate tern. There would be no effect on the northern long-eared bat.

Cumulative impacts on wildlife and listed species would be substantial and adverse because of habitat loss, pollution, feral predators, and recreation/visitor use. However, beneficial cumulative impacts would also result from management actions, improved control of invasive species, and efforts to improve and restore natural resource conditions around Jamaica Bay. Alternative B would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact by contributing additional biodiversity of wildlife within the Jamaica Bay watershed. When the impacts on wildlife and special status species under alternative B are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative B would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE C: CREATE DIFFERENT TYPES OF HABITAT

Impacts

Under alternative C, extensive construction would occur to create a variety of habitats, including estuarine habitats, palustrine marshes, ponded freshwater, and enhanced upland habitats. The increased diversity of habitats would include structural components important for various life stages of wildlife species (e.g., screening vegetation, substrates for forage availability, vertical canopy structure) and wildlife diversity would be expected to increase beyond existing and pre-Hurricane Sandy conditions once construction was completed and habitats stabilized. A groundwater well would be installed and the water control structure would be replaced to shift the current salinity from an estuarine system (saline) to levels closer to a palustrine system (freshwater), aided by precipitation and surface water runoff contributions from upland sites. This would allow national recreation area staff to manage freshwater levels within West Pond, with beneficial impacts for wildlife.

Reconfiguration of the site would decrease the size of the pond (to approximately 31.6 acres) and Terrapin Point would be separated from the newly created berm by approximately 14.3 acres of tidal creeks and low saltmarshes. Construction activity would cause extensive disturbance of various wetlands and upland wildlife habitats but would be followed by extensive habitat restoration and rehabilitation activities to establish a mosaic of habitats (freshwater, estuarine, and uplands) in the years following a multi-year construction period. Vigilant best management practices would be in place over the 2-3 year construction period to reduce impacts to wildlife habitats, including maintenance and monitoring during seasonal construction pauses. Although the long-term benefits of habitat changes under alternative C would be beneficial, temporary impacts during construction would be intensive and adverse, including substantial disturbance to the majority of the land surface in and around the previously existing West Pond. Existing habitats would be degraded during up to 3 year construction timeframe and several years and growing seasons would be required before habitat conditions stabilized for wildlife use. In addition, during construction there would be adverse noise-related impacts associated with construction equipment operation. Use of such equipment (e.g., excavators, bull dozers, and other heavy equipment) could have behavioral effects such as startling wildlife and masking calls, which could lead to nest abandonment or reduced mating success.

During construction, equipment would access the site along either side of portions of the West Pond loop trail. Reconfiguration of the berm and West Pond would result in a loss of individual macroinvertebrates and shellfish within the ponded sand and mud flats where excavation would occur. Wildlife communities in these areas would be impacted due to removal of habitat during grading and earth movement activities. Heavy equipment could substantially impact macroinvertebrates, shellfish, fish, birds, mammals, reptiles, and amphibians that were unable to move away from construction equipment.

Once the site recovered and stabilized following construction and restoration activities, the introduction of freshwater and increased diversity of habitats would encourage use of West Pond by waterfowl with strong affinities for freshwater, particularly during migration seasons. A freshwater source and water control structure would enable national recreation area staff to control water and salinity levels within the pond. This would aid in the transition to and maintenance of more freshwater conditions, allow for management of water quality during bird migration periods, and enhance management for seasonal use by wildlife. It would take an estimated 122-139 days to establish freshwater conditions at the newly created West Pond, however, some freshwater species are able to tolerate lower salinity levels and may establish earlier. By actively managing salinity and water levels in the reconfigured pond, habitat conditions would be improved for various amphibians and reptile species, restoring conditions important for their survival. Freshwater conditions would have substantial beneficial impacts on freshwater wetland-dependent species.

Management and other restoration activities would include long-term monitoring of constructed habitats, routine operation and maintenance activities, invasive species control activities, and installation of visitor amenities. Routine operation and maintenance activities would primarily be focused around maintained operability and access to the water control structure and removing debris in the newly configured West Pond. Management actions under alternative C would require maintenance of new amenities, including viewing platforms, boardwalk trails, and gravel trails and routine mowing that could disturb wildlife. Construction of boardwalk trails would require installation of support piers in low saltmarsh and high saltmarsh wildlife habitats. Construction of these amenities and associated impacts would be similar to those described under alternative B.

Under alternative C, improvements at Terrapin Point would include invasive vegetation species control and thinning of shrubland vegetation to restore diamond-backed terrapin and bird nesting habitat. These actions would be anticipated to provide a beneficial effect by promoting native maritime grasslands and other structural characteristics conducive to terrapin and bird nesting. Approximately 8.6 acres of upland habitat at Terrapin Point would be targeted for restoration under alternative C, with beneficial impacts for species like migratory passerines, amphibians, and reptiles.

Implementing alternative C would contribute some adverse impacts on wildlife and some species of concern from continued visitor use and other activities that disturb wildlife, including trail use in the vicinity of nesting species, visitors going off trail, kayakers venturing onto beach areas during nesting, and violations of closures by visitors, including those with dogs. These adverse impacts would be greater than impacts from current similar use and activities due to the increased trail access at Terrapin Point. Increased outreach and education efforts would help to counter some of these impacts and provide for increased sensitivity for the need to protect sensitive species.

As the mosaic of habitats established and habitat conditions improved under the influence of freshwater, the number and diversity of passerine, raptor, and waterfowl special status species utilizing the area could continue to increase. In summary, there would be extensive adverse impacts during construction, but many wildlife species and special status species would benefit over the long term from implementing alternative C.

Seasonal drawdowns of the pond for wildlife management purposes are estimated to release water into Jamaica Bay that would have lower salinity levels than the bay. The volume of releases would be dependent upon optimum management regimes to be determined based upon future pond management strategies to be developed. Should the NPS release water on a seasonal basis during spring and fall migratory seasons, it is anticipated that only partial drawdown would occur to expose mudflats for birds. These partial drawdowns would be less than full volume of West Pond. High intensity inputs of freshwater (low salinity) into the estuary (higher salinity) could have negative impacts on the ecosystem in the area of the water outfall. NPS would develop management strategies specific to West Pond to address these seasonal freshwater releases and ensure the chosen let down rates are compatible with the flushing rates of the bay (7-days) and peak flows of tidal cycles to the extent practicable. These efforts would avoid localized and extreme changes in salinity values and therefore would avoid impacting wetlands dependent on specific salinity ranges in the vicinity of the outfall. State-listed passerine species that are dependent on woodlands influenced by freshwater would likely benefit over time as upland habitat recovered. State-listed raptor species, including ospreys, would likely benefit from increased habitat diversity under alternative C. State-listed amphibians and reptiles that have utilized freshwater and brackish water habitats within West Pond would likely benefit as these habitats recover under alternative C.

Construction activities would disturb soils and sediments. Erosion during construction would be expected to be extremely high during berm construction as fill occurs, and this would cause sedimentation. Further, restoring the channelized saltmarsh between Terrapin Point and West Pond would change sedimentation dynamics due to tidally influenced water flows. Deposition of sediments would also be expected to change with tidal conditions proposed to be altered in the vicinity of a newly created island at Terrapin Point. This may have an adverse effect on essential fish habitat by reducing the quality and quantity of non-living, soft bottom substrates that constitute essential fish habitat in close proximity to the construction areas. These adverse effects would be minimal with a short duration, limited to the period of construction activities over several years. These activities may also have a minimal and temporary adverse effect on the water column essential fish habitat when soils and sediments are disturbed. All life stages for the species listed in table 8 occupy the water column. Adult and juvenile Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup would retreat from the area when water-column disturbing construction activities began, however, less mobile life stages (eggs and larvae) of Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup, if present at the time of construction activities, would be adversely impacted by activities because of short-term changes to water quality including the re-suspension of sediments in the water column and changes to the quality or quantity of soft bottom substrates, as discussed in the "Soils and Sediments" section. However, given the use of best management practices to control sedimentation and erosion; and given the large extent of Jamaica Bay compared to the small construction footprint; this adverse impact on the overall population of eggs and larvae for Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup would be negligible. As previously stated, adult and juvenile life stages would be able to retreat from the area once construction activities began without any adverse affects, as would their forage species. This impact is expected to be negligible given the temporary nature of the disturbance, the availability of suitable adjacent habitat for these life stages, and availability of suitable adjacent habitat for the prey species. Adult and juvenile life stages and their prey species would likely reestablish in the area surrounding West Pond once construction was completed. Pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, construction activities may have an adverse effect on essential fish habitat. Because the adverse effects to essential fish habitat would be minimal, localized to the area of construction, and temporary to the timeframe of construction activities (over several years), it is anticipated that alternative C would have no more than a minimal impact on habitats designated as essential fish habitat for Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup. There would be *de minimis* impacts relative to the available habitat within Jamaica Bay.

Under alternative C, reconfiguration of West Pond would remove some potential spawning area for horseshoe crabs; however, proposed shoreline restoration enhancements outside of West Pond may provide an increase in spawning habitat along the southern edge of Terrapin Point. Because horseshoe crab spawning habitat may be a limiting factor for use of West Pond by the red knot, alternative C may have a beneficial impacts on this species. Construction activities would not occur during May or early June when red knot presence would be expected to coincide with horseshoe crab spawning events. Pursuant to section 7 of the Endangered Species Act, alternative C may affect, but is not likely to adversely affect the red knot. Reconfiguration of the site and shoreline restoration south of Terrapin Point may benefit the roseate tern by providing bare sand area for potential nesting habitat; therefore, pursuant to section 7 of the Endangered Species Act, alternative C may affect, but is not likely to adversely affect the roseate tern. Because alternative C would not alter any habitats for the northern long-eared bat and because of the unlikelihood of its presence in the area during construction activities, pursuant to section 7 the Endangered Species Act, alternative C would have no effect on the northern long-eared bat.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative C would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years has had substantial adverse cumulative impacts, whereas more recent ongoing efforts to restore natural resources in Jamaica Bay, as well as steps taken to improve watershed conditions have had beneficial impacts to wildlife. Improved control of invasive plants, collective management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay and the refuge have had substantial long-term benefits to wildlife in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements do not offset the long-term adverse impacts to wildlife in and around West Pond due to the level of historical and continued development and sources of pollution entering the Jamaica Bay estuary. Taken together, these past, present, and reasonably foreseeable actions have resulted in primarily adverse impacts on wildlife and special status species.

Associated construction activities would have a substantial contribution to the existing adverse cumulative impacts on wildlife and special status species because even with best management practices in place, the relatively large scale of the project and relatively long construction period (up to 3 years) spread over multiple seasonal windows, there would be adverse impacts including unknown outcomes when a new tidal regime would be established.

Reestablishing freshwater habitat would have a slightly beneficial cumulative impact on those wildlife and special status species that rely on this type of habitat because of historic degradation to and loss of habitat within the area over the years and because of the limited availability of this type of habitat in the area. For those wildlife and special status species that do not rely on freshwater habitats, repairing the berm and eliminating access to 31.6-acres of estuarine habitat within West Pond would have a negligible cumulative impact because suitable habitat can be found in the larger 16,000-acre estuary of Jamaica Bay.

Habitat restoration activities proposed under alternative C would contribute moderate beneficial cumulative impacts on wildlife habitats once wetlands and uplands were stabilized in the future. The combination of a groundwater source and the water control structure to adjust water levels and salinity within West Pond would improve freshwater quality and quantity. Because this feature would improve habitat and water quality in an area that has a history of degradation, it would contribute a slightly beneficial cumulative impact on wildlife and special status species. The impact of other amenities proposed in alternative C would have only a slight beneficial contribution to the otherwise adverse cumulative impact.

Installation of a groundwater well and the water control structure that would enable NPS staff to manage and adjust water and salinity levels within West Pond would allow for the seasonal exposure of mudflats in a freshwater habitat and improve freshwater quality. This exposure would allow for foraging by migrating shorebirds along the perimeter of the pond. Because these features would allow for additional management and control of improved habitat and water quality in an area that has a history of degradation and habitat loss, it would contribute a slightly beneficial cumulative impact on wildlife and special status species. Habitat restoration activities proposed under future phases of alternative C have been established, they would contribute moderately beneficial cumulative impacts on wildlife and special status species in an area that has a history of degradation and habitat loss because of the improvements in habitat quality and quantity once the structure and function of these areas have been established.

Taken together, these past, present, and reasonably foreseeable actions have resulted in primarily adverse impacts on wildlife and wildlife habitats. When the impacts on wildlife and special status species under alternative C are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative C would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact.

Conclusion

Implementation of alternative C would have extensive, adverse impacts to the wildlife and special status species that utilize the West Pond area because of the extensive length and magnitude of disturbances to habitats both physically and audibly during construction and reconfiguration of the site. These adverse impacts would attenuate over the long-term as a mosaic of diverse habitats became established and increased wildlife diversity within the area of West Pond and environs improved.

Reestablishment of freshwater habitat from the installation of a groundwater well freshwater source to supplement natural precipitation and runoff would result in a beneficial impact to habitat and wildlife communities that depend on freshwater habitat by allowing for a faster transition from an estuarine system (saline) to levels closer to a palustrine system (freshwater). Additional beneficial impacts to wildlife and special status species would result from the recovery of upland vegetation habitat and increased diversity within upland habitats as a result of the proximity to freshwater. Recovery and establishment of varied habitat conditions would facilitate the return of waterfowl, passerines, and freshwater amphibians and reptiles. These beneficial impacts would be magnified due to the fact that freshwater communities have largely been lost within Jamaica Bay and are therefore unique to the area.

The ability to manage water levels with a water control structure and groundwater well would allow NPS staff to improve water quality by managing water levels and to seasonally expose mudflats for foraging by migrating shorebirds and waders along the perimeter of the pond, which would result in beneficial impacts for wildlife. Repairing the breach and maintaining freshwater habitat conditions would have beneficial impacts to vegetation and the species that depend on these habitat conditions. Over the long-term, management actions, including active management to manage freshwater conditions, invasive plant species control, and establishment of a variety of habitats would result in beneficial impacts to wildlife and special status species as a result of an increase in biodiversity at the site compared to both existing conditions and conditions that were present immediately prior to Hurricane Sandy. Reconfiguration of West Pond would remove some potential spawning area for horseshoe crabs; however, shoreline restoration south of Terrapin Point may provide additional spawning habitat, which may indirectly beneficially impact the red knot. Reconfiguration of the site and shoreline may also benefit the roseate tern by providing potential nesting habitat. No northern long-eared bat habitat would be impacted under alternative C. Pursuant to section 7 of the Endangered Species Act, the activities proposed under alternative C may affect, but not likely adversely affect the red knot and roseate tern. There would be no effect on the northern long-eared bat.

Cumulative impacts on wildlife and listed species would be substantial and adverse because of habitat loss, pollution, feral predators, and recreation/visitor use. However, beneficial cumulative impacts would also result from management actions, improved control of invasive species, and efforts to improve and restore natural resource conditions around Jamaica Bay. Alternative C would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact by contributing additional biodiversity of wildlife within the Jamaica Bay watershed. When the impacts on wildlife and special status species under alternative C are combined with the impacts from other past, present and foreseeable future projects in Jamaica

Bay, alternative C would contribute a slightly beneficial increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE D: BRIDGE THE BREACH

Impacts

Under alternative D, the West Pond area would continue to be tidally influenced with salinity levels similar to Jamaica Bay. Those species that were dependent on freshwater conditions would not likely return to the area and the diversity of wildlife species would continue to decline. Impacts associated with the lack of freshwater and influence of saltwater would be the same as described for alternative A.

Access for site preparation and earthwork in the area where the berm would be bridged would occur from the intact portions of the West Pond loop trail along the berm. Earthmoving equipment accessing the primary breach area would impact upland habitats through noise and physical disturbance along the trail (1.6 miles) to the breach, causing some disturbance to wildlife species. Construction activities would be avoided during periods of time that would affect sensitive or migratory species (see the “Mitigation Measures” section in chapter 2). Noise related impacts would be associated with construction equipment operation. Use of such equipment (e.g., excavators, bull dozers), could have behavioral effects such as startling wildlife and masking of calls, which could lead to nest abandonment or reduced mating success. However, these impacts would be temporary and minimal due to the previously disturbed nature of the cleared trail and surrounding area.

Installing a steel truss bridge or culvert at the primary breach would cover and temporarily disturb macroinvertebrates and shellfish within the sand and mud flats where the structures and any necessary stabilization activities would occur, but the loss of these individual organisms would be minimal due to the amount of ongoing erosion at the breach site that has degraded macroinvertebrate and shellfish habitat. Impacts would not be expected at the population level and would be minimized by implementing best management practices during construction. The stabilization of the secondary breach would also have temporary impacts associated with construction, but these impacts would be limited because the repair would primarily occur in uplands and would take place within the approximate footprint of the existing berm. With the stabilization of the primary breach and the secondary breach locations, vegetation and wildlife communities would resemble the current assemblage both within West Pond and outside of the berm.

Vegetation and wildlife communities within West Pond that had established under pre-Hurricane Sandy conditions (adapted to freshwater or low salinity conditions) would continue to shift in composition and structure, to resemble low saltmarsh and mudflats in the lower elevations transitioning to shrub lands in the upland locations. Under alternative D, precipitation and sheet flow would be the only freshwater sources into the wetlands. After the damage sustained by Hurricane Sandy, upland vegetation, such as hardwood trees common along riparian zones in other locations would likely continue to be stressed and eventually be replaced with a shrub-grassland community composed of plants more tolerant to seaspray and brackish water. The NPS would continue to monitor invasive plant species with control measures and targeted reduction efforts.

Terrapin and bird nests at Terrapin Point would still be connected to the West Pond berm land mass, providing easy predator access to nesting locations. Protective measures by NPS staff, such as seasonal closures, would help improve conditions for nesting species.

Implementing alternative D would contribute some adverse impacts on wildlife and some species of concern from continued visitor use and other activities that disturb wildlife, including recreational trail use in the vicinity of nesting species, visitors going off trail, kayakers venturing onto beach areas during nesting, and violations of closures by visitors, including those with dogs. Increased outreach and education efforts would help to counter some of these impacts and provide for increased sensitivity for the need to protect sensitive species.

State-listed passerine species that are dependent on woodlands influenced by freshwater would likely be negatively impacted over time as upland habitats influenced by freshwater continue to degrade. State-listed raptor species, with the exception of ospreys, would likely be negatively impacted under alternative D. State-listed reptiles that have utilized freshwater and brackish water habitats within West Pond would likely be negatively impacted as these habitats continue to degrade under alternative D.

Construction activities associated with alternative D may disturb soils and sediments in locations. This may have an adverse effect on essential fish habitat by reducing the quality and quantity of non-living, soft bottom substrates that constitute essential fish habitat around the construction area. These adverse effects would be minimal with a short duration, limited to the period of construction. These activities may also have a minimal and temporary adverse effect on water column essential fish habitat when soils and sediments are disturbed. All life stages for the species listed in table 8 occupy the water column. Adult and juvenile Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup would retreat from the area when water-column disturbing construction activities began, however, less mobile life stages (eggs and larvae) of Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup, if present at the time of construction activities, would be adversely impacted by activities because of short-term changes to water quality including the re-suspension of sediments in the water column and changes to the quality or quantity of soft bottom substrates, as discussed in the "Soils and Sediments" section. However, given the use of best management practices to control sedimentation and erosion; and given the large extent of Jamaica Bay compared to the small construction footprint; this adverse impact on the overall population of eggs and larvae for Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup would be negligible. As previously stated, adult and juvenile life stages would be able to retreat from the area once construction activities began without any adverse affects, as would their forage species. This impact is expected to be negligible given the temporary nature of the disturbance, the availability of suitable adjacent habitat for these life stages, and availability of suitable adjacent habitat for the prey species. Adult and juvenile life stages and their prey species would likely reestablish in the area surrounding West Pond once construction was completed. Best management practices would be in place during construction (see chapter 2). Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, construction activities may have an adverse effect on Essential Fish Habitat. Because the adverse effects to Essential Fish Habitat would be minimal, localized to the area of construction, and temporary to the timeframe of construction activities, it is anticipated that alternative D would have no more than a minimal impact on habitats designated as essential fish habitat for Atlantic butterfish, red hake, windowpane flounder, winter flounder, summer flounder, and scup. There would be *de minimis* impacts relative to the available habitat within Jamaica Bay.

Under alternative D, West Pond would remain as an estuarine habitat with mudflats and shorelines that may be conducive for horseshoe crab spawning. Because horseshoe crab spawning habitat may be a limiting factor for red knot use of the West Pond area, alternative D may benefit the red knot. Pursuant to section 7 of the Endangered Species Act, alternative D may affect, but is not likely adversely affect the red knot. Because alternative D would not alter any habitats for the northern long-eared bat or the roseate tern and because of the unlikelihood of their presence in the area during construction activities, pursuant to section 7 of the

Endangered Species Act, alternative D would have no effect on the northern long-eared bat and the roseate tern.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative D would be similar to those described for alternative A. Historic degradation of Jamaica Bay and habitat loss over the years has had substantial adverse cumulative impacts, whereas more recent ongoing efforts to restore natural resources in Jamaica Bay, as well as steps taken to improve watershed conditions would provide beneficial impacts to wildlife. Improved control of invasive plants, collective management actions, and efforts to improve and restore natural resource conditions and water quality around Jamaica Bay would result in substantial long-term benefits to wildlife in the region inclusive of the refuge and West Pond. Despite the improved environmental regulations and efforts to enhance and restore natural resource conditions around Jamaica Bay these improvements would not offset the long-term adverse impacts to wildlife in and around West Pond due to the level of historical and continued level of development and sources of pollution entering the Jamaica Bay estuary.

When the impacts on wildlife and special status species under alternative D are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative D would contribute a minimally adverse increment to the overall substantially adverse cumulative impact.

Conclusion

Alternative D would result in adverse impacts to wildlife because overall wildlife diversity within West Pond would continue to decline as habitat conditions continue to shift from freshwater to saltmarsh and mudflats. Although surface area of low saltmarsh within the West Pond area would likely increase over time, the trends in the number of species that use West Pond would decrease. Adverse impacts would also include the continued degradation of upland habitats that have developed under the influence of low saline conditions in place prior to the breaching of the pond.

Because the adverse effects to essential fish habitat would be minimal, localized to the area of construction, and temporary to the timeframe of construction activities, it is anticipated that alternative D would have no more than a minimal impact on habitats designated as essential fish habitat. Pursuant to the essential fish habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, there would be *de minimis* impacts relative to the available habitat within Jamaica Bay.

The remaining presence of estuarine habitat, mudflats, and shorelines under alternative D may be conducive for horseshoe crab spawning. Because horseshoe crab spawning habitat may be a limiting factor for red knot use of the West Pond area, alternative D may benefit the red knot. Because alternative D would not alter any habitats for the northern long-eared bat or the roseate tern and because of the unlikelihood of their presence in the area during construction activities alternative D would have no effect on the northern long-eared bat and the roseate tern. Pursuant to section 7 of the Endangered Species Act, the activities proposed under alternative D may affect, but not likely adversely affect the red knot. There would be no effect on the roseate tern and northern long-eared bat.

When the impacts on wildlife and special status species under alternative D are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative

D would contribute a minimally adverse increment to the overall substantially adverse cumulative impact.

VISITOR USE AND EXPERIENCE AND SCENIC RESOURCES

AFFECTED ENVIRONMENT

Recreational Opportunities

Gateway National Recreation Area offers a wide array of recreational opportunities and programming throughout the year. Trails and natural areas offer numerous opportunities for exploration and recreation, including the areas surrounding the West Pond area of the refuge. Various interpretive and educational activities for individuals, youth, school groups, and families are designed to illuminate and build appreciation for the national recreation area's history and ecology. Educational and interpretive programs are developed to encourage more enjoyment of resources and facilitate a greater appreciation of the significance of the national recreation area's resources. Natural and cultural resources education programs are offered to school groups, youth groups, and community organizations. The programs provide hands-on opportunities for learning and promote resource protection.

Partners play a role in promoting understanding, education, and interpretation. Partner organizations like the Audubon Society, the American Littoral Society, the National Wildlife Federation and others develop and operate independent interpretive activities such as birding tours and naturalist walks. The national recreation area also partners with local nonprofits and others to offer introductory recreational programming.

At the refuge, recreational opportunities consist of ranger-led hikes, educational programs, and interpretation. The wildlife refuge visitor center is located adjacent to West Pond, North and South gardens and trail, and offers visitors an opportunity to interact with rangers, view exhibits, and learn about activities such as ranger-led tours, self-guided tours, and recreation opportunities. Conditions in the North and South Gardens deteriorated subsequent to Hurricane Sandy, with vegetation die-off associated with saltwater influence. The gardens are being addressed under a separate action made possible through partnering. Access to the refuge is available from the Cross Bay Boulevard using either private vehicles or public transportation. Public transportation options include bus and train service.

Visitors to West Pond can enjoy a range of activities, including walking, bird watching, and photography. Prior to Hurricane Sandy, a mile and a half compacted gravel loop trail encircled West Pond along the berm. This loop trail was bisected when the berm was breached during the hurricane. The trail now consists of two out and back segments. Low-lying sections of trail near the North and South Gardens were damaged during Hurricane Sandy and are now impacted by the tidal fluctuations of West Pond as a result of the breach. The resulting muddy conditions can render portions of these trails inaccessible to some visitors. There are 13 benches located along the trail that are positioned for viewing wildlife and scenery. In addition, a boardwalk and wildlife viewing platform are under construction to the south of the visitor center. While the visitor center is currently universally accessible, the trails around West Pond are not. Historically, a trail branched off of the main loop trail and provided access to Terrapin Point; however, this trail has not been maintained in recent years and vegetation has taken over much of the path making access to the point difficult.

Scenic Resources

The open, natural spaces, marshes, coastal, and historic settings preserved within the national recreation area and at the refuge are a dramatic contrast to the surrounding urban environment and provide an attractive location for the national recreation area's many recreational uses. During scoping, the public expressed appreciation for the scenic qualities of the refuge and the quiet and solitude that it offers. The importance of maintaining access to the recreation area's diversity of natural landscapes and preserving the opportunity to experience nature and view wildlife and native plants was also noted during preparation of the national recreation area's recent general management plan (NPS 2014a). Urban naturalists and birders seek diverse habitat in the national recreation area to maximize the number of species seen, typically looking for places that offer access to different ecosystems. In particular, Jamaica Bay and West Pond have been an international destination for birders to enjoy the wildlife viewing and scenic resources the wildlife refuge offers.

Scenic views at West Pond include views of the saltmarsh islands, the near Rockaways, and Floyd Bennett Field to the west. Scenic views to the north include Hamilton Beach and New York City in the distance. To the south, scenic views include Broad Channel and the Far Rockaways.

Visitation

Gateway National Recreation Area stands in sharp contrast to the nearby metropolitan area of New York City. The refuge offers abundant opportunities for residents and visitors to engage in recreational activities and experience nature. Throughout the entire national recreation area, natural areas, historic coastal defense and maritime structures, diverse recreation opportunities, and educational and interpretive programming combine to create rich and varied visitor experiences.

The lands and waters within the national recreation area serve millions of visitors a year, making it an important urban park environment on the East Coast and in the New York and New Jersey Metropolitan area. The entire national recreation area encompasses 27,025 acres of land and water in New York City and New Jersey, creating an expansive public green space for both the local urban population and tourists to enjoy.

There were over 3.8 million visitors in 1974, the first year that the national recreation area reported visitation (NPS 2014d). Since then there have been substantial increases and intermittent decreases, with an annual visitation of around 6.1 million in 2013 (see figure 14) (NPS 2014d). Weather patterns along the northeastern seaboard have an influence on fluctuations because visitation is largely tied to outdoor recreation activities. Visitation in 2012 was only 5 million because of closures (November 2012-December 2012) due to Hurricane Sandy that resulted in unusually low visitation in the last quarter of the year. For example, in December 2012, total visits were down 96% from December 2011; annual visitor numbers were down 40% from 2011 totals (NPS 2014a). In 2011, Hurricane Irene caused a decrease in visitation levels. A review of data from the last five years indicates that visitor use levels peak in the summer months, decrease in the fall, and are lowest in the winter and spring (see figure 14) (NPS 2014d). Climate change and its associated effects could alter the timing of visits and activities at the national recreation area in the future. Heat waves are likely to become more frequent, more intense, and longer in duration (NYCPCC 2013). Higher temperatures and rising sea level associated with climate change could shift visitation toward cooler seasons and could also alter visitor access to portions of the area surrounding West Pond. As displayed in figures 10 and 11, sea level rise would affect low lying areas, including West Pond. An increase in the number and severity of storms, and coastal flooding could affect visitor experience, ability to access the wildlife refuge and West Pond, and the availability, and condition of visitor services and facilities.

Due to the proximity of the national recreation area to New York City and New Jersey residents, many of the visitors are local residents who use national recreation area lands for recreation and exercise. At most national recreation area sites, people from the local area account for the majority of visitors (NPS 2014a).

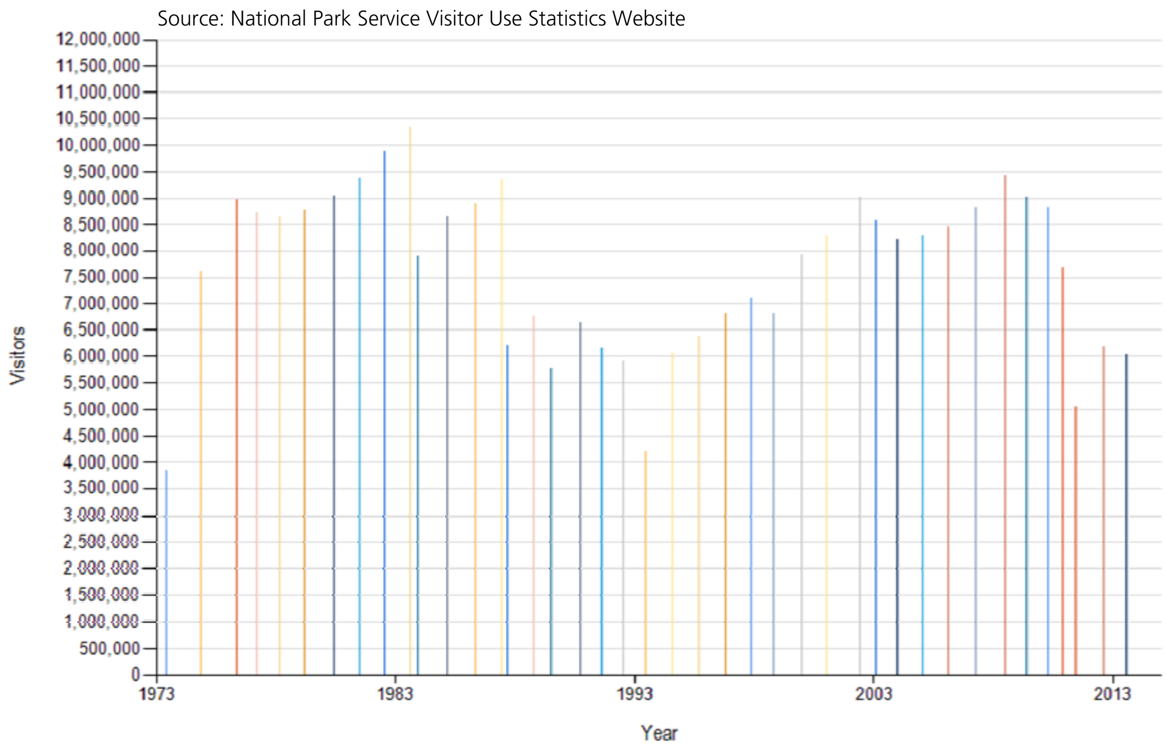


Figure 14: Total Annual Recreation Visitors at Gateway National Recreation Area (1973-present)

The refuge is accessible by public transportation and is therefore easily visited by residents from the nearby metropolitan areas. Its proximity to the John F. Kennedy airport also provides access to national and international visitors, many of whom are attracted to the refuge for wildlife viewing among other forms of recreation.

Visitation to the refuge is totaled monthly by staff at the visitor center and by use of a vehicle counter in the visitor center parking area. Between 2005 and 2011, the refuge averaged 550,000 visitors annually. In 2011, the year prior to Hurricane Sandy, there were 525,915 recorded visitors to the refuge. Post Hurricane Sandy, the refuge has seen a 37% decline in visitation with 331,273 recorded visitors in 2014 (Williams, personal communication 2015).

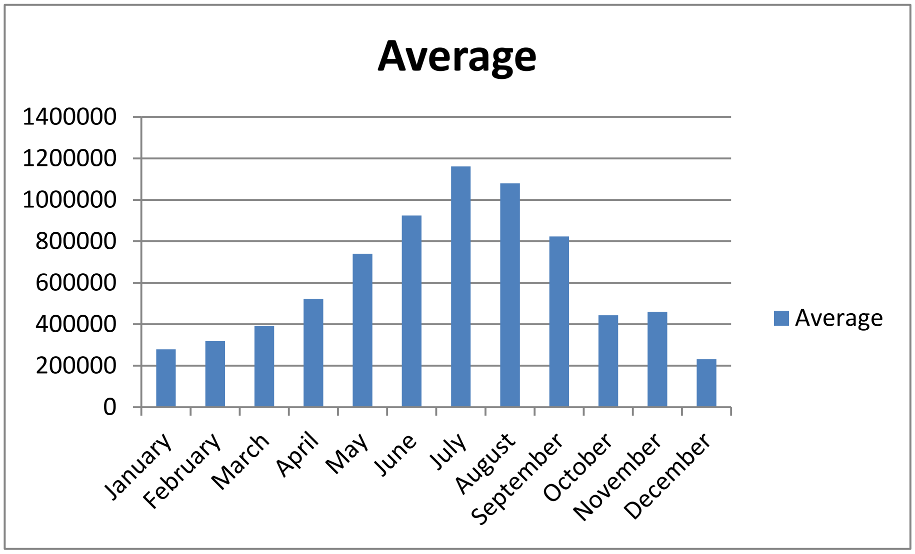


Figure 15: Five Year Average Monthly Visitation at Gateway National Recreation Area (2009-2013)

The trails at West Pond have been a destination for birders, local exercisers, tourists, and residents looking for an escape from the urban environment. The habitat and designation of West Pond as an international important bird area by BirdLife International and the National Audubon Society historically brought in an increase in the number of birders during the spring and fall bird migrations when thousands of migratory birds would frequent the pond. A shift in habitat types at West Pond, as a result of damages caused by Hurricane Sandy, drastically reduced the number of migratory birds seen at the pond (see also the “Wildlife and Special Status Species” section). This decline, in addition to damages to the trail, has greatly reduced the number of visitors coming to West Pond for the purpose of birding. Sea level rise and changes in seasonal temperatures as a result of climate change could further alter the timing and routes of spring and fall bird migrations and the condition of habitats available at West Pond in addition to limiting access to the trails around West Pond.

Visitor Health and Safety

The national recreation area experiences safety issues similar to those found in any national park as well as additional visitor safety challenges due to its urban and coastal location. Although NPS staff make considerable efforts to provide safety information in easily accessible locations and formats, there are many points of entry, and visitors are sometimes unaware of and unprepared for potential hazards. The most frequent injuries received by visitors occur from slips, trips, and falls. Current safety concerns at West Pond include uneven terrain and eroding banks at the site of the breach. Entrance to this area is blocked with an open wood fence. However, the fencing does not prevent visitors from walking down to the water. Additionally, the breach resulted in tidal fluctuations that inundated the North and South Garden areas and caused the trails to become muddy and slippery. The waterway between Jamaica Bay and West Pond is roped off to prevent kayakers from entering the pond and disturbing wildlife. Not all kayakers remain outside the breached West Pond area.

IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impacts

Under the no action alternative, the number of visitors to the refuge would be expected to continue to decline as resource conditions change, and the diversity and population of resident and migratory species declines.

The breach in the berm would remain open and the area identified as the secondary breach location would likely erode and breach after a significant storm event. As a result, the loop trail around West Pond would remain severed and the secondary breach could disrupt the trail even further along the northern edge of the pond. In addition, portions of the trail would remain periodically inaccessible to some visitors. These encroachments on the trail would continue to result in an adverse impact to visitor use and experience at West Pond by limiting access and impeding the visitor's ability to walk all the way around the pond on a loop trail. These impacts would be considered moderately adverse because of the decrease in opportunities for visitors to observe wildlife and due to the fact that visitors would need to double the length of their hike to access portions of the trail.

With the breach remaining open, there is potential for low-lying portions of the trail that were not previously exposed to tidal fluctuations to become tidally inundated. Both breach locations and the trail would continue to be monitored for safety by NPS staff. More portions of the trail would be susceptible to closures and erosion control measures could be implemented as necessary to ensure public safety. Any additional trail closures would result in additional adverse impacts to visitor use and experience by further restricting accessibility. Visual evidence of damages from Hurricane Sandy would remain evident, particularly around the breached portion of the berm and the area of the secondary breach, and the landscape in the vicinity of West Pond would continue to transition to be dominated by more saltwater tolerant species. West Pond would remain tidally influenced under alternative A and the species composition would continue to shift in response. The absence of freshwater wetland habitat would continue as a result of the influx of saltwater from Jamaica Bay. This habitat shift would continue to result in a decrease in species diversity resulting in ongoing impacts to visitors who come to West Pond for wildlife observation and to enjoy the scenery. These impacts would be considered moderately adverse given the history of the area being designated as an international important bird area and the scarcity of other accessible freshwater habitats along migration routes in this vicinity of the coast.

Cumulative Impacts

The variety of recreational opportunities proposed under the 2014 *Gateway National Recreation Area General Management Plan*, along with a substantial increase in recreational uses, instructional programming, facility upgrades, and the purposeful effort to engage a more diverse audience, would have a beneficial impact on visitor experience for the national recreation area overall, including the refuge. While actions proposed under the *General Management Plan* would have a beneficial impact on visitor experience, alternative A would not contribute to the desired visitor experiences for environmental education and natural immersion set forth in the *General Management Plan*.

Other recreational improvements include transportation planning efforts in the national recreation area and the region that propose improvements to transportation and circulation within the park sites of the Jamaica Bay Unit. Recommendations for the Jamaica Bay Unit include seasonal shuttle bus connections between mass transit stations/ stops and park sites; improved wayfinding, pedestrian, and bicycle signs; and providing guided kayak/canoe tours. The proposed actions would have ongoing benefits to the visitor use and experience in the vicinity of and including West Pond and the refuge.

The presence of invasive plant infestations within the national recreation area and the refuge has impacted the national recreation area's natural habitats and species diversity. These trends have had an indirect adverse impact on the visitor experience from a wildlife observation perspective and also on scenic resources.

The NPS manages the impacts of these, and similar, conditions through the development of management plans and implementing subsequent actions to improve the experience of visitors. Past and future management plans that affect visitor use and experience within the vicinity of West Pond and the refuge include the invasive species management plan (2014), and plans in partnership with the Nature Conservancy and Jamaica Bay-Rockaway Parks Conservancy to restore native vegetation at the North and South Gardens near West Pond. These plans and actions altered or would alter conditions, with adverse effects on visitor experience during implementation of the plans as applications take place and species are removed. However, these plans would have ongoing beneficial effects on visitor experience by restoring native habitat and attracting wildlife for viewing.

As a result of damage sustained during Hurricane Sandy, the national recreation area was closed to visitation for three months. Plans within the national recreation area and surrounding parks and communities to rebuild damaged visitor and recreation facilities and to make beaches and other areas safe for visitation would have beneficial impacts on visitor use and scenic resources once implemented and construction, as appropriate, is completed. Repairs and rebuilding once accomplished would expect to have beneficial effects as visitors return to these areas, and may also visit the refuge.

Actions taken by the New York Regional Transportation Authority immediately after Hurricane Sandy to repair breaches at East Pond and restore rail service enabled the pond to recently return to near freshwater conditions. Additional wetland mitigation and restoration efforts in Jamaica Bay, such as those included in the *Jamaica Bay Watershed Protection Plan* (NYCDEP 2014) and other post-Hurricane Sandy efforts, have been focused on ecological restoration and protection of the saltmarsh islands and other natural areas, in addition to public education about the importance of the Jamaica Bay watershed. Collectively, these efforts have and would continue to have indirect benefits to visitor use and experience and scenic resources by improving natural habitats, visitor knowledge, and wildlife viewing opportunities within the national recreation area, areas within view from the refuge and West Pond.

Taken together, these past, present, and reasonably foreseeable actions have resulted in primarily beneficial impacts on the visitor experience and scenic resources. Improved recreational opportunities, management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay would result in ongoing benefits to the visitor use and experience and scenic resources at the refuge.

When the impacts on visitor use and experience under alternative A are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative A would contribute a moderate adverse increment to the overall beneficial cumulative impact.

Conclusion

Alternative A would result in ongoing moderate adverse impacts to visitor use and experience and scenic resources. These impacts would be primarily related to fewer opportunities for wildlife observation resulting from a decline in species diversity as the habitat continues to shift from freshwater to more saltwater tolerant species. Adverse impacts would also result from sustained visual evidence of the damages caused by Hurricane Sandy and the inability to walk all the way around the pond due to the breached loop trail.

Cumulative impacts on visitor use and experience and scenic resources would be beneficial because of improved recreational opportunities, management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay. Alternative A would contribute a moderate adverse increment to the overall beneficial cumulative impact as a result of the disrupted loop trail around the pond and the absence of freshwater habitat and resulting decrease in species diversity. When the impacts on visitor experience and scenic resources under alternative A are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative A would contribute a moderate adverse increment to the overall substantially adverse cumulative impact.

IMPACTS OF ALTERNATIVE B: REPAIR THE BREACH AND IMPROVE HABITAT CONDITIONS, THE NPS PREFERRED ALTERNATIVE

Impacts

Phase 1. Under phase 1 of alternative B, visitors would be anticipated to return to the wildlife refuge once trail access improved and the freshwater pond was reestablished. Visitation levels would be anticipated to at least approach or exceed pre-Hurricane Sandy levels and increase compared to current levels.

Groundwater Well or Municipal Water Source – Under phase 1 of alternative B, the breach and secondary breach would be repaired and stabilized and the loop trail around West Pond would be restored so that visitors would once again be provided access around the pond. Repaired areas of the trail would be resurfaced with materials that would lessen the noise of visitors while walking in order to minimize disturbance to wildlife, where possible. At the breach locations, trail repair would be constructed with a trail surface that would allow for ABAAS accessibility in these improved areas. These trail improvements would result in beneficial impacts to visitor use and experience by improving access, improving opportunities for wildlife viewing, and restoring the visitor’s ability to walk around West Pond.

During construction of phase 1, visitors would be inconvenienced during the up to one year construction period as a result of trail and area closures to ensure visitor safety. While the impacts from these closures would be moderately adverse, they would be temporary. Temporary closures and the noise and visual presence of machinery and work crews during implementation of each phase of construction under the preferred alternative would have adverse impacts on visitor use and experience. The intensity of such impacts would vary depending on the season, the length of closures, and potential for any overlap with future construction work. Visitor safety would be improved overall as the breach was filled, the berm stabilized at the secondary breach, and trail work completed. Completion of phase 1 of alternative B would include closure/filling of the breach, installing a freshwater source (a groundwater well or municipal water source), and replacing the water control structure to restore and manage freshwater conditions in West Pond. While construction of these elements of the alternative would result in slight adverse impacts to the scenic resources during construction, over the long-term the impacts would be beneficial as conditions improved and the landscape became more accessible for viewing purposes.

Enhanced control measures to manage invasive plant species at West Pond, the installation of a freshwater source, and replacement of the water control structure to restore and manage freshwater conditions in West Pond, and habitat restoration at Terrapin Point would increase habitat types and thereby increase species diversity. As species return and diversity improves, there would be improved opportunities for wildlife observation thereby resulting in ongoing beneficial impacts to visitor use and experience at West Pond. Additionally, an increase in habitat types and species diversity would enhance opportunities for education and outreach focused on wildlife protection and the avoidance of wildlife disturbance. Improvements in signage, expanding interpretation, and implementing site-specific management strategies would improve opportunities for outreach at West Pond and environs and thereby improve the visitor experience, which would result in beneficial impacts.

Precipitation – An option of alternative B would consider relying solely on freshwater replenishment to West Pond from natural precipitation and runoff. Under this option, temporary impacts to visitor experience during phase 1 of work related to general construction (as described above for supplemental water sources from groundwater or municipal supply) would not change appreciably because the area would be subject to closure during construction of other alternative features.

Relying on natural precipitation and runoff as a freshwater source, in combination with management abilities provided by the water control structure, would result in a more gradual transition to freshwater conditions within West Pond. Over the long-term, freshwater habitat within West Pond would be more susceptible to saltwater influence or inundation during future storms because a reliance on natural precipitation as a freshwater source would result in a more gradual recovery following storm events. While the long-term impacts to visitor use and experience and scenic resources would be beneficial as conditions improved and the landscape became more accessible for viewing purposes, reliance on natural precipitation and runoff as a freshwater source would limit the NPS' ability to restore freshwater conditions in a timely manner and to manage future freshwater conditions in West Pond. Without the species diversity provided by a consistent source of freshwater, opportunities for wildlife observation may result in seasonal fluctuations and be subject to weather conditions and beneficial impacts to visitor experience and scenic resources could fluctuate based on precipitation rates and freshwater levels/conditions within the pond.

Future Phases. Completion of future phases of alternative B would include installation of additional visitor amenities. While construction of these elements of the alternative would result in slight adverse impacts to the scenic resources during installation, over the long-term the impacts would be beneficial as conditions improved and the landscape became more accessible for viewing purposes. Site repairs, installation of a freshwater source, improved habitat conditions, additional wildlife viewing areas, and other visitor amenities that would be installed as part of future phases may draw additional visitors to the wildlife refuge as the improvements were completed. There would also be new opportunities to provide interpretive activities to address the effects of climate change and resiliency with regard to the saltmarsh and shoreline habitat restoration activities in this dynamic and vulnerable environment.

Under future phases, additional work to restore saltmarsh south of the primary breach area and Terrapin Point would increase resiliency and improve measures to protect the berm, trail, and visitor facilities. A new trail would be constructed around Terrapin Point to allow visitor access to this area. These improvements would also allow additional opportunities for visitor outreach and education with regard to how the NPS is adapting to climate change, resulting in beneficial impacts to visitors by improving opportunities for access, learning, and wildlife viewing.

Under future phasing of alternative B, upland habitat restoration (thinning and control of invasive species) at Terrapin Point would take place and visitor access and experiences would be improved as opportunities for educational programs, wildlife protection, and viewing would be enhanced. Wildlife viewing areas and boardwalks would be strategically placed around West Pond to enhance the visitor experience while simultaneously limiting human disturbance to wildlife and thereby improving the potential for wildlife observation. This would result in beneficial impacts to visitor use and experience. Seasonal closures to the Terrapin Point trail would be anticipated to minimize impacts to nesting species such as terrapins and certain bird species. Impacts to visitors from these closures would be considered minor due to the fact that access to the point has been somewhat limited in the past due to Terrapin Point trail conditions.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative B would be similar to those described for alternative A. However, actions proposed under alternative B would contribute beneficial impacts to the desired visitor experiences for environmental education and natural immersion set forth in the *General Management Plan*. Beneficial impacts associated with improved recreational opportunities, management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay would result in ongoing benefits to visitor use and experience and scenic resources at the refuge. When the impacts on visitor use and experience under alternative B are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative B would contribute a substantial beneficial increment to the overall beneficial cumulative impact.

Conclusion

Under phase 1 and future phases, trail and area closures and visual and aural construction-related intrusions to the site during construction of alternative B would result in adverse impacts to visitor experience and scenic resources; however, these impacts would be temporary. Overall, alternative B would result in beneficial impacts to visitor use and experience and scenic resources. These impacts would be primarily related to improved opportunities for wildlife observation resulting from restoration of freshwater habitat, restoration of the loop trail and the construction of a new trail around Terrapin Point, installation of wildlife viewing areas, and increased resiliency of the site.

Under phase 1, reestablishing freshwater habitat from the installation of a freshwater source (a groundwater well or municipal water source) to supplement natural precipitation and runoff would result in a beneficial impact to visitor experience by allowing for a faster transition to freshwater habitat conditions and increased resiliency and recovery of the ecosystem in the event of future storm damage or saltwater influence.

Reestablishing freshwater habitat through replenishment by natural precipitation would also result in a beneficial impact to visitor experience; however, a reliance on natural precipitation would limit the NPS' ability to restore and manage freshwater conditions at West Pond to support wildlife use because they would not have the ability to add freshwater on demand. Therefore, the impact to visitor use would be dependent upon natural rates of precipitation and evaporation and the pond's ability to attract wildlife and beneficial impacts to visitor experience and scenic resources could fluctuate based on precipitation rates and freshwater conditions within the pond.

Cumulative impacts on visitor use and experience and scenic resources would be beneficial because of improved recreational opportunities, management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay. Alternative B would contribute a substantial beneficial increment as a result of the restored loop trail, improved opportunities for wildlife viewing. When the impacts on visitor experience and scenic resources under alternative B are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative B would contribute a substantial beneficial increment to the overall beneficial cumulative impact.

IMPACTS OF ALTERNATIVE C: CREATE DIFFERENT TYPES OF HABITAT

Impacts

Under alternative C, visitation levels would be anticipated to at least approach or exceed pre-Hurricane Sandy levels and increase compared to current levels. It is anticipated that visitors would return to the wildlife refuge once trail access improved, wildlife viewing opportunities were enhanced, and more opportunities for educational programs were established. Site activities including berm and pond relocation, installation of structural controls, restoration activities, and visitor amenities would be phased, and more visitors may be drawn to visit the newly reconfigured West Pond area within the wildlife refuge as the improvements were completed.

Under alternative C, the berm would be reconfigured and West Pond would be reconfigured as a smaller ponded area with freshwater and upland habitat. A loop trail would be established around the newly created pond. Repaired areas of the trails would be surfaced with materials that would lessen the noise of visitors while walking and allow for ABAAS accessibility. Terrapin Point would become an island and a boardwalk/bridge would be installed for visitors to connect to a new trail around it. These elements would result in ongoing beneficial impacts to visitor use and experience by improving and increasing access and restoring the visitor's ability to walk around the ponded area on a loop trail.

There would be seasonal closures to the Terrapin Point trail to minimize impacts to nesting terrapins and certain bird species. During seasonal closures there would be temporary adverse impacts to visitors; however, over the long-term, these closures would improve visitor experiences and understanding, protect wildlife, and improve the visitor potential for wildlife observation in the future resulting in beneficial impacts to visitor use and experience.

Additional wildlife viewing areas and boardwalks would be strategically placed around the newly created West Pond to enhance the visitor experience. These blinds, viewing platforms, and boardwalks would also provide new opportunities for gathering locations for groups for educational and outreach activities while simultaneously limiting human disturbance to wildlife. These efforts would improve the potential for wildlife observation while minimizing wildlife impacts, resulting in a beneficial impact to visitor use and experience.

During construction of alternative C, the West Pond area would be closed for up to 3 years, with the potential for longer closures pending final design details. While construction activity would not take place year-round, the site would remain closed to ensure for public safety. During this time frame the visitor center would remain open and a small portion of the parking area would remain free of construction staging to allow visitor parking access to the center. While temporary, the prolonged length of the closures would result in considerable adverse impacts to visitors to West Pond. The noise and visual presence of machinery and work crews during implementation of alternative C would have adverse impacts on visitor use and experience at the visitor center and in the general area of the refuge.

Following completion of construction activity, visitor safety would be improved overall once the new berm was created, vegetation was planted, and the trail work was completed. The inland location of the pond, provision of vegetated buffers, increased shoreline complexity, in combination with a freshwater source and water control structure, would increase the resiliency and sustainability of the West Pond area, which would result in ongoing beneficial impacts to visitor use, safety, and experience. Trail access to Terrapin Point by bridge or boardwalk may not be resilient to future storm events and would be closed if conditions were deemed unsafe.

Reconfiguration of a new berm to enclose the newly created West Pond, the installation of a freshwater source and water control structure to restore and manage freshwater conditions in this West Pond, and habitat restoration activities would restore habitats and reduce the visual evidence of Hurricane Sandy damages, providing long term improvements to visitor services, scenic resources, and the visitor experience. While construction of these elements of the alternative would result in adverse impacts to the scenic resources, over the long-term impacts to the scenic resources would be beneficial as site conditions improve, and species and habitats are established.

A reconfiguration of the landscape to relocate and reinforce the berm and create a smaller West Pond farther inland would result in a mosaic of habitat types. Combined with enhanced control measures to manage invasive plant species, the installation of a freshwater source and water control structure to manage freshwater conditions in West Pond, and habitat restoration activities, there would be an increase in habitat types and species diversity. These conditions would improve opportunities for wildlife observation and thereby result in beneficial impacts to visitor use and experience at West Pond. Additionally, an increase in habitat types and species diversity would enhance opportunities for education and outreach focused on wildlife protection and the avoidance of wildlife disturbance. Improved signage, boardwalks and observation areas expanded interpretation opportunities, including interpretation of the effects of climate change and resiliency, and implementing site-specific management strategies would improve conditions in this area of the wildlife refuge and thereby improve the visitor experience, which would result in beneficial impacts.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative C would be similar to those described for alternative A. However, actions proposed under C would contribute beneficial impacts to the desired visitor experiences for environmental education and natural immersion set forth in the *General Management Plan*. The beneficial impacts associated with improved recreational opportunities, management actions, and efforts to improve and restore wetland and other resource conditions around Jamaica Bay would result in ongoing benefits to the visitor use and experience and scenic resources at the refuge. When the impacts on visitor use and experience under alternative C are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative C would contribute a substantial beneficial increment to the overall beneficial cumulative impact.

Conclusion

Over the long term, alternative C would result in beneficial impacts to visitor use and experience and scenic resources. These impacts would primarily be related to improved opportunities for wildlife observation resulting from establishment of a smaller freshwater pond habitat, restoration of a loop trail and the construction of a boardwalk bridge and new trail around the newly created Terrapin Point island, installation of wildlife viewing areas, and increased resiliency of the site. Extended construction closures and visual and aural construction-related intrusions to the area during construction would result in temporary, but considerable adverse impacts to visitor experience and scenic resources due to the extended multi-year construction period.

Cumulative impacts on visitor use and experience and scenic resources would be beneficial because of improved recreational opportunities, management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay. Alternative C would contribute a substantial beneficial increment over the long-term as a result of the restored loop trail and improved opportunities for wildlife viewing. When the impacts on visitor experience and scenic resources under alternative C are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative C would contribute a substantial beneficial increment to the overall beneficial cumulative impact.

IMPACTS OF ALTERNATIVE D: BRIDGE THE BREACH

Impacts

Under alternative D, visitation levels would be anticipated to be somewhat lower than pre-Hurricane Sandy levels, yet increased compared to current levels. It is anticipated that visitors would return to the West Pond area once trail access was improved, wildlife viewing opportunities were somewhat enhanced and additional opportunities for educational programs were established. Site repairs could be phased, and more visitors may be drawn to visit the wildlife refuge as the improvements were completed. However, overall visitation may not mirror pre-Hurricane Sandy conditions due to the lack of freshwater habitat to attract birders.

A steel truss bridge or box culvert would be installed across the breach to restore the loop trail. Repaired portions of the trail would be resurfaced with materials that would lessen the noise of visitors while walking and allow for ABAAS accessibility. These trail improvements would result in beneficial impacts to visitor use and experience by restoring the visitor's ability to walk around West Pond on a loop trail. During construction of the bridge, there would be temporary trail closures. These temporary closures and the noise and visual presence of machinery and work crews during implementation of construction phasing under alternative D would have adverse impacts on visitor use and experience. The intensity of such impacts would vary depending on the length and potential overlap of construction components.

As under alternative A, West Pond would remain tidally influenced and the species composition would continue to shift in response. The absence of freshwater wetland habitat would continue to cause a decrease in species diversity resulting in ongoing adverse impacts to visitors who come to West Pond for the purposes of wildlife observation. These adverse impacts would be considerable given the history of the area as a designated international important birding destination, the historic importance of the area to birders during spring and fall bird migrations, the scarcity of other accessible freshwater habitats along migration routes within this area of the coast, and the value this area provides in such an urban environment.

Two additional wildlife viewing areas would be strategically placed around West Pond to enhance the visitor experience. These viewing platforms would limit human disturbance to wildlife thereby improving the potential for wildlife observation, which would result in a beneficial impact to visitor use and experience. The diversity of wildlife to be viewed would be similar to current conditions.

Under alternative D, the breach would remain open, but the banks along the breach and secondary breach would be stabilized thereby making the area in the vicinity of the breach safer for visitors on the trail compared to current conditions. With the breach remaining open, there is potential for low-lying portions of the trail that were not previously exposed to tidal fluctuations to become tidally inundated. Trail closures would be implemented if necessary to ensure public safety. Any trail closures would result in adverse impacts to visitor use and experience by further restricting accessibility. The intensity of these impacts would vary depending on the length of the closure.

Visual evidence of damages from Hurricane Sandy would be reduced around the breached portion or the berm, but would still be evident in the absence of freshwater wetlands and decreased habitat diversity. As a result, scenic resources would continue to be adversely impacted over the long-term.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative D would be similar to those described for alternative A. However, actions proposed under D would contribute some beneficial impacts to the desired visitor experiences for environmental education and natural immersion set forth in the *General Management Plan*. The beneficial impacts associated with improved recreational opportunities, management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay would result in ongoing benefits to the visitor use and experience and scenic resources at the refuge.

When the impacts on visitor use and experience under alternative D are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative D would contribute a slight beneficial increment to the overall beneficial cumulative impact.

Conclusion

Alternative D would result in beneficial impacts to visitor use and experience and scenic resources. These impacts would be primarily related to restoration of the loop trail. Temporary closures and visual and aural construction-related intrusions to the site during implementation of the alternative would result in adverse impacts to visitor experience and scenic resources. The intensity of these impacts would vary depending on the length of the closure.

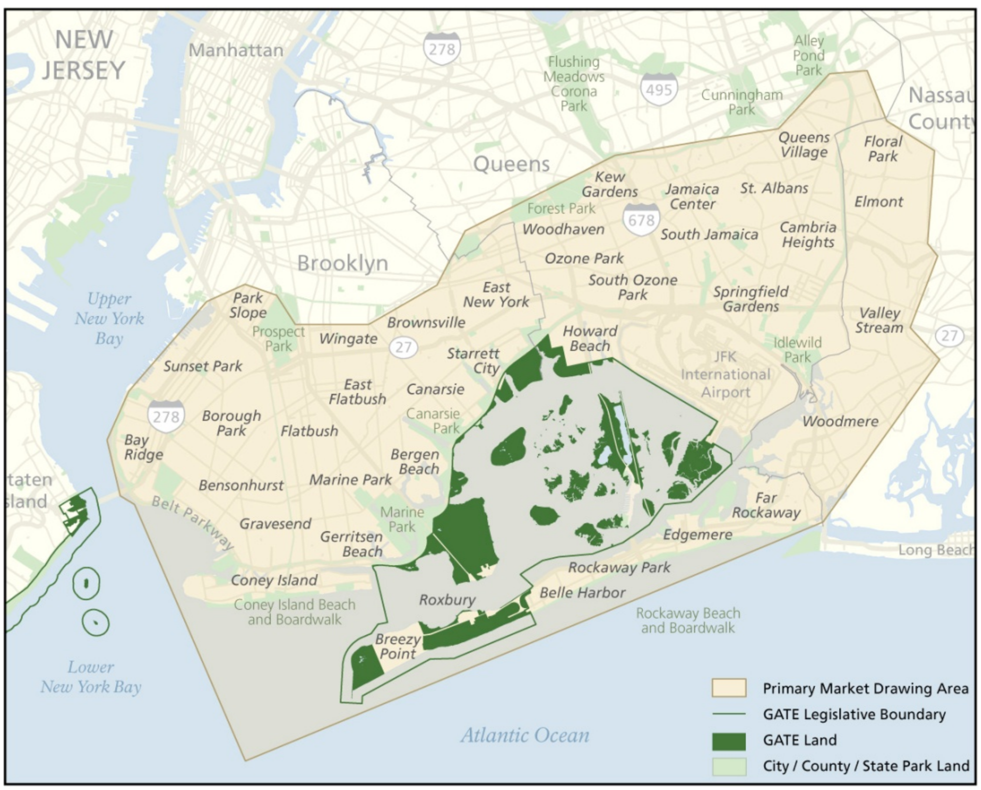
Cumulative impacts on visitor use and experience and scenic resources would be beneficial because of improved recreational opportunities, management actions, and efforts to improve and restore natural resource conditions around Jamaica Bay. Alternative D would contribute a slight beneficial increment as a result of the restored loop trail. When the impacts on visitor experience and scenic resources under alternative D are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative D would contribute a slight beneficial increment to the overall beneficial cumulative impact.

SOCIOECONOMICS

AFFECTED ENVIRONMENT

The national recreation area contributes to the social and economic conditions of the area as a whole. Additional information regarding these socioeconomic conditions are presented in the 2014 *Gateway National Recreation Area General Management Plan / Environmental Impact Statement (*NPS 2014a), the primary reference for this section.

Park and open space areas in and around an urban area are key contributors to the quality of life in the community. This becomes even more significant in very large metropolitan areas, where population densities and travel distances to open, public lands are greater. The primary market drawing area for the entire national recreation area falls within the New York Metropolitan Statistical Area, which is the largest metropolitan area in the United States. The primary market drawing area for the Jamaica Bay Unit includes portions of the boroughs of Queens and Brooklyn in New York. The primary market drawing area for the Jamaica Bay Unit was developed through comparison of the neighborhood tabulation area developed for the New York City Comprehensive Waterfront Plan to a market drawing area developed as part of the NPS Gateway National Recreation Area Supply and Demand Analysis (NPS 2014a).



(Source: *General Management Plan* 2014)

Figure 16: Primary Market Drawing Area for Jamaica Bay Unit, New York

The national recreation area has many direct and indirect positive effects on the area's economy. This impact can be traced to several sources and attributes, such as money spent by visitors at local businesses, jobs created at these local businesses due to visitor demand, NPS jobs created by the NPS, NPS contracts with local businesses, and other area tourism generated by the national recreation area.

Each year, millions of visitors to the national recreation area contribute hundreds of millions of dollars to the surrounding region. This money directly sustains the revenue stream and jobs at hotels, restaurants, and stores that serve visitors. Primarily, businesses in the boroughs of Queens and Brooklyn are the direct beneficiaries of the economic contribution for the Jamaica Bay Unit. Within the Jamaica Bay Unit primary market drawing area, the largest category of businesses are retail trade establishments. This is followed by other service businesses; accommodation and food services; and health care and social assistance (NPS 2014a). Between 2011 and 2014, there was a 37% decline in visitation to West Pond and the refuge (Williams, personal communication 2015). Within the refuge and West Pond area, Broad Channel is the closest local commercial area and is located less than half a mile southeast, also on Broad Channel Island. The community has approximately 3,000 inhabitants. Business types within Broad Channel include several restaurants, pubs, small markets, and bakeries. While these businesses are frequented mostly by local residents, they do have the potential to attract visitors to and from the refuge. Due to a lack of economic data specific to a correlation between West Pond and Broad Channel, the park obtained anecdotal information from the Broad Channel community and made some limited assumptions. Local business owners within the Broad Channel community, adjacent to the Jamaica Bay Wildlife Refuge, have stated that they see a correlation between loss in business and Hurricane Sandy-related damage to West Pond; in particular, they noted a reduction in customers with equipment associated with birding, such as binoculars, walking sticks, and cameras, who were presumably visitors to the West Pond.

The visitor money stream can also have other indirect, or secondary, effects. For example, this injected money that directly supports local businesses and jobs eventually circulates into the local economy and beyond. This circulation happens when the local businesses in the surrounding communities buy products or services from other sources, or when employees at the local businesses use their income earned at the local businesses in communities surrounding the national recreation area at other businesses in the area to sustain their lifestyle. This secondary effect is often referred to as an economic "multiplier," because one dollar injected into the local economy often has more than one dollar's effect on the local economy.

As an urban national recreation area, as opposed to a destination park, the preponderance of visitation is in the form of day-use recreation visits. Although overnight visitors spend significantly more than day visitors, the size of the day-use market results in significant economic impacts on the surrounding area. In total, visitors to the national recreation area spent $150 million in the surrounding local region in 2011. This spending figure is for the national recreation area as a whole and excludes airfare and other trip spending outside a 60-mile radius from the national recreation area, as well as any durable goods and major equipment (NPS 2014a). According to the NPS "Money Generation Model 2" developed by researchers at Michigan State University, the $150 million of total visitor spending at the national recreation area supports 668 jobs, supports a labor income of $30.7 million dollars, and added $50.5 million of value (NPS 2014a). Dollars spent in relation to visitor use at the refuge are not broken out, but included in these figures.

IMPACTS OF ALTERNATIVE A: NO ACTION / CONTINUE CURRENT MANAGEMENT

Impacts

Under alternative A, visitation to West Pond may continue to decline due to trail limitations, a decrease in species diversity, and a reduction in wildlife observation opportunities. The continued decline in visitors could lead to potential additional loss of business within Broad

Channel and the immediate vicinity on top of the loss reported by local business owners in association with Hurricane Sandy-related damage to West Pond; however, when compared to the entire Jamaica Bay Unit and the national recreation area in general and when compared to business lost from hurricane damages sustained directly by the community of Broad Channel, this reduction would be slight and adverse impacts to the local economy would be minimal.

Any continued visitor use spending, however slight, would continue to provide an ongoing, though slight, beneficial impact.

Cumulative Impacts

Actions under the 2014 *Gateway National Recreation Area General Management Plan* would increase the variety and number of recreational activities and support an increase in anticipated visitor use, which would have an overall beneficial impact on the socioeconomic environment. Beneficial impacts would include the potential for increases in employment and visitor spending.

Anticipated future waterfront development in Jamaica Bay would result in short-term construction-related jobs and could result in the generation of additional permanent jobs. Future development in Jamaica Bay could have both temporary and ongoing beneficial impacts on employment in the area and would potentially contribute positively to the household income in the surrounding communities.

NPS and surrounding park and community plans to rebuild damaged visitor and recreation facilities and to make beaches and other areas safe for visitation would result in the creation of additional short-term jobs. These temporary jobs would have a beneficial impact on local socioeconomics while repairs are implemented.

Taken together, these past, present, and reasonably foreseeable actions have resulted in primarily beneficial impacts on local socioeconomic conditions. Improvements within the national recreation area, regional development, and local restoration projects within Jamaica Bay would result in both temporary and ongoing benefits to socioeconomic conditions around the refuge.

When the impacts on socioeconomics under alternative A are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative A would contribute a nominally beneficial increment to the overall beneficial cumulative impact.

Conclusion

Under alternative A, the continued use of the national recreation area and the West Pond area would result in beneficial impacts to socioeconomic conditions. These impacts would be primarily related to continued visitor use spending, however slight it may be. A continued decline in visitation at West Pond could result in additional loss of business in the immediate area on top of the loss reported in association with Hurricane Sandy-related damage to West Pond, which could contribute a slight adverse impact to the local economy.

Cumulative impacts on socioeconomics would be beneficial because of the potential for increased visitor spending resulting from increased recreational activities within Gateway National Recreation Area and the potential for additional jobs and spending from future development and repairs in the area. Alternative A would contribute a nominal beneficial increment as a result of the continued potential for visitor spending, although minimal, in the West Pond area. When the impacts on socioeconomics under alternative A are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative A would contribute a nominal beneficial increment to the overall beneficial cumulative impact.

IMPACTS OF ALTERNATIVE B: REPAIR THE BREACH AND IMPROVE HABITAT CONDITIONS, THE NPS PREFERRED ALTERNATIVE

Impacts

Under alternatives B, the NPS would restore a freshwater pond and expand visitor amenities, facilities, and educational interpretation. This would increase the diversity of recreational opportunities at West Pond and encourage a return of greater visitation to the area by the local and regional population. It is anticipated these actions would result in an increase in visitor use to West Pond over the long term, resulting in a benefit to the local economy related to visitor use spending. The rate of increase would be commensurate with the completion of construction and the transition to freshwater habitat. At this time, it is difficult to gauge what percentage of visitors would come from the local area and what percentage would come from outside the area, although the return of migratory birds to West Pond would attract additional nonresident visitors. Regardless of whether it is from local or nonresident visitors, the additional recreational visitor use over the long-term would result in additional retail and recreational expenditures, with beneficial impacts for the local economy.

Economic benefits of additional visitor use spending include the potential for increased business opportunities created in the national recreation area by nonprofit partners, as well as outside the national recreation area, to service the increased level of visitation. State and local governments would collect additional sales tax from increased visitor spending, a beneficial impact for these agencies' budgets.

Implementing alternative B would require temporary closure of the West Pond area to visitors. The length of these closures would depend on environmental and other applied work restrictions. Under alternative B, construction would take up to a year, during which time the West Pond area would be partially or fully closed to visitors. While the NPS would strive to minimize construction closures during peak visitation times, there is the potential for temporary closures to occur during the high use summer months due to their overlap with the ideal construction window for the region.

During these closures, there would be a decrease in visitors and therefore a decrease in visitor spending at local businesses. However, nearby businesses in the Broad Channel area mostly serve the local community and therefore it is anticipated that these temporary adverse impacts would be modest. These adverse impacts to the local socioeconomic condition would be partially offset by the additional short-term jobs created during each construction phase for alternative B. The number and length of these positions would be commensurate with the magnitude and timing of construction phases. These jobs and the potential local spending of the work crews would have a beneficial impact on local socioeconomics while construction occurs under alternative B.

Alternative B would expand volunteer positions to manage the need for increased education, increases in visitor use, monitoring, and increased programming, which would result in an ongoing beneficial impact. Overall construction, development, and expanded visitor opportunities would have a beneficial impact on local spending and socioeconomic conditions.

Cumulative Impacts

Related projects and their impacts to the affected environment would be the same as those described for alternative A. Improvements within the national recreation area, regional development, and local restoration projects within Jamaica Bay would result in benefits to socioeconomic conditions around the refuge.

When the impacts on socioeconomic conditions under alternative B are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative B would contribute a moderate beneficial increment to the overall beneficial cumulative impact.

Conclusion

Alternative B would result in temporary adverse and temporary and ongoing beneficial impacts to socioeconomic conditions around the refuge. Temporary adverse impacts would be related to a decrease in visitor spending during construction closures. Due to the nature of businesses in the area that serve mostly local residents, these impacts would not be substantial. Beneficial impacts would primarily be related to increased visitor spending from an increase in visitation related to restored, expanded, and improved habitats and visitor facilities at West Pond. Additional economic benefits would result from the addition of short-term jobs during construction.

Cumulative impacts on socioeconomics would be beneficial because of the potential for increased visitor spending resulting from increased recreational activities within Gateway National Recreation Area and the potential for additional jobs and spending from future development and repairs in the area. Alternative B would contribute a moderate beneficial increment as a result of greater visitation and related visitor use spending over the long-term and the addition of short-term jobs and work crew spending over the short-term. When the impacts on socioeconomics under alternative B are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative B would contribute a moderate beneficial increment to the overall beneficial cumulative impact.

IMPACTS OF ALTERNATIVE C: CREATE DIFFERENT HABITAT TYPES

Impacts

Under alternative C, impacts would be very similar to those described under alternative B. As under alternative B, restoration of a freshwater pond and expanded visitor amenities, facilities, and educational interpretation would increase the diversity of recreational opportunities at West Pond and encourage a return of greater visitation to the area by the local and regional population, which would result in a benefit to the local economy related to visitor use spending. The rate of increase would be commensurate with the completion of construction and the transition to a freshwater ecosystem. As under alternative B, it is difficult to gauge what percentage of visitors would come from outside the local area versus within, although the return of migratory birds to West Pond would likely attract additional nonresident visitors. Regardless, the additional recreational visitor use over the long-term would result in additional retail and recreational expenditures, with beneficial impacts for the local economy.

As mentioned above, economic benefits of additional visitor use spending include the potential for increased business opportunities created in the national recreation area by nonprofit partners, as well as outside the national recreation area, to service the increased level of visitation. State and local governments would collect additional sales tax from increased visitor spending, a beneficial impact for these agencies' budgets.

Implementing alternative C would require temporary closure of the West Pond area to visitors for up to 3 years to implement, during which time the entirety of the West Pond area would be closed to visitors. During this extensive closure, there would be a decrease in visitors and therefore a decrease in visitor spending at local businesses. However, nearby businesses in the Broad Channel area mostly serve the local community and therefore it is anticipated that these temporary adverse impacts would be modest. The adverse impacts to the local socioeconomic condition would be partially offset by the additional short-term jobs created during construction. The number and length of these positions would be commensurate with the season, magnitude, and timing of construction. These jobs and the potential local spending of the work crews would have a beneficial impact on local socioeconomics while construction occurs.

Similar to alternative B, alternative C would expand volunteer positions to manage the need for increased education, increases in visitor use, monitoring, and increased programming, which would result in an ongoing beneficial impact. Overall construction, development, and expanded visitor opportunities would have a beneficial impact on local spending and socioeconomic conditions.

Cumulative Impacts

Related projects and their impacts to the affected environment would be the same as those described for alternative A. Improvements within the national recreation area, regional development, and local restoration projects within Jamaica Bay would result in benefits to socioeconomic conditions around the refuge.

When the impacts on socioeconomic conditions under alternative C are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative C would contribute a moderate beneficial increment to the overall beneficial cumulative impact.

Conclusion

Alternative C would result in temporary adverse and temporary and ongoing beneficial impacts to socioeconomic conditions around the refuge. Temporary adverse impacts would be related to a decrease in visitor spending during the extended construction closure. Due to the mostly local nature of businesses in the area, these impacts would be modest and would be partially offset by the additional short-term jobs and work-crew spending created during construction. Beneficial impacts would primarily be related to increased visitor spending from an increase in visitation related to restored, expanded, and improved habitats and visitor facilities at West Pond.

Cumulative impacts on socioeconomics would be beneficial because of the potential for increased visitor spending resulting from increased recreational activities within Gateway National Recreation Area and the potential for additional jobs and spending from future development and repairs in the area. Alternative C would contribute a moderate beneficial increment as a result of greater visitation and related visitor use spending over the long-term and the addition of short-term jobs and work crew spending over the extended, but short-term construction period. When the impacts on socioeconomics under alternative C are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative C would contribute a moderate beneficial increment to the overall beneficial cumulative impact.

IMPACTS OF ALTERNATIVE D: BRIDGE THE BREACH

Impacts

Under alternative D, the NPS would install a steel truss bridge or box culvert, stabilize the breach and secondary breach, and thereby restore the loop trail around West Pond. Restoration of the trail would increase recreational opportunities at West Pond and encourage an increase in visitation to the area by the local population who frequently used the loop trail prior to Hurricane Sandy. An increase in visitation from the regional population, many of whom visited West Pond to observe migratory birds dependent on freshwater habitat prior to Hurricane Sandy, would likely not be as great as under alternatives B and C given the lack of freshwater habitat under this alternative. It is anticipated these actions would result in a slight increase in annual visitor use to West Pond over the long term, which would result in a slight benefit for visitor use spending in the area when compared to current levels.

State and local governments would collect additional sales tax from any increase in visitor spending, a beneficial impact for these agencies' budgets.

Implementing alternative D would result in additional short-term jobs during construction. The number and length of these positions would be commensurate with the magnitude and timing of construction phases. These jobs would have a slight beneficial impact on local socioeconomics while construction occurs.

Alternative D would require some additional monitoring and additional management and maintenance efforts to maintain the bridgeworks. Overall, the construction and expanded operations would have a beneficial impact the local socioeconomic conditions.

Cumulative Impacts

Related projects and their impacts to the affected environment under alternative D would be the same as those described for alternative A. Improvements within the national recreation area, regional development, and local restoration projects within Jamaica Bay would result in benefits to socioeconomic conditions around the refuge.

When the impacts on socioeconomic conditions under alternative D are combined with the impacts from other past, present, and reasonably foreseeable actions, alternative D would contribute a slight beneficial increment to the overall beneficial cumulative impact.

Conclusion

Alternative D would result in temporary and ongoing beneficial impacts to socioeconomic conditions around the refuge. These impacts would be primarily related to increased visitor spending from a slight increase in visitation related to restoration of the loop trail and improved opportunities for wildlife observation. Additional economic benefits would result from the addition of short-term jobs during construction and continued NPS spending and operations.

Cumulative impacts on socioeconomics would be beneficial because of the potential for increased visitor spending resulting from increased recreational activities within Gateway National Recreation Area and the potential for additional jobs and spending from future development and repairs in the area. Alternative D would contribute a slight beneficial increment as a result of a slight increase in visitation and the addition of a few short-term jobs during construction. When the impacts on socioeconomics under alternative D are combined with the impacts from other past, present and foreseeable future projects in Jamaica Bay, alternative D would contribute a slight beneficial increment to the overall beneficial cumulative impact.

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CHAPTER 4: CONSULTATION AND COORDINATION

The "Consultation and Coordination" chapter describes the public involvement and agency consultation used during the preparation of the environmental assessment. A combination of activities, including public scoping, internal workshops, and agency briefings, has helped to guide the NPS in developing this environmental assessment. This chapter provides a detailed list of the various consultations initiated during the development of the environmental assessment, as well as a list of preparers.

BRIEF HISTORY OF PLANNING AND PUBLIC INVOLVEMENT

Pursuant to Director's Order #12, the NPS has made a diligent effort to involve the interested and affected public in this National Environmental Policy Act process. This involvement, known as scoping, occurs at the beginning of the National Environmental Policy Act process to identify the range of issues, resources, and alternatives to address in the environmental assessment. Typically, both internal and public scoping is conducted to address these elements. State and federal agencies were contacted to uncover any additional planning issues and to fulfill statutory requirements, as described in the following sections.

INTERNAL SCOPING

The internal scoping process for the proposed project began in November 5, 2013, when representatives from the refuge, the FHWA EFLHD, the NPS Denver Service Center, and their consultants met to discuss the purpose and need of the project, potential alternatives that could meet these needs, and resource conditions and issues within the project area. The group also initiated plans for future agency and public scoping activities. Throughout the development of this environmental assessment, the group coordinated regularly to review relevant issues, discuss the development of alternatives and impact analysis, and further develop means of including agencies and the public in the planning process.

PUBLIC SCOPING

Public scoping for this project began in June of 2014 when a newsletter describing the project and the initial alternative concepts was sent to the national recreation area's mailing list and posted on the NPS Planning, Environment and Public Comment (PEPC) website. Additionally, an open house public meeting was held at the Jamaica Bay Wildlife Refuge Visitor Center in Queens, New York on July 17, 2014. It was estimated that 85 people were in attendance, with 55 signing in and obtaining a handout package. The official public comment period for the alternatives began on June 30, 2014, and concluded on July 30, 2014.

A stakeholder scoping meeting was held for the Gateway National Recreation Area West Pond environmental assessment on July 28, 2014. Stakeholders discussed various topics concerning the proposed project including salinity levels at West Pond, wildlife, Jamaica Bay, visitor experience, costs, visitor amenities, and the project timeline.

Additionally, a second public open house was held on January 22, 2015, to inform the public about the further developed alternatives. There were roughly 50 people in attendance.

More than 200 pieces of correspondence were received during the 31-day review period. Support for repairing the breach was expressed most commonly throughout the comments received. The three topics that received the majority of the comments were support for restoration to pre-Hurricane Sandy conditions, concerns regarding wildlife and wildlife habitat, and concerns regarding visitor use and experience.

These comments were taken into consideration during the development of alternatives presented in this environmental assessment. The interested public and agencies will have an opportunity to review and comment on this environmental assessment during a 30-day review period.

AGENCY CONSULTATION

AGENCY INVOLVEMENT

An agency scoping meeting was held for the Gateway National Recreation Area West Pond environmental assessment on July 16, 2014. This meeting was held to review the National Environmental Policy Act process, review the purpose, need, goals, and objectives for the project, and to review the project area and affected environment. Participants also identified impact topics to be evaluated in the environmental assessment, reviewed the preliminary alternative concepts, and identified agency protocols. During the meeting, the agencies discussed the impact topics and their input helped to provide information included in the affected environment sections presented in "Chapter 3: Affected Environment and Environmental Consequences."

A subsequent agency scoping meeting was held on May 21, 2015. This meeting was held to review the status of the project and the proposed alternatives. Participants identified concerns to be evaluated in the environmental assessment and identified agency protocols.

The NPS initiated scoping with multiple relevant agencies early in the planning process. Scoping information was sent to the New York Department of Environmental Protection, New York Department of State, New York State Department of Environmental Conservation, New York State Historic Preservation Officer, Federal Emergency Management Agency, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey, and the U.S. Natural Resource Conservation Service. This consultation is discussed in more detail below. Copies of the scoping letters and responses from the agencies, if applicable, can be found in appendix F.

SECTION 7 OF THE ENDANGERED SPECIES ACT

Section 7 of the Endangered Species Act requires federal agencies to consult with the U.S. Fish and Wildlife Service regarding the potential for proposed actions to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The NPS reviewed species data for the project area through the U.S. Fish and Wildlife Information, Planning and Conservation System. Subsequently, in a letter sent in March 2014, the NPS initiated informal consultation with the U.S. Fish and Wildlife Service about the presence of federally listed threatened or endangered species in the vicinity of the national recreation area. Based on information gathered during scoping and a review of the U.S. Fish and Wildlife Service Information, Planning and Conservation website, three federally listed species were originally considered to potentially have a presence within the project area: seabeach amaranth

(*Amaranthus pumilus*), piping plover (*Charadruis melodus*), and roseate tern (*Sterna dougallii dougallii*). The last recorded occurrence of the seabeach amaranth and piping plover within the project area was decades ago and therefore, they were not considered in the analysis. The northern long-eared bat (*Myotis septentrionalis*) and the red knot (*Calidris canutus ssp. rufa*) were listed during development of this document and were therefore added for analysis. Pursuant to the Endangered Species Act, the NPS would make a finding that the preferred alternative may affect but is not likely to adversely affect the red knot and roseate tern; and would have no effect on the northern long-eared bat.

The NPS would continue to coordinate with the U.S. Fish and Wildlife Service with regard to listed species.

SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the National Historic Preservation Act requires federal agencies to take into account the impacts of their undertakings on historic properties. At the onset of this environmental assessment process, in accordance with section 800. 3(c) of the Advisory Council on Historic Preservation's regulations (36 CFR 800), the national recreation area sent a letter to consult with the New York State Historic Preservation Officer to notify them that National Historic Preservation Act compliance would be conducted by the national recreation area separately but concurrent to the environmental assessment. Following this consultation, a historic resources survey inventory was completed at the West Pond project area. This survey concluded that the portion of the refuge on Rulers Bar Hassock, including East and West Ponds, was not eligible for listing as a cultural landscape in the National Register of Historic Places. A copy of the historic resources survey was sent to the State Historic Preservation Officer. In a letter dated September 18, 2014, the Deputy Commissioner for Historic Preservation concurred with the findings presented in the survey. As a result, the NPS will continue consultation with the State Historic Preservation Officer and tribes with an expected determination of "no historic properties affected" and send separate correspondence to the New York State Historic Preservation Office and tribes associated with the refuge for their review, comments, and concurrence.

SECTION 404 OF THE CLEAN WATER ACT AND RIVERS AND HARBORS ACT

The identification of wetlands and other waters of the U.S. within the project area is necessary to ensure their protection in accordance with federal laws (section 404 of the Clean Water Act and the Rivers and Harbors Act of 1899) and state laws. At the state and federal level, wetlands are defined as:

> "Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3[b]; 40 CFR 230.3[t]).

Wetlands, as separately classified ecosystems, are designated as a special aquatic site under section 404 of the Clean Water Act and are therefore a subset to waters of the U.S.

The NPS would continue to coordinate with reviewing agencies and complete the necessary permits to address section 404 concerns.

NATIONAL PARK SERVICE PROCEDURAL MANUALS #77-1 AND #77-2

Pursuant to NPS Procedural Manuals #77-1: *Wetland Protection* (NPS 2012), a wetlands statement of findings was developed and is included as appendix B. This statement of findings has been prepared in accordance with Executive Order 11990 (*Protection of Wetlands*) and NPS Director's Order #77-1. It summarizes the wetland delineation and functional analysis used to assess wetlands functions at West Pond. The statement of findings also describes how the use and modification of wetlands in the project area are essential for fulfilling the mission of the refuge and would increase functional values of essential wetlands functions.

Pursuant to NPS Procedural Manuals #77-2: *Floodplain Management* (NPS 2003), a floodplains statement of findings has been developed and is included as appendix A. The statement of findings has been prepared in accordance with Executive Order 11988 (Floodplain Management), NPS Director's Order #77-2, and Floodplain Management and Procedural Manual #77-2. It summarizes the floodplain development associated with actions to repair the primary and secondary breaches in the West Pond berm and restore freshwater habitat in West Pond. The statement of findings also describes the reasons why encroachment into the floodplain is required to implement the project, the site-specific flood risks involved, and the measures that would be taken to mitigate floodplain impacts. Appendix B provides a wetlands statement of findings in accordance with Executive Order 11990 (*Protection of Wetlands*) and NPS Director's Order #77-1. This statement of findings provides a detailed description of the assessment of wetland functions and impact projected for alternative B.

COASTAL ZONE MANAGEMENT ACT

The NPS would comply with the provisions of New York's Coastal Management Program (44 enforceable policies) and the New Waterfront Revitalization Program (10 policies) prepared under the Coastal Zone Management Act. As defined by the Coastal Zone Management Act, the actions subject to the enforceable polices of approved state management programs are any actions that (1) cause changes in the manner in which land, water, or other coastal zone natural resources are used, (2) cause limitations on the range of uses of coastal zone natural resources, or (3) cause changes in the quality or quantity of coastal zone natural resources. New York's coastal zone extends seaward from the mean high tide line to 3 nautical miles offshore and includes the project area. The NPS would review and coordinate the proposed action with the state.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The NPS would comply with the provisions of section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and its implementing regulations (50 CFR Part 600), which directs federal agencies to consult with the National Marine Fisheries Service on all actions or proposed actions that may adversely affect essential fish habitat. Adverse effects include the 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 ecosystem components, if such modifications reduce the quality or quantity of essential fish habitat. Adverse effects to essential fish habitat may result from actions occurring within or outside the essential fish habitat, and may include site-specific or essential fish habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires the National Marine Fisheries Service to recommend measures that may be taken by the action agency to conserve essential fish habitat. Because the analysis determined the adverse effects to essential fish habitat would have no more than a minimal impact (*de minimis* impacts) on habitats designated as essential fish habitat, the NPS would coordinate the proposed action with the National Oceanic and Atmospheric Administration Fisheries' Northeast Regional Essential Fish Habitat Coordinator.

SAFE DRINKING WATER ACT AND CLEAN WATER ACT

40 CFR 149 of the Safe Drinking Water Act deals with Environmental Protection Agency regulations on sole source aquifers. 40 CFR 133 of the Clean Water Act deals with the secondary treatment regulations and 1977 amendments of the Clean Water Act deal with conventional pollutants and nonconventional pollutants. In this instance conventional pollutants (i.e. Sec 304.(a) (4)) deals with conventional pollutants such as biological oxygen demand, suspended solids, fecal coliform, and pH levels. Groundwater is regulated under various New York State Department of Environmental Conservation and New York City Department of Environmental Protection statutes and requirements, including but not limited to York State Department of Environmental Conservation Part 701: Classifications-Surface Waters and Groundwaters, New York Environmental Conservation Law §15-1528 and the New York State Water Well Driller Registration Law. Several types of regulatory and administrative controls would be considered if withdrawal of groundwater was contemplated in the vicinity of West Pond for purposes of freshwater supply. A well permit from, and coordination with, the New York State Department of Environmental Conservation would be required for use of Long Island aquifers. For the NPS to obtain access to the municipal water supply, the NPS would coordinate with the New York State Department of Environmental Conservation who provides drinking water to residents of the City of New York in accordance with Rules of the City of New York Title 15, Chapter 20.

LIST OF PREPARERS AND CONTRIBUTORS

This document was prepared by Parsons with input from staff at Gateway National Recreation Area, the NPS Denver Service Center, and the NPS Northeast Regional Office.

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PUBLIC REVIEW

The environmental assessment will be on formal public and agency review for 30 days and has been distributed to a variety of interested individuals, agencies, and organizations. It also is available for public review on the NPS Planning, Environment, and Public Comment web site <http://parkplanning.nps.gov/gate>, and hard copies are available at the NPS headquarters at Floyd Bennett Field, the Ryan Visitors Center, the Floyd Bennett Visitor Center, and the Jamaica Bay Wildlife Refuge Visitor Center.

REFERENCES

GLOSSARY

ABAAS: Architectural Barriers Act Accessibility Standard

Anadromous Fish: Fish that spawn in freshwater, migrate to the ocean to grow up, and then return to freshwater to spawn and complete its lifecycle.

Aquifer: An underground geological formation able to store and yield water (see “Artesian,” “Confined,” and “Unconfined Aquifers”).

Artesian (or Confined) Aquifer: exist where the groundwater is bounded between layers of impermeable substances like clay or dense rock. When tapped by a well, water in confined aquifers is forced up, sometimes above the land surface.

Artesian Well: A well tapping a confined (or artesian) aquifer. Water in the well rises above the top of the aquifer under artesian pressure, but does not necessarily reach the land surface. When a well in which the water level is above the land surface (see "Pontiometric Surface"), a natural flow of water out of the well occurs. When water flows above the land surface the well is defined as a *flowing* artesian well.

Best Management Practices: Methods or techniques found to be the most effective and practical means in achieving the objective of preventing or minimizing an impact.

Confining Layer: Geologic material with little or no permeability or hydraulic conductivity. Water does not pass through this layer or the rate of movement is extremely slow.

Drawdown: A lowering of the groundwater level caused by pumping.

Dust Palliative: A substances applied to road/construction surface materials to reduce airborne dust.

Estuarine Wetlands: Wetlands classified under the Cowardin classifications system as non-oceanic wetlands influenced by tidal flows.

Exotic Species: Alien species, native to another part of the world and introduced, intentionally or accidentally.

Fetch: The maximum distance of open water over which the wind can blow unobstructed. Waves with the highest energy levels will result from a combination of a long fetch and a consistent dominant wind blowing in the same direction. In simple terms, the bigger the fetch, the bigger the wave.

Groundwater: Water found in the spaces between soil particles and cracks in rocks underground located in the saturation zone. Cracks in rocks can be due to joints, faults, etc. Groundwater is a natural resource that is used for drinking, recreation, industry, and growing crops.

Hydraulic Conductivity: A measure of a material's capacity to transmit water. It is independent of the thickness of that material. See "Transmissivity" for related definition. Another term for hydraulic conductivity is "coefficient of permeability".

Impermeable Layer: A layer of material (such as clay) in an aquifer through which water does not pass or passes extremely slowly.

Infiltration: Flow of water from the land surface into the subsurface.

Infiltration Rate: The quantity of water that enters the soil surface in a specified time interval. Often expressed in volume of water per unit of soil surface area per unit of time.

Lacustrine Wetlands: Wetlands classified under the Cowardin classifications system as open freshwater systems.

Marine Wetlands: Wetlands classified under the Cowardin classifications system as wetlands associated with oceanic environments.

Net Construction Cost: The estimated cost of all labor, equipment, and materials required for construction of the proposed project (the bricks and mortar) in addition to mark-ups that include the location factor, design contingency, general conditions, and overhead and profit. Design contingency relates to the accuracy of the definition of scope of work. General conditions include everything the construction contractor is required by contract to provide or perform in excess and in order to provide contracted work.

Palustrine Wetlands: Wetlands classified under the Cowardin classifications system as freshwater wetland systems.

Potentiometric Surface: The potential level to which water will rise above the water level in an aquifer in a well that penetrates a confined aquifer; if the potential level is higher than the land surface, the well will overflow. See "Artesian Well" and "Confined Aquifer".

Pumping Test: Evaluation of an aquifer by "stimulation" through controlled pumping and observing the aquifer's "response" (drawdown) in the production and observation wells. Also "aquifer test". As opposed to "pump test" which measures the performance of a pump.

Recharge: Water added to an aquifer. For example, when rainwater seeps into the ground. Recharge may occur artificially through injection wells or by spreading water over groundwater reservoirs.

Recharge Rate: The quantity of water per unit of time that replenishes or refills an aquifer.

Resiliency: The ability of natural systems and constructed infrastructure to withstand the forces of large storms, to quickly recover, and/or efficiently and cost-effectively be restored or reconstructed.

Restoration: Defined by the National Research Council in its 1992 “Restoration of Aquatic Ecosystems”, restoration is defined as the “return of an ecosystem to a close approximation of its condition prior to disturbance.” This concept is further clarified by defining many types of restoration-related activities (USEPA 2015).

Restoration of Wetlands: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to former or degraded wetland. For purposes of tracking net gains in wetland acres, restoration is divided into reestablishment and rehabilitation (USEPA No date). The NPS defines restoration of wetlands under the NPS Procedural Manual #77-1: Wetland Protection, section 4.2.1 (h) Actions designed to restore degraded (or completely lost) wetland, stream, riparian, or other aquatic habitats or ecological processes. For this exception, “restoration” refers to reestablishing environments in which natural ecological processes can, to the extent practicable, function as they did prior to disturbance (NPS 2012). The NPS further defines wetland mitigation terms in NPS Procedural Manual #77-1: Wetland Protection (NPS 2012).

Riverine Wetlands: Wetlands classified under the Cowardin classifications system as wetlands associated with rivers, streams and drainage features.

Semidiurnal Tide: The predominant type of tide throughout the world is semidiurnal, with two high waters and two low waters each tidal day. These tides are mixed semidiurnal, meaning that there are two unequal low and high tides each day

Sustainability: The minimal use of energy, materials, and labor over time to ensure reduced long-term depletion of nonrenewable resources.

Transmissivity: A measure of the capability of the entire thickness of an aquifer to transmit water. In other words, it is product of hydraulic conductivity and aquifer thickness. Also "coefficient of transmissivity". Technically defined as the rate of flow at which water is transmitted through a unit width of the saturated thickness an aquifer under a unit hydraulic gradient. In the English Engineering system it is flow in gallons per minute through the vertical section of an aquifer one foot wide and extending the full saturated height of an aquifer under a hydraulic gradient of 1.

Unconfined Aquifers: An aquifer in which the water table is at or near atmosphere pressure and is the upper boundary of the aquifer. Because the aquifer is not under pressure the water level in a well is the same as the water table outside the well.

Water Table: The top of an unconfined aquifer; indicates the level below which soil and rock are saturated with water. See "Potentiometric Surface" for definition of water level of confined aquifer.

Watershed: When rain or snowmelt saturates the ground, the excess water becomes runoff that eventually collects in a stream channel, lake, reservoir, bay, ocean, or other water body. The collection area from where all this water drains is called the drainage basin or watershed. A watershed is the area of land where all the water under it or drains off of it goes to the same place.

Well: A bored, drilled or driven shaft, or a dug hole whose depth is greater than the largest surface dimension and whose purpose is to reach underground water supplies to inject, extract or monitor water.

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APPENDIX A: FLOODPLAINS STATEMENT OF FINDINGS

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Floodplains Statement of Findings

INTRODUCTION

Jamaica Bay is one of the largest coastal wetland ecosystems in the region and is part of a series of tidal estuaries extending along the Atlantic coast. The rich biodiversity that characterizes the Jamaica Bay ecosystem is derived from a mosaic of estuarine features-- open water, mud flats, low and high saltmarshes and intertidal beaches with small areas of freshwater wetlands in adjacent upland habitats. These wetlands are interfaces between the open water and land, and serve many essential ecological functions such as wave and storm surge protection, wildlife habitat, nutrient cycling, and sediment trapping.

Prior to the intensive development of the Jamaica Bay watershed, the bay supported an estimated 16,000 acres of saltmarsh. Initially, saltmarshes of Jamaica Bay were used by settlers as pastureland, which were later filled for development. Large expanses of saltmarsh were used as landfills, some of which were later converted to parks or commercial and residential uses.

Within this setting, West Pond was constructed in 1954 when a dike was constructed and the Goose Creek Channel was impounded. West Pond is located at Jamaica Bay Wildlife Refuge (refuge) within the Jamaica Bay Unit of Gateway National Recreation Area. The NPS manages West Pond and the surrounding area as a wildlife refuge, the only such designation with the National Park Service (NPS) system. The national recreation area is proposing to repair a breach in the West Pond berm sustained during Hurricane Sandy in October 2012 and restore freshwater habitat.

This statement of findings has been prepared in accordance with Executive Order 11988 (Floodplain Management), NPS Director's Order #77-2, and Floodplain Management and Procedural Manual #77-2. The statement of findings summarizes the floodplain development associated with actions to repair a breach in the West Pond berm and restore freshwater habitat in West Pond. The national recreation area and West Pond project location are shown on figures 1 and 2. The statement of findings also describes the reasons why encroachment into the floodplain is required to implement the project, the site-specific flood risks involved, and the measures that would be taken to mitigate floodplain impacts.

Brief Description of the Proposed Action

The proposed action emphasizes repair of the primary and secondary breaches and the subsequent restoration of West Pond and the loop trail. Three options are considered under this alternative. A groundwater well or municipal water supply would be installed and the water control structure would be replaced to shift the current salinity from an estuarine system (saline) to levels closer to a palustrine system (freshwater), aided by precipitation and surface water runoff contributions from upland areas. The third option would consider relying solely on freshwater replenishment to West Pond from natural precipitation and runoff. This alternative would include replacement of the water control structure and use of best management practices to improve seasonal use by wildlife and opportunities for recreation and interpretive activities. Alternative B would be implemented in phases, with phase 1 addressing filling and repairing the primary and secondary breaches, replacing the water control structure, installing a groundwater well to provide freshwater to the pond, and restoring the West Pond loop trail. Future phases would include upland habitat restoration at Terrapin Point; shoreline restoration, saltmarsh restoration; and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage). In addition to maintaining the berm and repairing the primary and secondary breached areas, shoreline habitat and salt marsh restoration outside the primary breach would serve as an additional measure to increase resiliency against potential future storm damage. This habitat would create a breakwater to reduce the effects of tidal wave action.

Figure 1: Gateway National Recreation Area and the Jamaica Bay Wildlife Refuge Map

Figure 2: West Pond Project Area

Brief Site Description

Gateway National Recreation Area, established in 1972, consists of three administrative units: Staten Island, Sandy Hook, and Jamaica Bay. The refuge is located within the Jamaica Bay Unit. The Jamaica Bay Unit includes West Pond and is one of the largest expanses of open space in the region, consisting of over 19,000 acres of land, bay, and ocean waters within the densely populated and urban areas of Brooklyn and Queens, New York.

This entire area is located within the Jamaica Bay watershed. The Jamaica Bay watershed is located at the southwestern tip of Long Island. It falls within the broader Atlantic Ocean/Long Island Sound watershed which consists of approximately 91,000 acres (142 square miles) and includes portions of Brooklyn, Queens, and Nassau County, New York. Jamaica Bay itself encompasses approximately 13,000 acres ranging from brackish to saline conditions with an average depth of 13 feet and a tidal range of about 4.9 feet. The center of the bay is dominated by sub-tidal open water and extensive low-lying islands composed of saltmarsh, tidal flats, mudflats, and adjacent uplands.

Within Jamaica Bay, the refuge encompasses approximately 9,000 acres that include the bay itself, several island, two brackish ponds (East Pond and West Pond –now breached), trails, and a visitor center. The refuge is composed of saltmarsh, natural inlets, grassy hassocks, sand dunes, small beaches, and upland habitats. It is located along the Atlantic flyway and is a significant bird sanctuary with sightings of over 300 species of songbirds, shorebirds, and waterfowl over the last 30 years. The shoals, bars, and mud flats provide habitat for a number of small mammals, reptiles, and amphibians. The refuge provides opportunities for recreation, scenic vistas, birding, visitor orientation, environmental education, national recreation area maintenance, and ranger operations.

The study area includes West Pond and the surrounding area west of the visitor center. The West Pond area is largely undeveloped. Facilities in the study area include trails around West Pond, a visitor center, gardens, and viewing areas with benches. West Pond was approximately 44 acres and approximately 3 to 4 feet deep prior to Hurricane Sandy. West Pond was breached during Hurricane Sandy, allowing waters from Jamaica Bay to flow unabated into the pond thereby changing habitat conditions in and around the pond. The east and west banks of the breach continue to erode with tidal and storm activity.

Originally owned and managed by New York City, East Pond, West Pond, and the surrounding landscape was created when Park Commissioner Robert Moses established the two ponds. The Jamaica Bay Bird Sanctuary was established in the 1950s by New York City, and was renamed Jamaica Bay Wildlife Refuge in 1972 when it was incorporated into the national recreation area under NPS administration.

General Characterization of Floodplain Values and of the Nature of Flooding and Associated Floodplain Processes in the Area

Jamaica Bay is one of the largest coastal wetland ecosystems in the region and is part of a series of tidal estuaries extending along the Atlantic coast. The rich biodiversity that characterizes the Jamaica Bay ecosystem is derived from a mosaic of estuarine features-- open water, mud flats, low and high saltmarshes and intertidal beaches with freshwater wetlands in adjacent upland habitats. These wetlands are interfaces between the open water and land, and serve many essential ecological functions such as wave and storm surge protection, wildlife habitat, nutrient cycling, and sediment trapping. However, large expanses of saltmarsh were used as landfills, some of which were later converted to parks or commercial and residential uses. Human disturbances, including these and other historical land uses, dredge and fill activities of the bay (including East and West Ponds) and marshes, hard-edged constructed shorelines, ongoing urban development have changed the nature and functionality of the floodplain in the project area. The project area is located within the Coastal Barrier Resources System. As defined by the Coastal Barrier Resources Act, an "undeveloped coastal barrier" is a “depositional geologic feature that is subject to wave, tidal and wind energies; and protects landward aquatic habitats from direct wave attack”.

JUSTIFICATION FOR USE OF THE FLOODPLAIN

A. Description of Why the Proposed Action Must be Located in the Floodplain

This project would reestablish West Pond to freshwater habitat, which has become rare in the region. Freshwater habitat has largely been replaced within the Jamaica Bay watershed by urban development. West Pond and the surrounding area are located entirely within the 100-year floodplain and as such is the only practicable location for the proposed action. The purpose of this project is to provide a solution to future erosion of the berm and damage to the trail while enhancing visitor experiences within the West Pond trail area that supports a diversity of Jamaica Bay habitats and wildlife. The proposed project is needed for the following reasons:

- Conditions in the area around the breach and the portion of West Pond loop trail that previously crossed the embankment (berm) are not currently safe for public access.
- The existing breached condition is vulnerable to reoccurring storm activity and susceptible to future damage from erosion.
- Opportunities for universal access by visitors from near and far to the West Pond loop trail to view wildlife, enjoy the bay, and learn about the resources are limited.
- The refuge does not currently provide habitat that supports a diversity of species in an environment that is resilient to erosion from storms by sustainable means.

The Jamaica Bay Unit of Gateway National Recreation Area is one of the largest expanses of open space in the region, consisting of over 19,000 acres of land, bay, and ocean waters within two boroughs of New York City: Brooklyn and Queens. Special mandates in the national recreation area’s enabling legislation include conservation and management of wildlife and natural resources in the Jamaica Bay Unit. This mandate states that the Secretary shall administer and protect the islands and waters within the Jamaica Bay Unit with the primary aim of conserving the natural resources, fish, and wildlife located therein and shall permit no development or use of this area which is incompatible with this purpose. Repairing the breach and maintaining freshwater would have beneficial impacts to vegetation, the species that depend on these habitat conditions, wetland habitats, and floodplains values.

B. Investigation of Alternative Sites

Because the purpose of the project is to provide for environmentally sensitive and resilient conditions and enhanced visitor experiences within the West Pond trail area that support a diversity of Jamaica Bay habitats and wildlife, there is no practicable alternative to undertaking this particular action outside the floodplain in an alternative location. The efforts undertaken under the proposed action would benefit the floodplain once restoration efforts were completed, installation of living shoreline and saltmarsh efforts outside the berm were completed, established, and able to function by absorbing storm energy and storing water.

DESCRIPTION OF SITE-SPECIFIC FLOOD RISK

A. Recurrence Interval of Flooding at the Site

The Federal Emergency Management Agency maps flood hazard areas, which are locations on the landscape with a greater than 1% chance of flooding within any given year. After Hurricane Sandy, flood zone maps, known as flood insurance rate maps (FIRMs) were revised and preliminary maps made available to the public on December 5, 2013. The Federal Emergency Management Agency released revised maps in January 2015 (see figure 3). These maps show the entire West Pond area within the 100-year floodplain, with the exception of an upland area on Terrapin Point and the area along Cross Bay Boulevard encompassing the visitor's center. The outer areas that include low marshes are considered to be within the coastal flood zone with a "wave action velocity hazard." Base flood elevations within these areas range from 12 to 13 feet. Relatively more protected flood zone areas without the velocity hazard have base flood elevations at 11 feet (FEMA 2015).

In 2013, the U.S. Fish and Wildlife Service updated maps produced through the Coastal Barrier Resources System (CBRS), originally produced in the 1980s. The comprehensive revision of maps along the Atlantic coast is intended to assist federal agencies' compliance with the Coastal Barriers Resources Act. This legislation, signed into law in 1982, designated relatively undeveloped coastal barriers as part of the CBRS, and made these areas ineligible for most new federal expenditures and assistance. West Pond was added to the CBRS in 1991 (FEMA 2015).

B. Hydraulics of Flooding at the Site (Depths, Velocities)

During Hurricane Sandy, a combination of high tides, wind-blown waves, and the enormous circulation of the superstorm pushed water to a peak surge of nearly 14 feet (NPS 2014). Its amplified wave height and reach, along with strong winds, pushed sand across roads, parking lots, and structures, flooded structures and destroyed machinery, and took beach sands with it as it receded, resulting in a patchwork of coastal erosion and inland areas covered in sand. Although tropical cyclones like Hurricane Sandy primarily flood coastal areas where the storm comes ashore, seasonal storms can cause much wider-ranging damage and major coastal erosion (NPS 2014).

During the Hurricane, West Pond, which comprises approximately 44 acres and is approximately 3 to 4 feet deep, was fully breached at the southeast corner and a potential secondary breach is likely along the southwestern edge of the pond. The resulting sea water inundation has increased the salinity, created tidally influenced conditions, and changed habitat composition within the pond. West Pond trail along the top of the berm of the pond was breached and other portions of the trail were damaged.

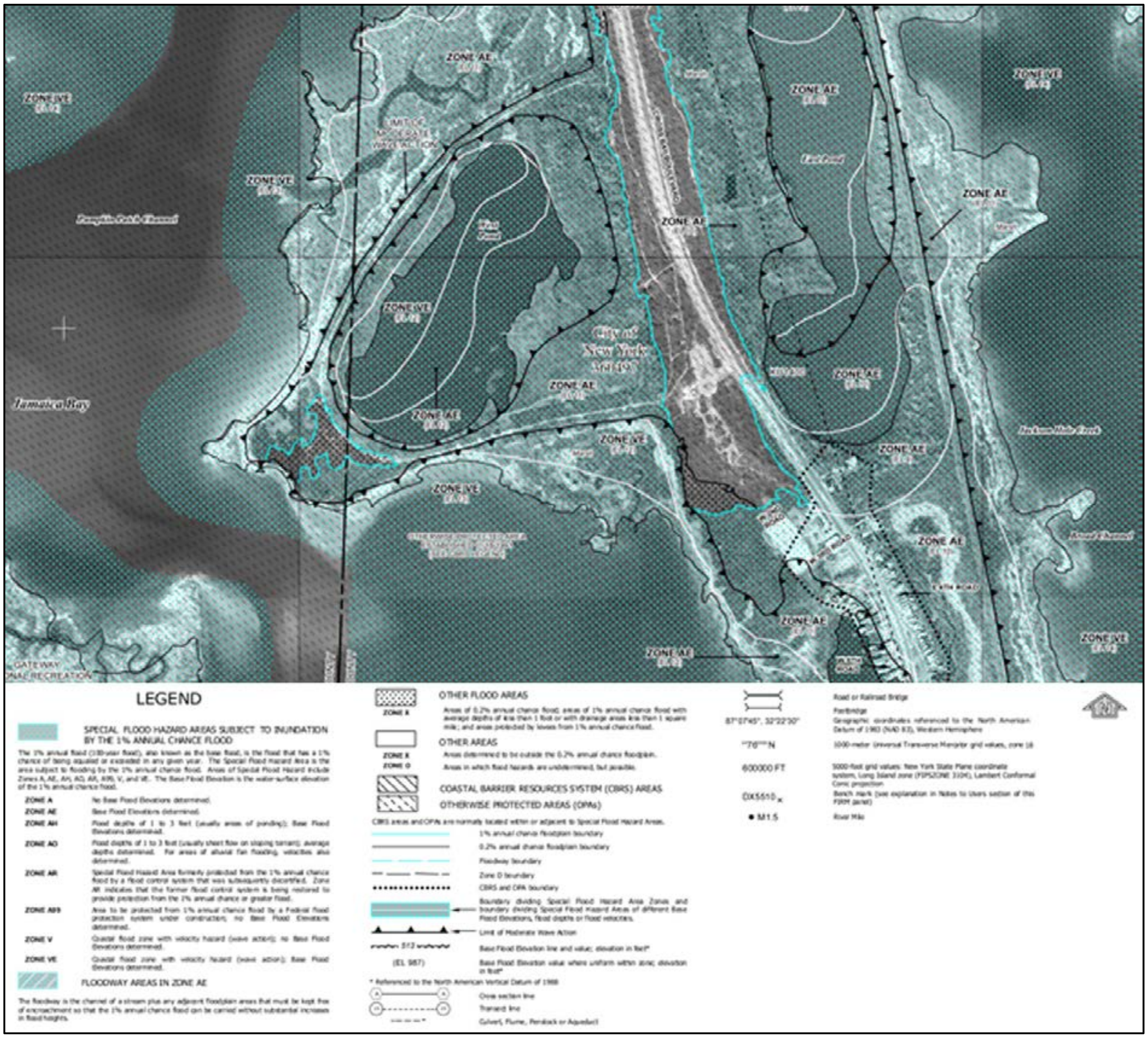

Figure 3: FEMA Flood Insurance Rate Map 3604970377G – Revised January 30, 2015

C. Time Required for Flooding to Occur (Amount of Warning Time Possible)

The berm surrounding West Pond does not have much vertical relief; roughly a 6-7 foot elevation above mean sea level and the majority of the Pond is protected by wetlands providing valuable water storage. Flooding generally occurs in the project area as a result of storm surge, making storm and marine warnings a practical option for protection of human life. Flash flooding is not likely in this area.

D. Opportunity for Evacuation of Site in the Event of Flooding

Evacuation of West Pond once weather and marine warnings are issued would occur via actions taken at the refuge visitor center. Circling West Pond is a trail leading to the visitor center parking area lot located off Cross Bay Boulevard. The NPS would close the parking lot to visitors as necessary and appropriate. Cross Bay Boulevard is a median-divided boulevard connecting Rockaway Peninsula to Queens. This road is one of three hurricane evacuation routes for the residents of the Rockaway Peninsula. It is also served by Metropolitan Transportation Lines bus routes.

E. Geomorphic Considerations (Erosion, Sediment Deposition, Channel Adjustments)

Flooding in the area of West Pond can range from minor overwash events from high tides to major flooding from hurricanes and other coastal storms. Excessive precipitation can also flood low elevation areas across the floodplain. Major storms can drive ocean storm surges completely across Jamaica Bay, dramatically changing habitats as well as the entire landscape. As storm winds and waves scour away sand and sediments from one location, they are deposited in new areas as coastal dynamics can reform the area. Storm surge combined with a high tide can breach the islands and create new inlets. As demonstrated by Hurricane Sandy in 2012, Jamaica Bay is extremely vulnerable to coastal flood events. Scouring and soil erosion of the inlet walls is occurring at the breach location and it is widening the breach. Eroding soils and sediments have been transported through the breach into the pond and out into the bay where they are settling and creating shoals. However, the area supports a number of natural features that reduce flooding severity. For example, estuarine wetlands along the shoreline provide various functions, such as flood flow storage and sediment retention.

DESCRIPTION AND EXPLANATION OF FLOOD MITIGATION PLANS

Under the proposed action, West Pond would be repaired similar to pre-Hurricane Sandy conditions. These actions would have beneficial impacts on floodplains because the berm would be replaced and would provide protection from storm surges and decrease fetch and better protect facilities. This action would increase protections for people and structures by decreasing fetch, thereby decreasing the potential for storm surge to reach permanent infrastructure (e.g., the visitor center). Alternative B would also have beneficial effects on wetlands because the repaired breaches would protect wetlands inside the berm from wave action and the enable park staff additional capacity to manage the hydrology within West Pond to improve wetland and floodplain function.

Alternative B (the preferred alternative) would include restoration efforts to establish high saltmarsh vegetation (e.g., saltmarsh cordgrass) outside the primary breach location, as well as provide resiliency measures to further protect the berm from future erosion. These resiliency measures to protect the berm would include the restoration of an estimated 5 acres of high salt marsh within the subtidal estuarine areas outside of the berm. These estimates have been based solely on a conceptual design and final engineering plans have not been completed.

The existing estuarine wetlands found inside the West Pond berm would be isolated from tidal influence once the primary and secondary breaches are repaired. The addition of a groundwater well or municipal water source for freshwater supply to West Pond would cause the area to shift from estuarine, tidally influenced habitat to freshwater habitat. This would be a more gradual transition if the pond is maintained by freshwater replenishment from natural precipitation and runoff only. These efforts are designed to dissipate water energy and flows, encourage deposition of sediment, and create freshwater habitat. Filling the breach and stabilizing the banks, and restoring vegetation would mitigate flood impacts because root systems would stabilize soils and sediments by anchoring them vertically and laterally in both wetland and upland habitats. These efforts would make soils and sediments less vulnerable to erosion and storm impacts because they have been bound and retained within the roots of the vegetation. This would slow the erosion of exposed areas, accelerate the process of soil and sediment recovery, and create a more stable configuration.

A. Measures to Reduce Hazards to Human Life and Property to the Regulatory Floodplain Level, while minimizing the impact to the Natural Resources of the Floodplain, Including the Use of Non-structural Measures as Much as Practicable

Conditions associated with flooding at this location are not considered particularly hazardous to people or property. Flooding generally occurs in the project area as a result of storm surge, making weather/marine warnings and evacuation a practical option for protection of human life.

B. Acknowledgement that Structures and Facilities are Designed to be Consistent with the Intent of the Standards and Criteria of the National Flood Insurance Program (44 CFR Part 60).

The NPS would ensure that the final engineering designs are approved and the project would receive all necessary permits from those governmental agencies from which approval is required by Federal or State law. These permits would ensure consistency with 44 CFR Part 60.

SUMMARY

A statement of findings is prepared if the action falls within the defined regulatory floodplain:

- Class I includes the location or construction of administrative, residential, warehouse and maintenance buildings, non-excepted parking lots or other man-made features, which by their nature entice or require individuals to occupy the site, are prone to flood damage, or result in impacts to natural floodplain values. Actions in this class are subject to the floodplain policies and procedures if they lie within the 100-year regulatory floodplain (the Base Floodplain).

- Class II includes "critical actions"–those activities for which even a slight chance of flooding would be too great. Examples of critical actions include schools, hospitals, fuel storage facilities, irreplaceable records, museums, and storage of archeological artifacts. Actions in this class are subject to the floodplain policies and procedures if they lie within the 500-year regulatory floodplain.
- Class III includes all Class I or Class II actions that are located in High Hazard Areas, including coastal high hazard areas and areas subject to flash flooding. Actions in this class are subject to the floodplain policies and procedures if they lie within the Extreme Flood regulatory floodplain.

In accordance with NPS Procedural Manual 77-2 (Floodplain Management), the repair and restoration activities proposed under the preferred alternative is a "Class III" action. These actions include activities that require construction within flood prone areas, but exclude infrastructure that are permanently occupied. Class III actions allow for trails, viewing platforms, and picnic and rest areas, with appropriate signage to warn visitors of flood hazards.

The NPS finds that the repair of the breached berm at West Pond and freshwater control structures and groundwater supply and management actions to maintain habitats within West Pond are essential for public use and safety, despite the fact that the actions would be located in flood-prone areas. The NPS also finds that in repairing the berm, there are no practicable alternatives to enhance resiliency outside of the floodplain since the entire West Pond is within the 100-year floodplain. This project is consistent with the policies and procedures of NPS Director's Order #77-2 (Floodplain Management) and Executive Order 11988.

REFERENCES

Federal Emergency Management Agency (FEMA)

2015 Flood Insurance Rate Map, City of New York, New York. Panel 377 of 457. Map Number 3604970377G. Revised Preliminary Map, Released January 30, 2015.

National Park Service (NPS)

2003 Director's Order #77-2: Floodplains Management. Washington, DC: NPS Office of Policy. Approved September 8, 2003.

2014 *A New Vision for a Great Urban National Park Gateway National Recreation Area Final General Management Plan / Environmental Impact Statement*. April.

New York City Department of Environmental Protection

2007 *Jamaica Bay Watershed Protection Plan*. Volume 1. October 1, 2007.

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APPENDIX B: WETLANDS STATEMENT OF FINDINGS

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Wetlands Statement of Findings

INTRODUCTION

Jamaica Bay is one of the largest coastal wetland ecosystems in the region and is part of a series of tidal estuaries extending along the Atlantic coast. The rich biodiversity that characterizes the Jamaica Bay ecosystem is derived from a mosaic of estuarine features-- open water, mud flats, low and high saltmarshes and intertidal beaches with freshwater wetlands in adjacent upland habitats. These wetlands are interfaces between the open water and land, and serve many essential ecological functions such as wave and storm surge protection, wildlife habitat, nutrient cycling, and sediment trapping.

Prior to the intensive development of the Jamaica Bay watershed, the bay supported an estimated 16,000 acres of saltmarsh (U.S. Fish and Wildlife Service 1997). Initially, saltmarshes of Jamaica Bay were used by settlers as pastureland, which were later filled for development. Large expanses of saltmarsh were used as landfills, some of which were later converted to parks or commercial and residential uses (NYCDEP 2007).

Within this setting, West Pond was constructed in 1954 when a dike was constructed and the Goose Creek Channel was impounded. Gateway National Recreation Area manages West Pond and the surrounding area as a wildlife refuge, the only such designation with the National Park Service (NPS) system. The national recreation area is proposing to repair a breach in the West Pond berm sustained during Hurricane Sandy in October 2012 and restore freshwater habitat.

This statement of findings has been prepared in accordance with Executive Order 11990 (*Protection of Wetlands*) and NPS Director's Order #77-1.

PREFERRED ALTERNATIVE PROPOSED ACTION

The (NPS) at Gateway National Recreation Area proposes to address storm damages to West Pond and the trail at Jamaica Bay Wildlife Refuge (refuge) within the Jamaica Bay Unit. The proposed action would restore West Pond to pre-Hurricane Sandy conditions. Figure 1 presents a conceptual design of the proposed action to repair the breach and improve habitat conditions. The representation of proposed features is presented as conceptual at this stage and the features identified on figure 1 are not to scale.

The primary and secondary breaches at West Pond would be repaired. West Pond and the loop trail would be restored. This alternative would also include replacing the water control structure, possible installation of a groundwater well or municipal water source, and implementation of resource management strategies to improve seasonal use by wildlife. Alternative B would be implemented in phases, with phase 1 addressing filling and repairing the primary and secondary breaches, replacing the water control structure, installing a groundwater well or connecting to a municipal water source to provide freshwater to the pond, and restoring the West Pond loop trail. Future phases would include upland habitat restoration at Terrapin Point by thinning vegetation and treating invasive species; shoreline and saltmarsh restoration to increase the ability to withstand adverse impacts from storm events; and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage).

Detailed pond design and planning would be completed subsequent to the environmental assessment. Best management practices as described in appendix 2 of the NPS Procedural Manual #77-1 (NPS 2012) and site specific mitigation measures detailed in section 2 of the environmental assessment would be implemented.

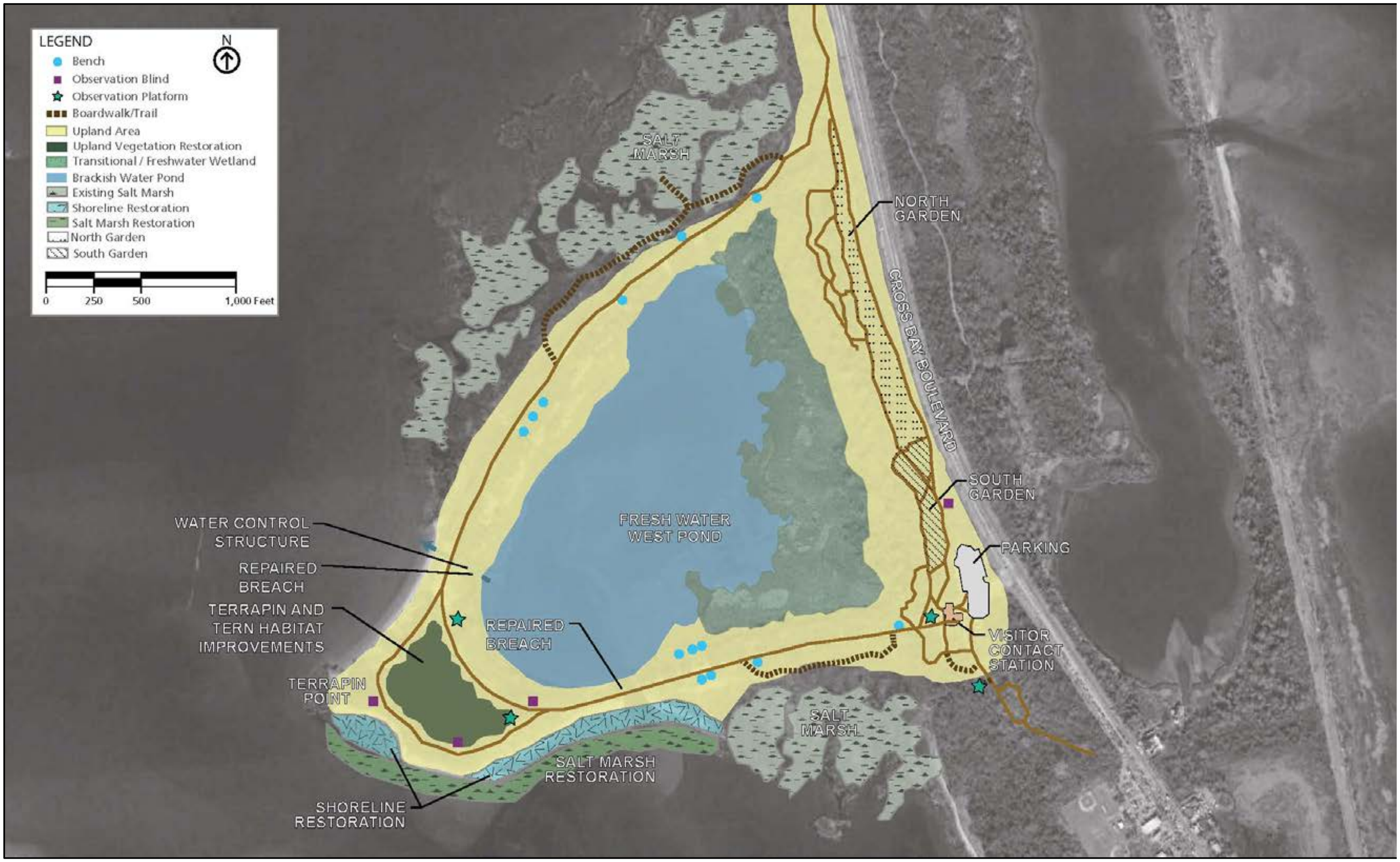

Figure 1: Conceptual Representation of Proposed Action

Phase 1 would include in-kind repair of the primary and secondary breach areas of West Pond, in-kind replacement of the water control structure, and in-kind repair the loop trail that surrounds West Pond to restore visitor access as defined in section 4.1.2(g) of the NPS Procedural Manual #77-1 (NPS 2012). In addition, a groundwater well or municipal water source would be installed to artificially supply freshwater to West Pond for wildlife management purposes. Natural replenishment (precipitation and runoff) and the water supply would support freshwater wetland habitat, unique resources for wildlife in the region. There would have been hundreds, if not thousands of areas of brackish wetland systems that would have surrounded the bay prior to European settlement and the development of New York City. Therefore, freshwater would be pumped into West Pond in order to maintain an example of brackish marsh habitat. No habitat restoration activities would occur within the interior of West Pond as this area would rely on natural recruitment of plant and animal species.

During future phases, visitor amenities such as birding platforms/observation areas, boardwalks, and educational signs would be constructed and in the wetland areas. The boardwalk would require review for compliance with DO 77-1 Wetland Protection prior to construction. In the future, habitat restoration actions would be proposed for Terrapin Point upland area. A trail would be constructed around the Point to provide visitor access in this area. Terrapin and tern nesting habitat would be created along the shoreline around Terrapin Point. Habitat restoration would include resource management measures to reduce the shrub layer and the reestablishment of beach habitat along the edge of the western end of the site. Measures to increase resistance against potential future beach erosion from storm damage would include constructing a high salt marsh offshore of the repaired breach. Restoration would include shoreline armoring and high saltmarsh tidal wetlands that would be established along the southern edge of the berm. This compensatory mitigation habitat would create a breakwater to reduce the effects of tidal wave action.

Details of the high marsh restoration (hydrologic restoration, excavation, grading, plantings, etc.) are not available at this conceptual stage of the project. The anticipated schedule for completion has not been clearly defined and therefore, the anticipated time-frame for full function of the saltmarsh wetlands would be dependent upon final design details. Multiple growing seasons would be anticipated before wetlands would be fully functioning. Monitoring and maintenance requirements and schedule would also be determined in follow-on detailed design.

ALTERNATIVES CONSIDERED

Elements of the four alternatives considered to fulfill the proposed action are described in the environmental assessment. Each alternative provides varying measures that contribute to resiliency and sustainability of the project. There are a variety of components that would be implemented under all action alternatives. The alternatives are:

Alternative A: No-action Alternative / Continue Current Management

Under alternative A, no additional measures would be taken to alter the state of the primary or secondary breached areas or the integrity of the berm over time. Natural processes would proceed uninhibited. This alternative would represent a continuation of current actions in the West Pond area without any modifications to water resource conditions, habitat enhancements, or marshland restoration.

Alternative B: The NPS Preferred Alternative

Alternative B would be implemented in phases, with phase 1 addressing filling and repairing the primary and secondary breaches, replacing the water control structure, installing a groundwater well, or municipal water supply to provide freshwater to the pond, and restoring the West Pond loop trail.

Three options were considered under this alternative. A groundwater well or municipal water supply would be installed and the water control structure would be replaced to shift the current salinity from an estuarine system (saline) to levels closer to a palustrine system (freshwater), aided by precipitation and surface water runoff contributions from upland areas. This would allow national recreation area staff to manage freshwater levels within West Pond. It would take an estimated 174 days to fill West Pond when considering both natural water inflow from precipitation combined with inflow from groundwater pumping or the municipal drinking water source. The third option of this alternative would consider relying solely on freshwater replenishment to West Pond from natural precipitation and runoff. Relying only on natural precipitation and runoff, would result in a more gradual transition to freshwater conditions within West Pond over approximately one year.

Future phases of work would include upland habitat restoration at Terrapin Point, shoreline and saltmarsh restoration to increase resiliency against potential future storm damage, and installation of other visitor amenities (such as boardwalks, trails, pathways, viewing blinds, and educational signage).

Alternative C: Create Different Types of Habitat

Alternative C would entail reconfiguring the site to construct a new berm further inland thereby establishing a smaller, more inland West Pond and converting Terrapin Point into an island. The new configuration would create a mosaic of wetland and upland habitat types to support a diversity of species across the study area. A groundwater well would be installed and the water control structure would be replaced in the vicinity of the reconfigured West Pond to establish freshwater conditions, aided by precipitation and surface water runoff contributions from upland. It would take an estimated 122 – 139 days to fill West Pond when considering both natural water inflow from precipitation combined with inflow from groundwater pumping.

Alternative D: Bridge the Breach

Under alternative D, the primary breach would be bridged to restore the loop trail around West Pond and the banks of the primary and secondary breaches would be stabilized. Two different structures to span the breach would be considered, a steel truss bridge or a box culvert, both of which would continue to allow for tidal conveyance within West Pond. As a result, salinity levels in West Pond would remain similar to those in Jamaica Bay and wetland conditions and species composition would continue to shift in response.

NPS preferred alternative, would cause the most short-term impacts to wetlands. The justification for 2.4 acres of wetland impacts centers around the sustainment of freshwater wetland habitat in the west pond, and the enhancement of visitor use experience. Of the 2.4 acres of impacts 2.2 acres are required to fill the primary breach, and 0.2 acres of fill is required to fill the secondary breach. Filling the primary breach would enable the restoration of connectivity to the trail and hydrologically separate the estuary from west pond enabling a freshwater habitat to be created.

A variety of engineered shoreline stabilization options were considered as defensive measures to protect the berm against future storm surge and erosion at the location of the existing primary breach. Options included hardscape, such as cobble, rock toes, cross vanes, rock or concrete sea walls, rip rap, and other types of armoring the shoreline. However, the NPS preferred the proposed shoreline/marsh restoration. This restoration includes the fill in the intertidal zone to restore approximately 5 acres of high saltmarsh (saltmarsh cordgrass) outside and south of the primary breach location. The restored marshland would be configured to match the predisturbance size and grade. This compensatory mitigation habitat would create a breakwater to reduce the effects of tidal wave action. Armoring along the toe of slope would be installed to protect the existing berm from scour and planted with native species. The beach and intertidal area temporarily impacted during construction would be restored with native soils and reseeded with native vegetation. Based on concept drawings the width of the berm and adjacent marshland would be approximately 650 linear feet and 250 feet wide totaling approximately 3.7 acres.

SITE DESCRIPTION

Jamaica Bay encompasses approximately 13,000 acres ranging from brackish to saline conditions with an average depth of 13 feet and a tidal range of about 4.9 feet. The center of the bay is dominated by sub-tidal open water and extensive low-lying islands composed of saltmarsh, tidal flats, mudflats, and adjacent uplands. The refuge (the Jamaica Bay Unit) spans approximately 9,000 acres, includes the water and islands of Jamaica Bay, two ponds (East Pond and West Pond), trails, and a visitor center (see figures 2 and 3). It is the only wildlife refuge within the National Park System. East Pond (and West Pond prior to Hurricane Sandy) is highly valued in this area as freshwater communities are unique and have largely been lost within Jamaica Bay.

Figure 2: Gateway National Recreation Area and the Jamaica Bay Wildlife Refuge Map

Figure 3: West Pond Project Area

Originally owned and managed by New York City, East Pond, West Pond, and the surrounding landscape was created when Park Commissioner Robert Moses established the two ponds, which lie in the central part of the refuge. The refuge was established in the 1950s by New York City. Ownership of the refuge was transferred to the NPS in 1972 when it was incorporated into Gateway National Recreation Area. The national recreation area provides opportunity for public interpretation, visitor orientation, environmental education, and NPS ranger, maintenance, and other operations. The refuge comprises 9,000 acres of saltmarsh, natural inlets, grassy hassocks, sand dunes, small beaches, and uplands. Much of the refuge is accessible only via water. The refuge is situated along the Atlantic flyway and annually supports hundreds of species of migratory and resident songbirds, shorebirds, and waterfowl. The coastal shoals, bars, and mud flats provide habitat for a number of small mammals and birds.

During Hurricane Sandy, a combination of high tides, wind-blown waves, and the enormous circulation of the superstorm pushed water to a peak surge of nearly 14 feet (NPS 2014a), which damaged the West Pond impoundment. Its amplified wave height and reach, along with strong winds, pushed sand across roads, parking lots, and structures, flooded structures and destroyed machinery, and took beach sands with it as it receded, resulting in a patchwork of coastal erosion and inland areas covered in sand. Although tropical cyclones like Hurricane Sandy primarily flood coastal areas where the storm comes ashore, seasonal storms can cause much wider-ranging damage and major coastal erosion (NPS 2014a).

WETLANDS DELINEATION AND IMPACTS

A wetlands delineation and assessment was completed in May 2014 by wetlands scientists under contract by the NPS. The wetlands delineation was conducted in accordance with the NPS Procedural Manual #77-1: *Wetland Protection* (NPS 2012) and the *U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual* (Environmental Laboratory 1987), *Regional Supplement to the Corps Engineers Wetlands Delineation Manual: North Central and Northeast Region (Version 2.0)* (U.S. Army Corps of Engineers 2012).

Wetland boundaries were determined by evaluating the presence or absence of wetland indicators at two or more observation points. The boundary was mapped between an observation point evaluated as an upland location and an observation point evaluated as a wetland. Three criteria must be met for an observation point to be considered within a wetland location: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. Thirty-four observation points were assessed to delineate the wetlands-upland boundary within the West Pond footprint. Other wetlands located to the east of West Pond within the forested uplands and along the upland-marsh gradient on the western shoreline with Jamaica Bay were also delineated.

Delineated wetlands were characterized using the Cowardin classification system (Cowardin et al. 1979). Under this classification, wetlands may be generally placed into marine (wetlands associated with oceanic environments), riverine (wetlands associated with rivers, streams, and drainage features), estuarine (non-oceanic wetlands influenced by tidal flows), palustrine (freshwater wetland systems), and lacustrine systems (open freshwater systems). Only estuarine wetlands were delineated within the West Pond vicinity, but freshwater wetlands are found in the East Pond vicinity to the east of Cross Bay Boulevard and are expected to be present upon implementation of the preferred alternative. Wetlands were grouped in four distinct areas—Wetlands A, B, C, and D (see figure 4). Table 1 lists the wetlands delineated by Cowardin classification, and figure 4 shows these locations on the map.

Table 1: Delineated Wetlands within the West Pond Area

Designation	Cowardin Classification	Description	Size (Acres)
Wetlands A	E1UBL	Subtidal waters within the berm and channel connecting West Pond with Jamaica Bay	45.00
		Subtidal channel connecting West Pond with Jamaica Bay	1.26
	E2EM1N	Emergent marshes and mudflats within West Pond	33.7
	E2SS6P	Estuarine intertidal shrub scrub	9.26
Wetlands B	E2EM1N	Estuarine intertidal emergent marsh regularly flooded within the South Marsh area	7.07
	E2EM1P	Estuarine intertidal marsh with irregular flooding	10.83
	E2US2N	Intertidal sand and mudflats	0.35
Wetlands C	E1UBL	Subtidal waters around North Marsh	20.85
	E2EM1N	Emergent marshes and mudflats within along the North Marsh shoreline	86.35
	E2SS6P	Estuarine intertidal shrub scrub	8.63
Wetlands D	E2EM1N	Emergent marsh regularly flooded surrounding Terrapin Point periphery	0.91
	E2US2M	Mud and sand deposits around Terrapin area	6.86
Total			***231.07***

Source: Field work and GIS analyses conducted by NPS contractors in May 2014.
Wetland impacts created by the replacement of the water control structure and repair of the primary and secondary breach are excepted actions according to section 4.2.1g of the Procedural Manual #77-1: Wetland Protection.

The wetland delineation defined 231.2 acres of wetlands. The existing wetlands present by Cowardin Classification are depicted in figure 5. After implementation of the preferred alternative, it is estimated that 235.7 acres of wetlands would be present (see figure 6). The estimated change in acreage of wetland from the preferred alternative is represented in table 1. Repairing the breach would fill conveyance with approximately 0.35 acre of open water and mud flats and would accommodate a mean high water elevation of 3 feet (0.9 m) (see figure 7). The potential secondary breach location would require approximately 0.08 acres of fill within upland areas and potential temporary disturbance of mudflats and emergent wetland. Replacement of the water control structure would require construction access through intertidal sand and mudflat wetlands. Installation of the water control structure would temporarily disturb approximately 0.15 acres of mudflat and emergent wetland during construction.

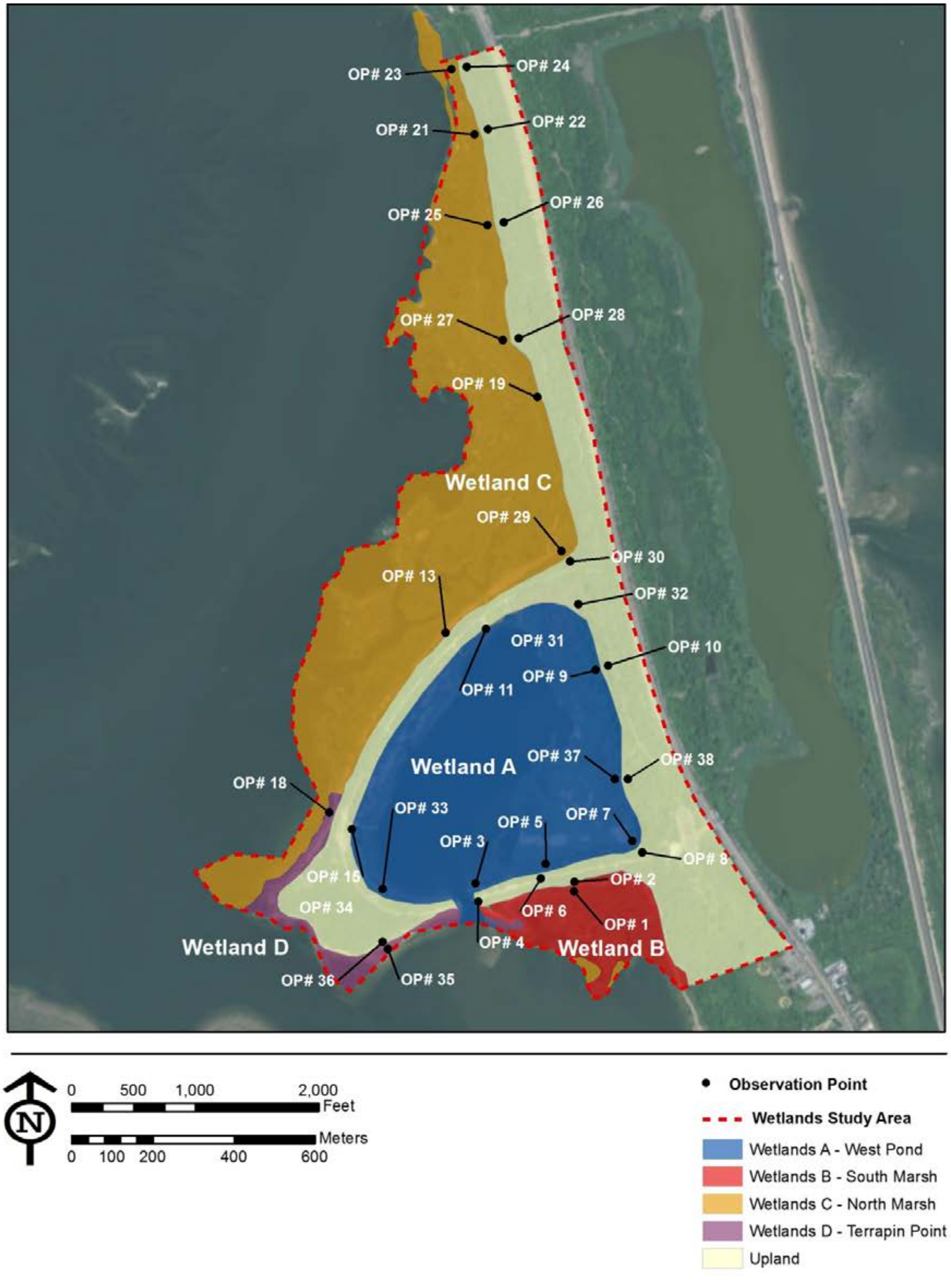

Figure 4: Wetland Areas within the West Pond Area

Figure 5: Existing Classifications within the West Pond Area

Figure 6: Estimated Wetland Classifications within the West Pond Area Following Implementation of Alternative B

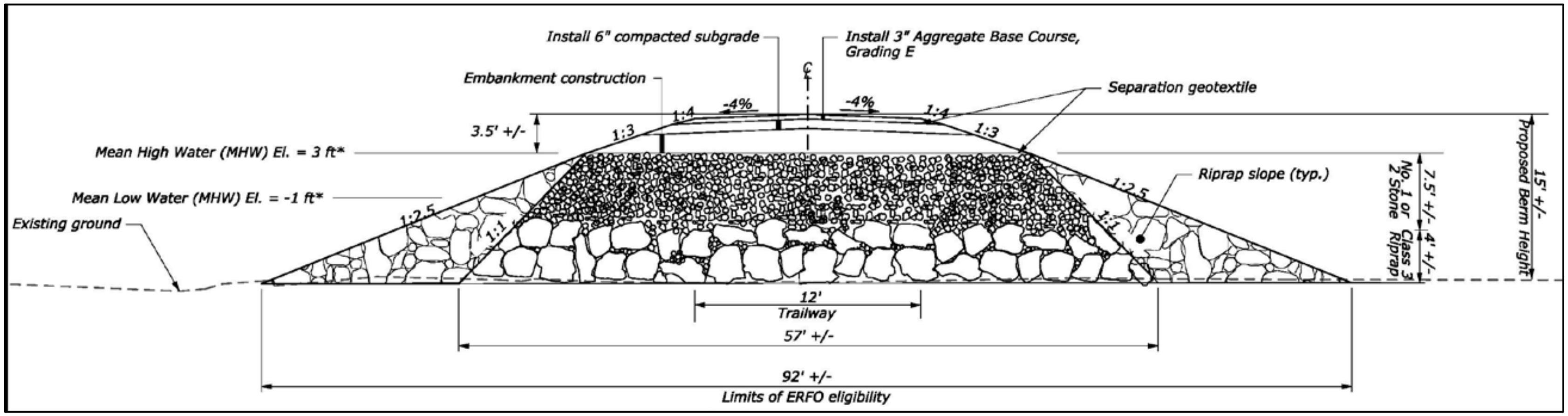

Figure 7: Mean High and Low Water Elevations Depicted on the Proposed Primary Breach Embankment Repair (Source: FHWA 2015)

These estimates have been based solely on a conceptual design and final engineering plans have not been completed.

Alternative B (the preferred alternative) would include restoration efforts to establish approximately 5 acres of high saltmarsh (saltmarsh cordgrass) outside and south of the primary breach location, as well as 3.7 acres of shoreline habitat. These restoration actions would further protect the berm from future erosion. The existing estuarine wetlands found inside the berm would be isolated from tidal flow through the breach once the breach was repaired. The addition of a groundwater well or municipal water source for freshwater supply to West Pond would cause the area to shift from estuarine, tidally influenced habitat to freshwater habitat. This change can be seen in table 1 and figure 6 with the addition of palustrine and lacustrine wetlands and the loss of estuarine wetlands inside the berm. This would be a more gradual transition if the pond is maintained by freshwater replenishment from natural precipitation and runoff only.

FUNCTIONAL ANALYSIS

Overview of the Evaluation of Planned Wetlands Functional Analysis Technique

For the purposes of evaluating the loss or gain of wetlands functions, NPS contractors selected the evaluation of planned wetlands (EPW) technique (Bartoldus et al. 1994). EPW is a rapid functional assessment method used by regulatory stakeholders in the Jamaica Bay watershed and was therefore used to assess wetlands functions at West Pond. Wetland functions assessed in this procedure included: shoreline bank and erosion control (SB), sediment stabilization (SS), water quality (WQ), wildlife (WL), and uniqueness/heritage (UH) (see table 2).

Several elements were considered for each of the functions analyzed following the EPW technique. An element is a physical, chemical, or biological characteristic of the wetland or landscape that dominates the capacity of the wetland to perform a function. For each assessment area, multiple elements were evaluated. This is one of the strengths of the EPW approach, in that it allows the reviewer to identify important elements in assigning a functional capacity index (FCI) for a particular function.

The FCI is identified in the EPW procedure as a dimensionless expression of the varying capacity of wetlands to perform a given function. The FCI ranges from 0.0 to 1.0, where 0.0 represents no functional capacity and 1.0 represents optimum functional capacity. A score of “NA” may also be assigned, indicating that a particular function is not applicable for the wetland assessed. The FCI for a given function (e.g., SB, SS, WQ, WL, UH) is derived from an assessment model that combines element scores based on the relationship between the various elements and the function itself. By multiplying the area (in acres) with the FCI, the functional capacity unit (FCU) is calculated, which provides the cross-functional comparison values to determine what functions are gained or lost from the proposed activity.

Table 2: Functional Descriptions and Applications

Function	Code	Definition	Application and Notional FCI Values
Shoreline bank erosion	SB	Capacity to provide erosion control and to dissipate erosive forces at a shoreline bank	The proposed action would increase erosion control and dissipate forces along the exposed shoreline bank. Therefore, existing conditions would be scored at 0, and the proposed action would be scored at 1.
Sediment stabilization	SS	Capacity to stabilize and retain previously deposited sediments	Sediments deposited in West Pond over the years would continue to flow with tides out of West Pond if the breach remained open under the no action alternative. TSS would score high under the proposed action with the breach repaired, and low under the no action alternative.
Water quality	WQ	Capacity to retain and process dissolved or particulate materials down current within Jamaica Bay	Repairing the breach would exclude the area of West Pond from providing ecosystem services for Jamaica Bay. Therefore, the preferred alternative would score low at 0 by repairing the breach, and the preferred alternative would allow inflows for nutrient cycling and score higher (toward 1, depending on the design).
Wildlife	WL	Degree to which a wetland functions as habitat for wildlife as described by habitat complexity	The preferred alternative would restore habitat diversity and therefore score above 0.5.
Fish	FT	Tidal fish: degree to which a wetland habitat meets the food/cover, reproductive, and water quality requirements of fish	The preferred alternative would repair the breach and score zero, the no action alternative would score higher, depending on the amount of estuarine water available for tidal fish.
	FP	Non-tidal pond fish: degree to which a wetland habitat meets the food/cover, reproductive, and water quality requirements of fish	The preferred alternative would repair the breach and would score higher at 1.
Uniqueness / heritage	UH	Presence of characteristics that distinguish a wetland as unique, rare, or valuable	The preferred alternative would diversify habitats and therefore score at or near 1. The no action alternative would maintain the breach and score at zero because the habitats would resemble the rest of the wetlands complex within Jamaica Bay.

Functional Analysis for the NPS Preferred Alternative

Four wetland assessment areas were used to properly compare functions for all the alternatives analyzed in the environmental assessment. These areas included the inner portion of West Pond, three areas on the bayside of the berm that support low saltmarshes, tidal creeks, beach habitats, and mudflats. This statement of findings includes the functional assessment for the repair the breach and improve habitat conditions alternative in the environmental assessment, which only occur within "Wetlands A / West Pond WAA." Table 3 show the functional assessment comparison to existing conditions and the NPS' preferred alternative within Wetlands A / West Pond WAA.

As shown in table 3, functional values of the proposed action increase wetland functions across all functional areas, with the exception of tidal fish. This is because repairing the breach would lose this functional capacity for tidal fish, but would replace it by providing habitat for freshwater fish.

Table 3: Functional Descriptions and Applications

Function	Code	Existing Conditions		Repair the Breach		Gain / Loss of Wetlands Functions by FCU
		FCI	FCU	FCI	FCU	
Shoreline bank erosion	SB	0.265	7.732	0.807	23.498	***15.767***
Sediment stabilization	SS	0.410	0.398	0.919	0.891	***0.493***
Water quality	WQ	0.753	21.920	0.868	25.295	***3.374***
Wildlife	WL	0.845	24.609	0.944	27.491	***2.883***
Fish	FT	0.518	15.099	0	0	***-15.099***
	FP	0	0	0.758	22.081	***22.081***
Uniqueness / heritage	UH	0.571	16.646	0.857	24.969	***8.323***

JUSTIFICATION OF THE PREFERRED ALTERNATIVE FOR USE OF WETLANDS

This project would reestablish West Pond to freshwater habitat, which has become rare in the region. Freshwater habitat has largely been replaced within the Jamaica Bay watershed by urban development. The purpose of this project is to provide a solution to future erosion of the berm and damage to the trail while enhancing visitor experiences within the West Pond trail area that supports a diversity of Jamaica Bay habitats and wildlife. The proposed project is needed for the following reasons:

- Conditions in the area around the breach and the portion of West Pond loop trail that previously crossed the embankment (berm) are not currently safe for public access and.
- The existing breached condition is vulnerable to reoccurring storm activity and susceptible to future damage from erosion.
- Opportunities for universal access by visitors from near and far to the West Pond loop trail to view wildlife, enjoy the bay, and learn about the resources are limited.
- The refuge does not currently provide brackish habitat that supports a diversity of species in an environment that has the ability to withstand adverse impacts from storm events.

The Jamaica Bay Unit of Gateway National Recreation Area is one of the largest expanses of open space in the region, consisting of over 19,000 acres of land, bay, and ocean waters within two boroughs of New York City: Brooklyn and Queens. Special mandates in the national recreation area's enabling legislation include conservation and management of wildlife and natural resources in the Jamaica Bay Unit. This mandate states that the Secretary shall administer and protect the islands and waters within the Jamaica Bay Unit with the primary aim of conserving the natural resources, fish, and wildlife located therein and shall permit no development or use of this area which is incompatible with this purpose. Repairing the breach, and maintaining freshwater would have beneficial impacts to freshwater wetlands and the species that depend on these habitat conditions. These freshwater communities are unique and have largely been lost within Jamaica Bay.

MITIGATION

Wetland impacts created by the replacement of the water control structure and repair of the breaches are excepted actions according to section 4.2.1g of the Procedural Manual #77-1: Wetland Protection. Therefore, the best management practices and conditions described in appendix 2 of the manual have been met or will be implemented, and wetland compensation is not required for these actions.

The shoreline armoring along the southern edge of the West Pond area (labeled shoreline restoration) would fill approximately 3.7 acres of intertidal wetland. The creation of approximately 5.0 acres of high salt marsh, to be located adjacent to the armoring, would compensate for the loss of 3.7 acres of intertidal habitat created by the armoring fill for a net gain of 5 acres of high marsh habitat.

SUMMARY

The NPS finds that the repair of the breached berm at West Pond and associated enhancements and management actions to restore habitats within West Pond are essential for fulfilling the mission of the refuge. Further, the proposed action would increase functional values of essential wetlands functions. This project is consistent with the policies and procedures of NPS Director's Order #77-1 (Protection of Wetlands) and Executive Order 11990.

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APPENDIX C: WEST POND GROUNDWATER ANALYSIS AND REPORT

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West Pond Groundwater Analysis and Report

INTRODUCTION

On October 29, 2012, Hurricane Sandy created a breach in the southern portion of the berm of West Pond, located within the Jamaica Bay Unit of Gateway National Recreation Area. The berm remains breached, and the resulting sea water inundation has increased the salinity of the pond and created tidally influenced conditions. As a result, habitat composition has changed within the pond, which historically was only slightly saline. West Pond covered approximately 44 acres and was 3 to 4 feet deep prior to Hurricane Sandy. Current data are not available for the bathymetry of the pond subsequent to Hurricane Sandy. West Pond and the surrounding area provide opportunities for recreation, scenic vistas, and birding along a self-guided trail. The National Park Service is evaluating the potential for repairing the breach in the berm and installing a groundwater supply well near West Pond in order to provide freshwater to the pond. A supplemental source of freshwater would provide increased opportunities for NPS management of water levels and quality, and would also enhance wildlife use of the pond. This report presents the results of a hydrogeologic analysis performed to support evaluation of potential groundwater use in support of the West Pond Environmental Assessment.

Purpose

The purpose of this hydrogeologic analysis is to evaluate the potential effects of using groundwater as a supply source for maintaining a freshwater environment at West Pond, including but not limited to aquifer hydraulic properties, the regional groundwater flow system including historical potentiometric surfaces, historical pumping, and water balance elements for West Pond.

Approach and Methodology

The following tasks were performed as part of the hydrogeologic analysis:

- Review of readily available published literature,
- Development of a preliminary quantitative water balance for West Pond,
- Use of simple analytical equations to assess the impacts of groundwater extraction from a water supply well,
- Review of information from a local water well drilling company familiar with the area,
- Preliminary review of pertinent regulatory requirements, and
- Preliminary well search using readily available online records.

Limitations of this Analysis

This hydrogeologic evaluation is primarily qualitative with limitations summarized below. No fieldwork was completed, and no local municipalities were visited to search available archives for historical water withdrawal records.

- To the extent practical, the most recent information readily available online was used for this analysis. However, much of the hydrogeologic information (including historical groundwater usage) was published more than five years ago and is not necessarily representative of current conditions. Although some aquifer properties will remain the same over time (e.g., transmissivity), others such as potentiometric surface elevations, hydraulic gradients, and groundwater quality (e.g., nitrate and chloride concentrations) may have changed.
- Future changes in site conditions are unaccounted for in this analysis. These include changes such as (but not limited to) aquifer management and the degree of development.
- Although this analysis is sufficient to fulfill the stated requirements, additional research and/or quantitative analysis would likely be required to finalize well design specifications and pond management objectives, as well as to obtain necessary regulatory approvals (e.g., New York State well permits and U.S. Environmental Protection Agency approval for sole source aquifer use).
- The analysis used the lower end of the range of estimated mean annual precipitation amounts for the period 1971 – 2000 (Sanford and Selnick 2013) on Long Island, New York. Site-specific conditions will vary.
- The specific freshwater holding capacity of West Pond and site-specific evapotranspiration rates are unknown, and the holding capacity of the pond may vary based upon final design details. Information presented is based upon preliminary alternative concepts.

REGIONAL SETTING

Geology

The study area for this hydrogeologic evaluation is located at the western end of Long Island and includes Queens and Kings Counties, New York (figure 1). This area lies within the Atlantic Coastal Plain Physiographic Province of the U.S. and includes geological deposits and regional aquifers that are bounded to the south by the Atlantic Ocean and the north by Long Island Sound. West Pond is located near the central portion of Jamaica Bay along the boundary between Kings and Queens Counties.

Long Island was formed primarily by Pleistocene-age glaciations including the Wisconsin Ice Age and Laurentide Ice Sheet, which retreated approximately 10,000 years ago. Two advances of the Wisconsin ice sheet during the Upper Pleistocene Epoch of the Quaternary Period caused the island to be blanketed with glacial till, ice-contact stratified drift, outwash deposits, and other deposits composed of clay, silt, sand, gravel, and boulders. The terminal moraines and the north shore of Long Island are composed primarily of stratified glacial drift with some till. The area between the moraines and the south shore of Long Island is primarily covered by outwash deposits. Central and South Long Island are of glaciofluvial origin. These Pleistocene deposits lie atop gently dipping, metamorphic, Paleozoic or Precambrian-age rocks (USEPA 1983a; USEPA 1983b; Misut and Monti 1999).

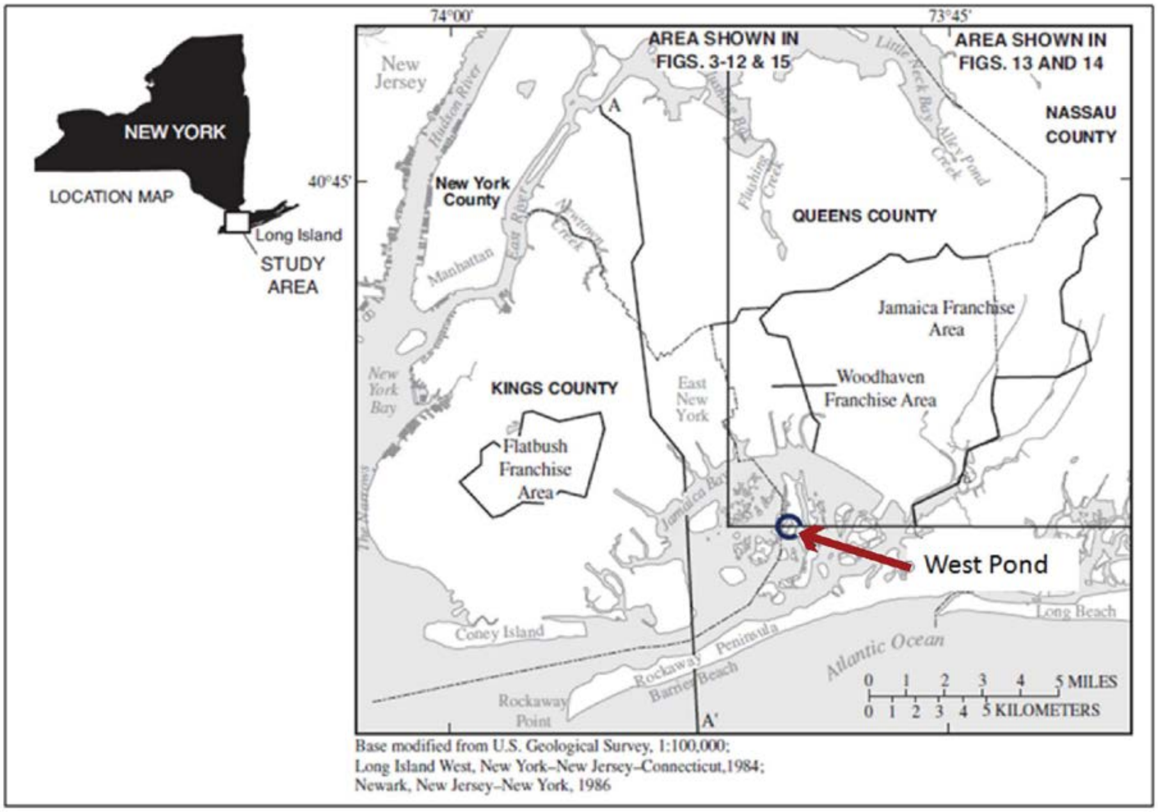

Figure 1: Regional Map and Cross-Section Location (Cartwright 2002)

The undifferentiated igneous and metamorphic bedrock of Paleozoic or Precambrian age that underlies the Cretaceous sediments was eroded to a nearly flat or broadly undulating plain before the overlying Cretaceous-age sediments were deposited; the rock surface was later eroded by Pleistocene glaciation in north-northwestern Queens County near the East River and slopes southward at about eighty (80) feet per mile (USEPA 1983a; USEPA 1983b). This dipping bedrock surface and the depositional environment of the overlying sediments resulted in a series of south-dipping, unconsolidated, morainal and outwash accumulations associated with the continental glaciers (USGS 1914).

The Raritan Formation, consisting of the Lloyd Sand Member and an unnamed clay member, directly overlies the igneous and metamorphic bedrock. Overlying the Raritan Formation is the Magothy Formation and Matawan Group (undifferentiated), the Jameco Gravel, the Gardiners Clay, and upper Pleistocene deposits. Rockaway Peninsula and Coney Island consist of Holocene fluvial deposits. There are four primary water-bearing formations on Long Island: the Upper Glacial, Jameco, Magothy, and Lloyd aquifers. Figure 1 shows the location of a regional, north-south trending geologic cross-section published by Cartwright (2002), and figure 2 shows a cross-section depicting the stratigraphic sequence.

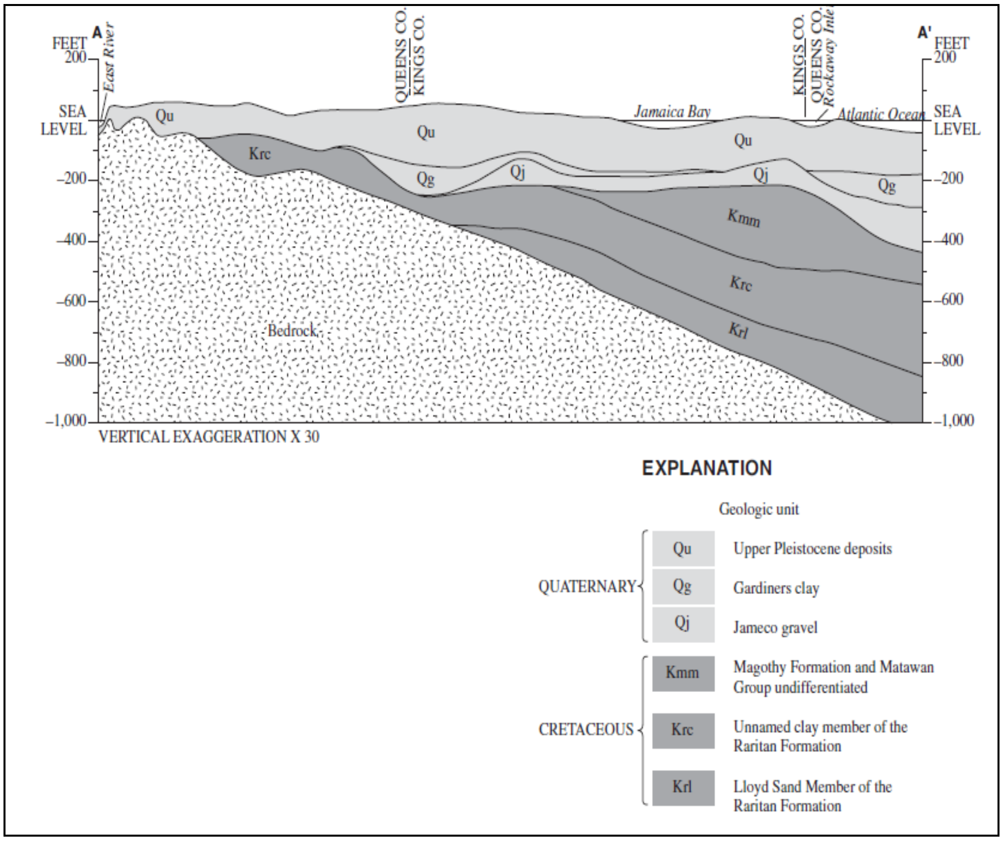

Figure 2: Geological Cross-Section through Kings and Queens Counties, New York (Cartwright 2002)

Hydrogeology

Through historical development and geological exploration, the aquifers below Kings and Queens Counties have been thoroughly studied. Much hydraulic data from historical studies have been incorporated into various U.S. Geological Survey reports to include the Water Resources Investigations Report (WRIR) 98-4071 (Misut and Monti 1999). This report is the source of hydrostratigraphic data summarized in table 1.

The upper glacial aquifer is not of primary interest in this groundwater analysis because it is shallow, relatively thin, lithologically and hydrogeologically heterogeneous, and more susceptible to contamination from surface sources and saltwater intrusion than deeper aquifers. Therefore, this analysis focuses on the deeper Jameco, Magothy, and Lloyd aquifers. According to Cartwright (2002), “the Magothy aquifer and overlying Jameco aquifer (where present) are hydraulically connected and, therefore, commonly are considered as one hydrogeologic unit (Buxton and Shernoff 1995 in Misut and Monti 1999).” These units are jointly termed the Jameco-Magothy aquifer (Cartwright 2002). This same naming convention is followed in this groundwater analysis report.

Table 1: Hydrostratigraphy of Kings and Queens Counties, Long Island, New York (Misut and Monti 1999)

Unit	Approximate Range in Thickness	Description	Hydraulic Properties
Holocene (recent) deposits (upper glacial aquifer)	0-40	Beach sand and gravel and dune sand, tan to white; black, brown, and gray bay-bottom deposits of clay and silt; artificial fill. Beach and dune deposits are mostly stratified and well sorted. Fill includes earth and rocks, concrete fragments, ashes, rubbish, and hydraulic fill.	Sandy beds of moderate to high permeability beneath barrier beaches locally yield fresh or salty water from shallow depths. Clayey and silty beds beneath bays retard saltwater encroachment and confine underlying aquifers.
Upper Pleistocene deposits (upper glacial aquifer)	0-300	Till composed of clay, sand, gravel, and boulders, forms Harbor Hill and Ronkonkoma terminal moraines. Outwash consisting mainly of fine to coarse sand and gravel, stratified. Interbedded with clays.	Till is poorly permeable. Sand and gravel part of outwash highly permeable; yields of individual wells are as much as 1,700 gal/min. Specific capacities of wells as much as 109 gpm/ft of drawdown. Horizontal hydraulic conductivity: 20-80 feet per day (ft/d) (moraine), 200-300 ft/d (outwash). Horizontal to vertical anisotropy is 10:1. Specific yield is 0.25 (moraine), 0.3 (outwash).
Upper Pleistocene deposits (upper glacial aquifer)	0-40	Clay and silt, some lenses of sand and gravel. Interbedded with outwash in southern part of area.	Relatively impermeable confining unit. Retards saltwater encroachment in shallow depths. Confines water in underlying outwash deposits when present.
Gardiners Clay	0-150	Clay and silt, grayish-green; some lenses of sand and gravel. Interglacial deposit.	Relatively impermeable confining layer above Jameco aquifer. Locally contains moderately to highly permeable sand and gravel lenses. Confines water in underlying Magothy aquifer. Vertical hydraulic conductivity is 0.001 - 0.0029 ft/d.
Jameco Gravel (Jameco aquifer)	0-200	Sand, coarse, granule to cobble gravel,	Highly permeable. Yields as much as 1,500 gpm to individual wells. Specific capacities as high as 135 gpm per foot of drawdown. Contains water under artesian pressure. Horizontal hydraulic conductivity is 200-300 ft/d. Horizontal to vertical anisotropy is 10:1. Specific storage is 1 x 10^{-6} per ft.
Reworked Matawan-Magothy channel deposits (upper glacial or Magothy aquifer)	0-260	Sand, fine to coarse, gravel. Contains some thin beds of silt and clay.	Moderate to highly permeable. Provides an interconnection between Magothy aquifer and upper glacial aquifer where Gardiners Clay is absent.
Matawan Group-Magothy Formation, undifferentiated (Magothy aquifer)	0-500	Sand, fine to medium, interfingered with lenses of coarse sand, sandy clay, silt, and solid clay. Generally contains gravel in bottom 50 to 100 ft.	Slightly to highly permeable. Individual wells yield as much as 2,200 gpm. Specific capacities as high as 80 gpm per foot of drawdown. Water mainly under artesian pressure; some wells in southern part of area are flowing at the surface. Horizontal hydraulic conductivity is 30-180 ft/d. Horizontal to vertical anisotropy is 100:1. Specific storage is 1 x 10^{-6} per ft.

Table 1: Hydrostratigraphy of Kings and Queens Counties, Long Island, New York (Misut and Monti 1999) cont.

Unit	Approximate Range in Thickness	Description	Hydraulic Properties
Unnamed Clay Member (Raritan confining unit)	0-200	Clay, contains interbedded layers of sand and gravel	Relatively impermeable confining unit. Local lenses and layers of sand and gravel, moderate to high permeability. Vertical hydraulic conductivity is 0.001 ft/d.
Lloyd Sand Member (Lloyd aquifer)	0-300	Sand, fine to coarse, gray and white, and gravel; some lenses of solid sandy clay, and clayey sand. Thin beds of lignite locally.	Yields as much as 2,000 gpm to individual wells. Specific capacities as high as 44 gpm per foot of drawdown. Water under artesian pressure; some wells flow. Horizontal hydraulic conductivity is 35-75 ft/d. Horizontal to vertical anisotropy is 10:1. Specific storage is 1 x 10^{-6} per ft. Water of generally good quality except for high iron content.
Undifferentiated gneiss, schist, pegmatite (Bedrock)	----	Crystalline metamorphic and igneous rocks. Soft, clayey weathered zone at top, as thick as 100 ft.	Relatively impermeable. Contains water along joints and fault zones.

Hydraulic Properties. The horizontal hydraulic conductivity of the Jameco aquifer and outwash zone of the upper glacial aquifer ranges from 200 to 300 feet per day (ft/d), while that of the morainal zone ranges from 20 to 80 ft/d. Horizontal hydraulic conductivity of the Magothy and Lloyd aquifers ranges from 30 to 180 ft/d. The horizontal-to-vertical anisotropy of these deposits is greater than that of the Jameco and upper glacial aquifers because the Magothy and Lloyd aquifers contain an abundance of discontinuous clay lenses (Misut and Monti 1999). As a result, groundwater can more readily migrate laterally than vertically in the aquifer. Consequently, flow to a pumping well installed in an aquifer with a higher horizontal-to-vertical anisotropy would be primarily lateral rather than vertical, and groundwater from portions of the aquifer substantially above or below the well screen interval may not readily flow to the well screen, depending on the specific locations of clay lenses. Anisotropy is an important attribute to consider during both qualitative and quantitative analyses which examine the potential for water from overlying (or underlying) aquifers to migrate to active pumping wells.

Each of the deeper aquifers (i.e., below the upper glacial aquifer) located in Kings and Queens Counties (and therefore the West Pond area) has a high transmissivity (except where the aquifers thin or pinch out). The Lloyd aquifer has the lowest average horizontal hydraulic conductivity and transmissivity of the four main aquifers on Long Island (Chu 2006). Average horizontal hydraulic conductivity of the Lloyd aquifer ranges from 40 to 67 ft/d, and transmissivity ranges from 1,500 to 19,000 square feet per day (ft^2/d). Average transmissivity of the Lloyd aquifer varies locally from about 4,700 ft^2/d in Kings County, to 8,000 ft^2/d in Queens County; 12,000 ft^2/d in northern Nassau County; 16,000 ft^2/d in southern Nassau County; and 10,000 to 12,000 ft^2/d in Suffolk County (Chu 2006).

Using the unit thicknesses below Jamaica Bay as shown on figure 2, wells completed in the Jameco-Magothy and Lloyd aquifers are expected to have specific capacities ranging from 44 -135 gallons per minute per foot (gpm/ft) of drawdown (Misut and Monti 1999). Even at the lower end of the range, these specific capacities should allow a water supply well installed in these aquifers to be pumped at a sufficiently high flow rate to fill West Pond within a reasonable timeframe. Communication with a local well driller supported the presence of highly transmissive aquifers below Jamaica Bay (personal communication with American Well and Pump Company 2015).

Potentiometric Surfaces and Hydraulic Head. Recent potentiometric surface maps for the combined Jameco-Magothy aquifer and the Lloyd aquifer (figures 3 and 4, respectively) were obtained from a comprehensive 2013 Long Island survey (USGS 2015). These potentiometric surface maps include the area of interest and show the direction and magnitude of the hydraulic gradient below Jamaica Bay. In both aquifers, elevated hydraulic heads in central Long Island (east of the area shown on figures 3 and 4) result in a significant east to west flow potential due to recharge from precipitation. In both aquifers, the hydraulic gradients decrease in magnitude with distance away from central Long Island and increasing proximity to the ocean, which is the ultimate groundwater discharge location. In the Jameco and Magothy aquifers, there is a groundwater sink (likely due to groundwater withdrawals) east of Jamaica Bay where the groundwater potentiometric surface is drawn down below sea level. Potentiometric data indicate that the Lloyd aquifer, confined by the overlying Raritan Clay, likely has a higher hydraulic head (by approximately 2- 3 feet) than the Jameco-Magothy aquifer in the area below West Pond, although there is some uncertainty due to spatial and temporal data density.

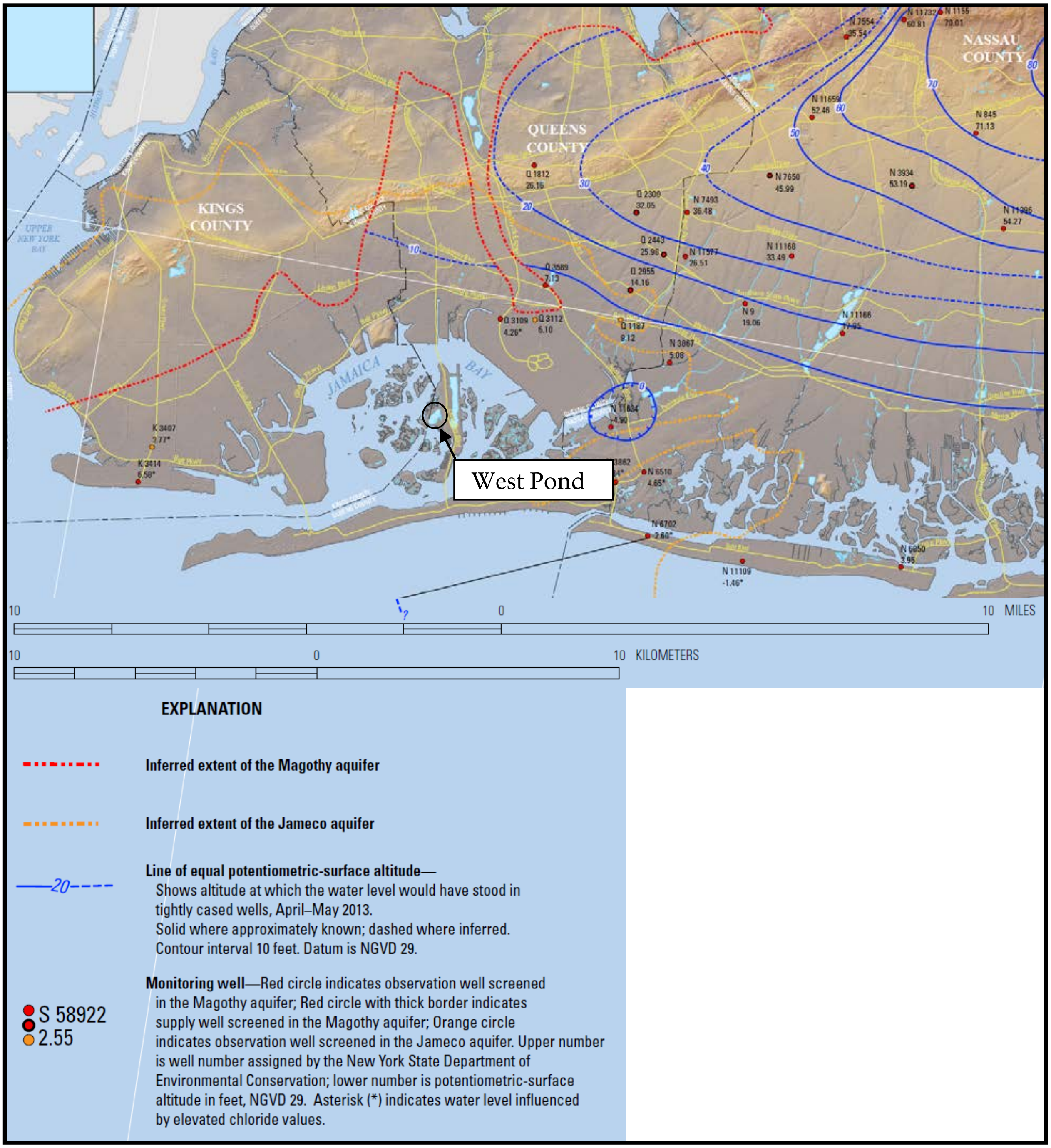

Figure 3: Potentiometric Surface of the Jameco-Magothy Aquifer in 2013 (USGS 2015)

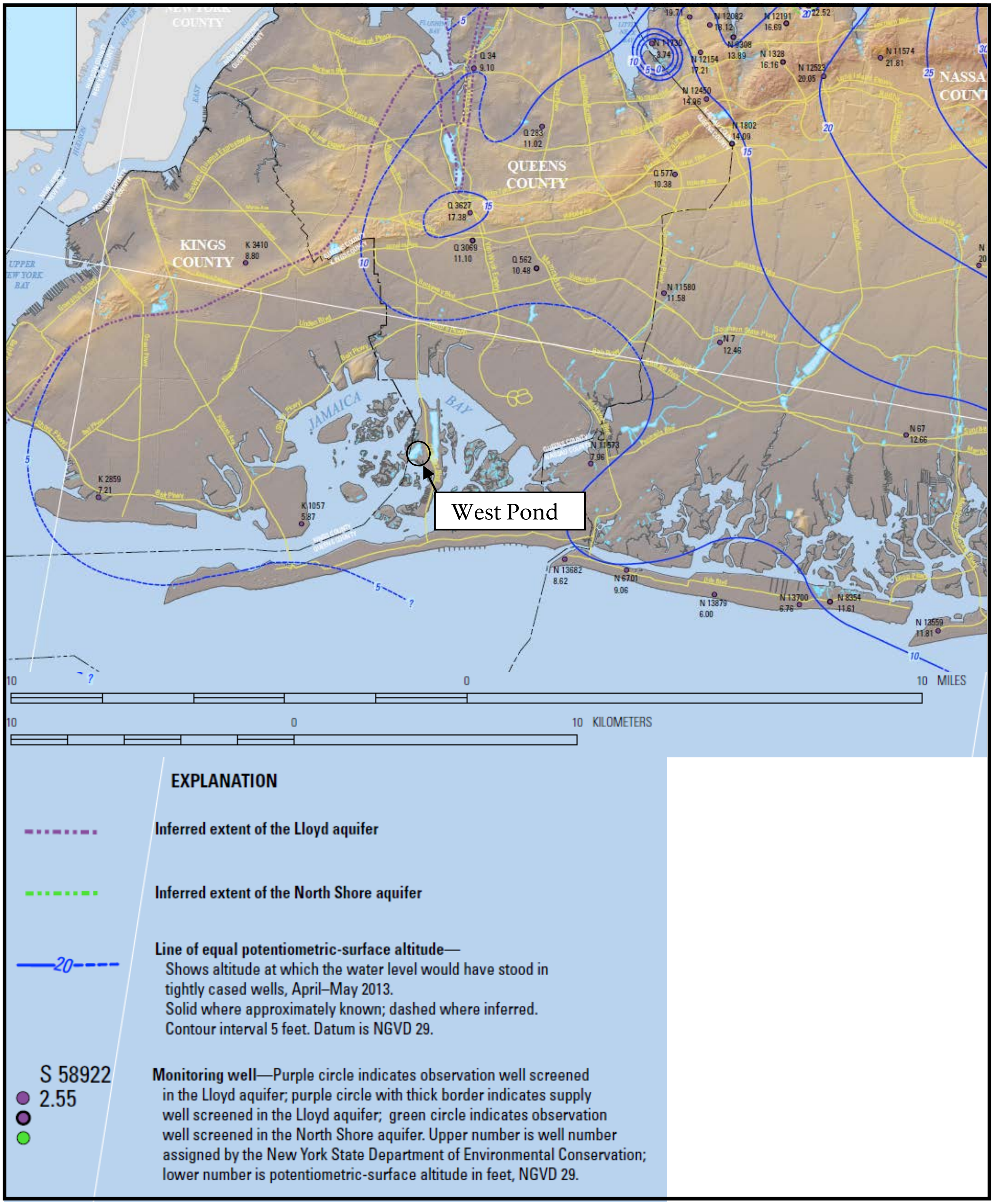

Figure 4: Potentiometric Surface of the Lloyd Aquifer in 2013 (USGS 2015)

Source: http://www.eserc.stonybrook.edu/cen514/info/LI/Groundwater.pdf

Recharge and Discharge. Regional recharge and discharge information is summarized from an online "Long Island Groundwater" reference from the "*Proceedings of the Conference on Water Quality on Long Island*" sponsored by The Center for Regional Policy Studies and the Long Island Regional Planning Board (State University of New York at Stony Brook 1998). Figure 5 illustrates regional groundwater recharge and discharge.

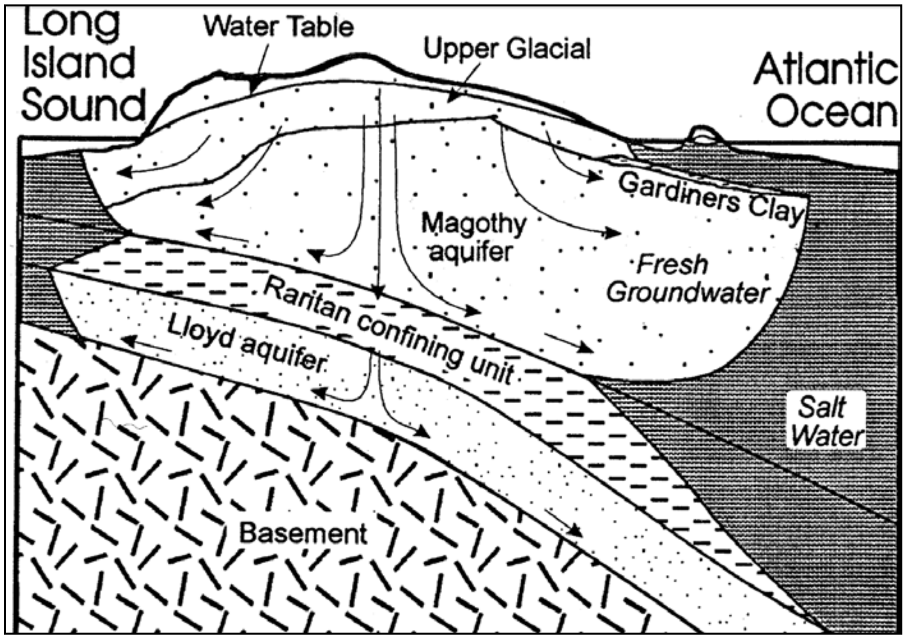

Figure 5: Groundwater Recharge and Discharge

The primary recharge area for subsurface water bearing units, especially the Magothy and Lloyd aquifers, is located near the center of Long Island, where a groundwater divide is present. The primary source of recharge is precipitation; there is no outside source of freshwater because recharge is not possible from the mainland.

General information influencing groundwater conditions for Long Island is summarized as follows:

- Daily average precipitation is 1,600 million gallons per day (mgd)
- 780 mgd is lost to evapotranspiration
- 820 mgd becomes surface water or groundwater
- 340 mgd is stream runoff
- 480 mgd enters groundwater and is eventually returned to the ocean
- Of the 480 mgd entering groundwater, 340 mgd migrates from the upper glacial aquifer into groundwater-fed streams
- The remaining 140 mgd remains in subsurface aquifers as groundwater and is eventually discharged to the ocean (State University of New York at Stony Brook 1998).

The Lloyd aquifer has been estimated to contain about 9% of Long Island's freshwater, but receives only 3.1% of the recharge that enters the Long Island aquifer system. Recharge enters the Lloyd aquifer through a corridor that is generally less than 0.5 mi. wide, and located approximately along the ground-water divide in the central portion of Long Island (Chu 2006).

Historical Trends in Groundwater Use. Historical trends in groundwater use on western Long Island (Kings and Queens Counties) are summarized from Cartwright (2002). Historically, high rates of groundwater pumping resulted in extremely large drawdowns of the water table and large declines in potentiometric heads of underlying aquifers. Sanitary sewer systems that were installed during the 1930s resulted in diminished recharge to aquifers due to diversion of wastewater to coastal water bodies that would otherwise infiltrate into the subsurface. As a result of groundwater pumping and diminished recharge, water levels in northern Kings County in 1936 had declined as much as 45 feet below 1903 levels, and water levels in southern Queens County in 1961 had declined as much as 35 feet. The decline in water levels resulted in reversal of hydraulic gradients such that they were directed inland instead of toward the ocean, inducing saltwater intrusion and local groundwater contamination. This in turn caused all public water supply wells in Kings County and some in Queens County to be shut down. The cessation of pumping allowed water levels to recover (Cartwright 2002).

Misut and Monti (1999) present additional, complementary information on historical trends in groundwater use (summarized in this paragraph). Groundwater was the principal source of water supply for Kings and Queens Counties on Long Island, New York until after World War II. Historical pumping rates exceeding 100 mgd resulted in extensive saltwater intrusion into freshwater aquifers. Public water-supply systems were shut down in 1947 in Kings County and in 1974 in Queens County and use of groundwater was replaced by surface water from upstate reservoirs. Some pumping of groundwater for industrial water supply was still occurring in Kings and Queens Counties as of the late 1990s. In addition, as of the late 1990s groundwater remained a source of water supply in southeastern Queens County and was the sole source of supply for Nassau and Suffolk Counties to the east. Former cones of depression in central Queens that resulted from groundwater pumping (Buxton and Shernoff 1995, cited in Misut and Monti 1999) have recovered. However, more subdued cones of depression are present at subway tunnel- dewatering areas and the Queens County area supplied by groundwater.

Chu (2006) reports that pumpage from the Lloyd aquifer in Kings County ceased in 1946, but as of 2006 continued in Queens and Nassau Counties along with a handful of sole source water supply wells on the barrier beaches of Suffolk County.

Groundwater Quality

Groundwater quality below the West Pond area was considered so that the National Park Service can evaluate use of groundwater to fill the pond and create freshwater habitat conditions. If the water is too saline, it does not meet the needs for freshwater supply to support aquatic resources and wildlife. Previous studies (Misut and Monti 1999; Cartwright 2002) provide valuable information regarding the water quality of each aquifer. The upper glacial aquifer represents the uppermost water-bearing unit and is in contact with saline surface water; therefore, it does not represent a reliable source of freshwater to fill and replenish the pond. This conclusion is supported by Cartwright (2002) and the New York City Department of Environmental Protection (NYCDEP n.d.).

The combined Jameco-Magothy aquifer is reported to be confined to semi-confined below Jamaica Bay; however, chloride concentrations in this aquifer are reported to exceed approximately 3,000 milligrams per liter (mg/L) immediately adjacent to Jamaica Bay on all sides (Cartwright 2002), indicating that slightly saline water exists in this aquifer below West Pond. This level of chloride, which is likely representative of groundwater in the Jameco-Magothy aquifer below Jamaica Bay, would make this aquifer unsuitable as a supplemental water source for West Pond. This observation is supported by the cross-section shown on figure 6.

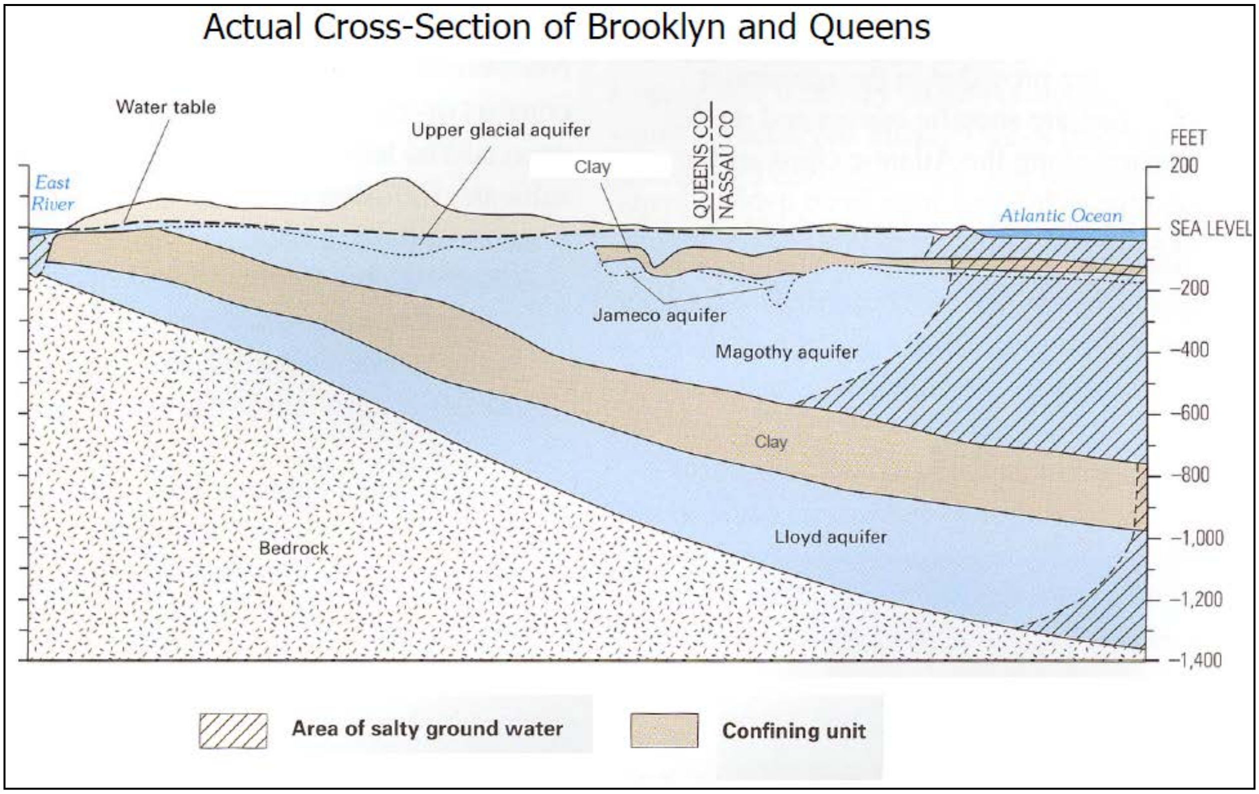

Figure 6: Cross-section through Kings and Queens Counties Including Approximate Locations of the Salt Water Wedge (NYCDEP n.d.)

Given the salinity of the Jameco-Magothy aquifer below the area of interest, nitrate concentrations in this hydrogeologic unit were not fully evaluated, but appear to be less than 0.1 mg/L in the vicinity of Jamaica Bay, and therefore are not of concern from a water quality standpoint given a New York State Department of Environmental Conservation water quality standard for surface water and groundwater of 10 mg/L. Maillacheruvu and Roy (1999)indicate that nitrate levels in West Pond in 1999 were very low, ranging from 0.068 to 0.1 nanomolar (nM) (4.2×10^{-6} to 6.2×10^{-6} mg/L).

Water quality data are available for Lloyd aquifer wells relatively near West Pond. In contrast, the nearest wells completed in the Jameco-Magothy aquifer are located outside Jamaica Bay and may not be as accurate an indicator of water quality in the West Pond area. In particular, a Lloyd aquifer monitoring well sampled by the U.S. Geological Survey is located along Cross Bay Blvd approximately 0.8 mile south of West Pond (i.e., the closest well to West Pond shown on the left panel of figure 9). Another monitoring well is present south of Jamaica Bay on Rockaway Peninsula (figures 1 and 9), which provides information regarding the distance to the saltwater wedge in the Lloyd aquifer.

Groundwater in the Lloyd aquifer below West Pond and as far south as Rockaway Island has a low salinity (chloride concentrations of 120 mg/L (or less) and nitrate concentrations ranging from below the limit of detection to 0.72 mg/L (Cartwright 2002). The relatively low salinity in the Lloyd aquifer below West Pond is supported by the position of the saltwater wedge shown on figure 6. Little water quality data apart from chloride and nitrate are readily available, but the Lloyd aquifer is reported to have a high dissolved iron concentration (Misut and Monti 1999; personal communication with American Well and Pump Company 2015). According to the U.S. Environmental Protection Agency report, *A Support Document for Nassau and Suffolk Counties* (USEPA 1975), "the natural water quality of the aquifers is generally good, except for iron. The dissolved solids concentration is very low, about 40 to 50 mg/L, varying with aquifer. Locally the iron content of the waters of the Magothy and Lloyd aquifers may be higher than the U.S. Environmental Protection Agency's National Recommended Aquatic Life Water Quality Criterion for iron (1 mg/L for chronic exposure); oxidation of iron in pumped groundwater may result in iron staining in the pond. The Raritan clay protects the Lloyd aquifer from contamination from the overlying aquifers, but also inhibits recharge to the Lloyd aquifer (Chu 2006).

Well Search and Groundwater Quantity

The water withdrawals maps shown on figures 8a and 8b were obtained from the New York State Department of Environmental Conservation website using Google Earth. These maps include industrial and municipal wells. Of note is the water withdrawal well on the east end of Jamaica Bay, which is used for power by National Grid; this well is located 3.66 miles east of West Pond. The average daily withdrawal rate for this well was reportedly 0.26 mgd. Information obtained from the U.S. Geological Survey National Water Information System website (http://maps.waterdata.usgs.gov/mapper/index.html) suggests that this well may be completed in the Lloyd aquifer to a depth of 1,044 feet. However, this information is uncertain because the National Grid well depicted on figures 8a and 8b could not be identified with certainty on the U.S. Geological Survey National Water Information System website (figure 9). The map shown on figure 8a does not include subway dewatering wells, which are known to cause a cone of depression in Brooklyn (at least), indicating this map does not show all wells that withdraw water from the subsurface. Review of well information on the New York City Department of Environmental Protection website did not yield additional useful well inventory information.

Additional information was obtained via the online U.S. Geological Survey National Water Information System (see link provided in previous paragraph). Figure 9 shows maps of "Active and Inactive Sites" (left side) and "Active Sites" (right side) obtained from the U.S. Geological Survey site. The U.S. Geological Survey site does not specify the type of well (e.g., monitoring, production, etc.). However, the following types of information can be obtained for each well shown on the map (figure 7):

DESCRIPTION:

Latitude 40°39'31.4", Longitude 73°48'27.4" NAD83
Queens County, New York , Hydrologic Unit 02030202
Well depth: 400. feet
Hole depth: 449. feet
Land surface altitude: 22.7 feet above NGVD29.
Well completed in "Northern Atlantic Coastal Plain aquifer system" (S100NATLCP) national aquifer.
Well completed in "Magothy Aquifer" (211MAGT) local aquifer

AVAILABLE DATA:

Data Type	Begin Date	End Date	Count
Field groundwater-level measurements	1981-12-30	2015-04-23	253
Field/Lab water-quality samples	1983-08-18	2012-07-11	7
Additional Data Sources	**Begin Date**	**End Date**	**Count**
Groundwater Watch **offsite**	1981	2015	253
Annual Water-Data Report (pdf) **offsite**	2005	2009	5

OPERATION:

Record for this site is maintained by the USGS New York Water Science Center
Email questions about this site to New York Water Science Center Water-Data Inquiries

Figure 7: Well Information Available from U.S. Geological Survey National Water Information System

The inactive well located adjacent to Cross Bay Blvd near West Pond (figure 9) is reportedly screened in the Lloyd aquifer to a depth of 725 feet.

Figure 8a: Water Withdrawals Map from New York State Department of Environmental Conservation Website

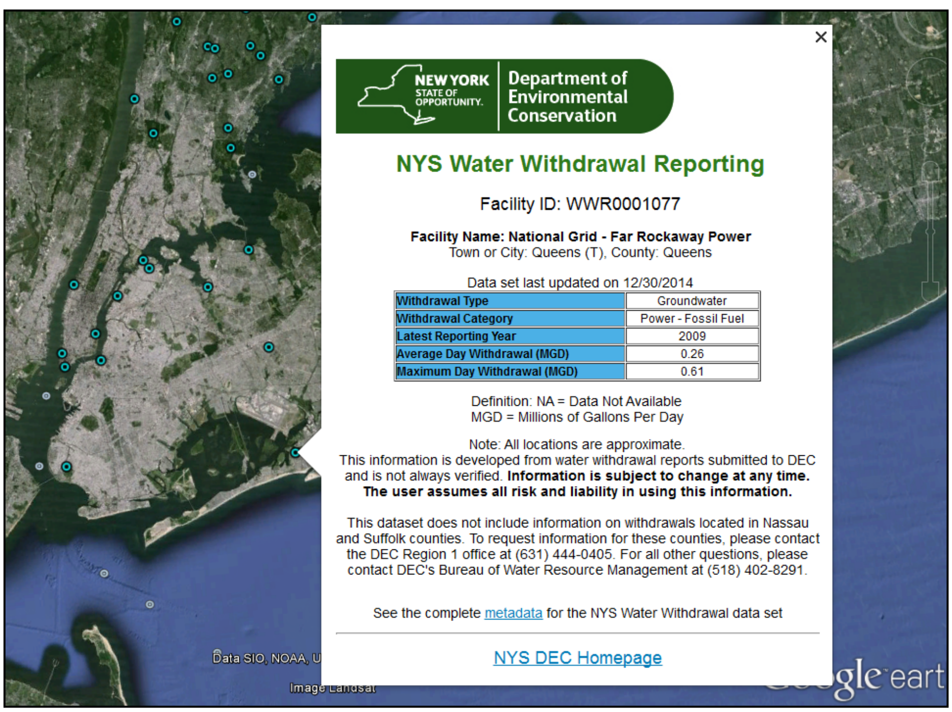

Figure 8b: Details for Water Withdrawal Well Nearest West Pond

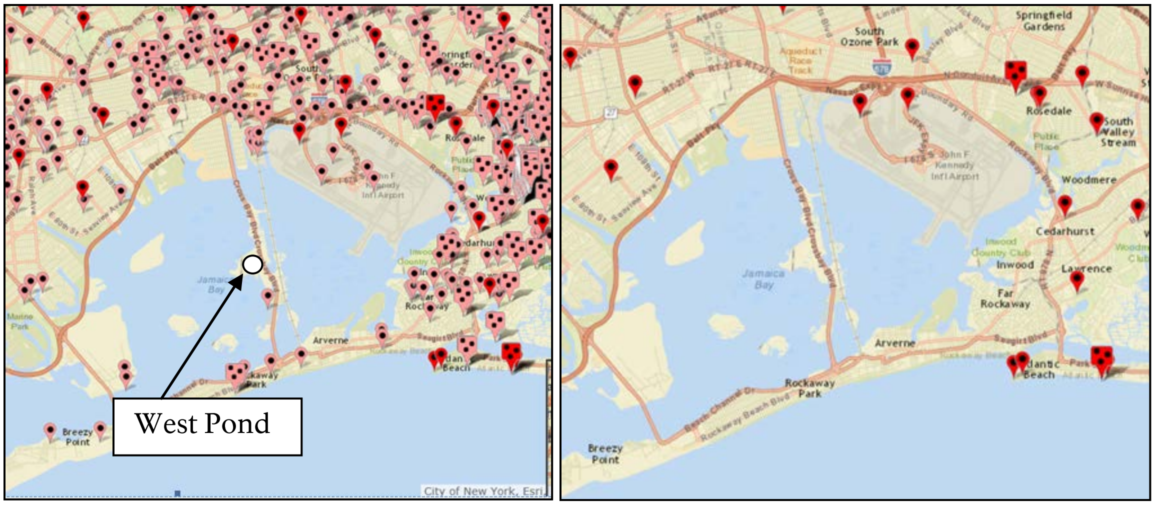

Figure 9: Well Search Results Using USGS National Water Information System (Active and Inactive Sites on Left Side, Active Sites on Right Side)

Groundwater Regulatory Overview

The National Park Service is evaluating the potential for installing a groundwater supply well near West Pond in order to provide freshwater to the pond. A supplemental source of freshwater would provide increased opportunities for NPS management of water levels and quality, and would also enhance wildlife use of the pond. Optimum wildlife and pond management regimes would be determined based upon future pond management strategies to be developed by the NPS dependent upon final design.

This section provides a regulatory framework and addresses federal and state policies and regulations that apply to these two phases covered by this groundwater analysis and report: groundwater withdrawal and pond operation (using the groundwater supply).

Groundwater Withdrawal. The Lloyd aquifer on Long Island, New York is a heavily protected source of groundwater. Groundwater is regulated under various New York State Department of Environmental Conservation and New York City Department of Environmental Protection statutes and requirements, including but not limited to New York State Department of Environmental Conservation Part 701: Classifications-Surface Waters and Groundwaters, New York Environmental Conservation Law §15-1528 and the New York State Water Well Driller Registration Law. Long Island has been designated as a sole-source aquifer region by the U.S. Environmental Protection Agency. The Lloyd aquifer is the sole source of public water supply for Long Beach Island, Nassau County, New York (Chu 2006). On September 26, 2008, the Long Island Lloyd Aquifer Protection Bill was signed into law. This legislation ensures continued protection of the Lloyd aquifer (http://www.citizenscampaign.org/campaigns/long-island-groundwater.asp). However, designation of the Lloyd aquifer as a sole source aquifer is reportedly limited to Nassau and Suffolk Counties, exempting Kings and Queens Counties (http://www.epa.gov/region2/water/aquifer/nasssuff/nassau.htm).

In 1986, New York passed a law that banned the granting of new permits to either drill wells into the Lloyd aquifer or to permit new withdrawals of water from the aquifer.

Several types of regulatory/administrative controls must be considered when withdrawal of groundwater is contemplated in the vicinity of West Pond for purposes of freshwater supply:

1. A well permit from the New York City Department of Environmental Protection and coordination with New York State Department of Environmental Conservation is required for use of Long Island aquifers.
2. The U.S. Environmental Protection Agency must agree to commit federal funding if the water is withdrawn from a sole source aquifer, pursuant to section 1424 of the Safe Drinking Water Act, if exemption from this requirement is not confirmed.
3. A "Letter of Non-Jurisdiction" from New York State Department of Environmental Conservation may be required because of the discharge into surface waters and adjacent wetlands. In addition, a letter of Coverage for Discharges from Construction Activities that may affect endangered or threatened species (Part I.F.4) may need to be obtained from New York State Department of Environmental Conservation pursuant to 6 NYCRR Part 182 (an "Incidental Take Permit"); alternatively, a letter of non-jurisdiction could be sought. The required authorizations would be based on NPS final design.
4. If the Lloyd aquifer is the preferred source for West Pond water supply, regulatory coordination and negotiations would be required prior to obtaining a permit, especially given the existing moratorium on new Lloyd aquifer wells in non-coastal communities (Tenney 2013).

The moratorium on new water wells screened in the Lloyd aquifer is applicable to non-coastal communities, as defined by a separate statute: 55. NY Envtl. Conserv. Law § 15-1502(1). This statute defines coastal communities as "those areas on Long Island where the Magothy aquifer is either absent or contaminated with chlorides". Given the information described under Groundwater Quality above, chloride levels in the Magothy aquifer below West Pond may qualify West Pond as a coastal community according to this definition. However, additional assessment and testing would be required to determine whether this scenario would be feasible from a regulatory perspective. Additional assessment may involve more sophisticated groundwater modeling. If a permit to drill a test well into the Magothy aquifer for water sampling purposes could be obtained, chloride concentrations could be determined. Depending on the results, it may be possible to demonstrate that the West Pond area is a non-coastal community, thereby exempting the well from the moratorium. However, if the Magothy aquifer has sufficiently low chloride concentrations and the moratorium applies, an alternative approach would be to install the water supply well for West Pond in the Magothy aquifer.

Pond Operation. The New York State Department of Environmental Conservation is in the process of conducting a 3-year review of its water quality standards. Current standards can be found in 6 NYCRR 706.1. Nutrients (nitrogen and phosphorus) are regulated in New York using a narrative standard (descriptive terms) rather than numerical values. The current standard for these nutrients is "None in amounts that result in the growths of algae, weeds and slimes that will impair the waters for their best usages". New York State Department of Environmental Conservation is developing specific numeric criteria which will better define these levels; however, based on the current projected timeline of implementation, the soonest these criteria would be implemented for bodies of water similar to West Pond (lakes/reservoirs) would be 2019. Current state regulations do not appear to address the use of a freshwater supply to a pond for wildlife management purposes.

Other regulatory considerations focus on indirect impacts on resources using the pond. The Endangered Species Act of 1973 (16 U.S.C. §§ 1531-1544) established protection over and conservation of threatened and endangered species and the ecosystems upon which they depend. The Endangered Species Act allows the designation of geographic areas as critical habitat for threatened or endangered species. The project would need to ensure that water inputs and management measures would not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. The NPS would be required to consult with the U.S. Fish and Wildlife Service (50 C.F.R. § 402.14(a)). The Magnuson-Stevens Fishery Conservation and Management Act and Sustainable Fisheries Act (16 U.S.C. § 1801-1882), enacted in 1976 and amended by the Sustainable Fisheries Act in 1996, mandates identification and conservation of essential fish habitat. Essential fish habitat is defined as those waters and substrates necessary (required to support a sustainable fishery and the federally managed species) to fish for spawning, breeding, feeding, or growth to maturity. These waters include aquatic areas and their associated physical, chemical, and biological properties used by fish, and may include areas historically used by fish. Federal agencies are required to consult with the National Marine Fisheries Service and to prepare an essential fish habitat assessment if potential adverse effects on essential fish habitat are anticipated from their activities.

Summary. Due to regulatory complexities, the fact that multiple regulatory agencies and statutes are involved, and the fact that the timing of project implementation has not been determined in relation to evolving state water quality criteria, a more detailed investigation of the regulatory environment and interfacing with regulatory agencies would be necessary prior to finalizing plans to install a water supply well. Further, final applicable Aquatic Life Water Quality Criteria would be dependent upon optimum management regimes determined based upon future pond management strategies to be developed by the NPS dependent upon final design.

PROJECT SETTING AND ANALYSIS

Freshwater Requirements to Fill and Maintain West Pond

A preliminary, site-specific water balance (table 2) was developed to estimate: 1) the volume of fresh groundwater required to dilute the more saline pond water to the desired chloride concentration, and 2) the time needed to add the required volume of groundwater to West Pond after repair of the berm given an assumed pumping rate. The water balance was completed by quantitatively summarizing inflows and outflows and solving the following water balance equation where the volume of water required to fill the pond and achieve the desired water quality equals inflows versus outflows.

$$\text{Target Volume} = \text{Inflow} - \text{Outflow}$$

Table 2: Summary of Water Balance

PARAMETERS			
	Parameter	**Value**	**Unit**
Target Volume	Area of Pond	44	Acres
		1,916,640	ft^2
	Depth of Pond	4	ft
	Target Volume of Water in Pond	7,666,560	ft^3
Dilution Adjusted Target Volume	Percent for Dilution-based Reduction from 30 g/L to 4 g/L Sodium (see Attachment 1)	14%	
	Dilution Adjusted Target Volume	6,571,337	ft^3
Natural Inflows and Outflows	Annual Precipitation [(1)]	101	cm
		3.3	ft
	Basin Area (inside berm)	4,991,778	ft^2
	Annual Inflow Volume from Precipitation	16,540,964	ft^3
	Daily Average inflow Volume from Precipitation	45287	ft^3/day
	Annual Evapotranspiration as % of Precipitation [(1)]	49%	
	Evapotranspiration Rate	22190	ft^3/day
	Seepage (S) Out of Pond as Percent of Precipitation (estimated)	10%	
	S	4529	ft^3/day
Calculation of Days to Fill Target Volume with Pumping Well	Daily Average Natural Inflow - Outflow	18,568	ft^3/day
	Pumping Rate (input)	100	gpm
		19,250	ft^3/day
	Days to Fill Basin	174	days

(1) **Ward E. Sanford and David L. Selnick (2013)** ESTIMATION OF EVAPOTRANSPIRATION ACROSS THE CONTERMINOUS UNITED STATES USING A REGRESSION WITH CLIMATE AND LAND-COVER DATA STATES USING A REGRESSION WITH CLIMATE AND LAND-COVER DATA. JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION, AMERICAN WATER RESOURCES ASSOCIATION, Vol. 49, No. 1 February 2013

The calculations were completed for a 44-acre pond having a depth of 4 feet. Assuming the target chloride concentration of the pond is approximately 4,000 mg/L, an adjusted total pond volume was calculated by determining the ratio of added groundwater having a chloride concentration of approximately 100 mg/L to existing surface water having a chloride concentration of approximately 30,000 mg/L that is required to obtain a target concentration of 4,000 mg/L. This target salinity is the mid-range reported for West Pond before Hurricane Sandy which ranged from 3,580 mg/L to 5,200 mg/L in 1999 (Maillacheruvu and Roy 1999).

Inflows (water additions) in the water balance include precipitation falling within the area inside the perimeter walking trail, using the low end of the estimated range (conservative) of yearly mean Long Island precipitation rates (3.3 feet per year) for the period 1971 to 2000 (Sanford and Selnick 2013), and additions from groundwater pumping. Outflows (water subtractions) in the water balance include evapotranspiration (Sanford and Selnick, 2013), expressed as a percent reduction in precipitation, and an assumed 10% seepage rate out of the pond through the bottom of the pond and the perimeter berm. The natural inflows and outflows were normalized to units of volume per day for ease in developing the time required to reach the total target volume in the pond when combined with daily pumping rates. The water balance equation was solved for time in days to reach the total dilution-adjusted volume, based on an assumed pumping rate.

The total dilution-adjusted volume required to fill the 44-acre West Pond to a depth of 4 feet is calculated to be 7.6×10^6 cubic feet (cf). The daily average natural inflow-outflow is estimated to be 18,568 cf, which includes an average of 45,287 cf/day added from precipitation and associated runoff into the pond, 22,190 cf/day lost due to evapotranspiration, and 4,529 cf/day lost due to seepage out of the basin. Therefore, a water supply well pumping 100 gpm (pumping 24 hours a day) would take an estimated 174 days to fill West Pond. Additional details are provided in table 2 and attachment 1.

The U.S. Environmental Protection Agency has National Recommended Aquatic Life Water Quality Criteria (USEPA 1988) exposure levels for pollutants, including chloride. The purpose of these guidelines is to establish criteria to limit pollutant inputs (e.g., road salt) into existing freshwater stream or pond habitats. West Pond is not currently an intact freshwater ecosystem. Therefore, these criteria are not directly applicable to reestablishing freshwater habitats in West Pond where the freshwater system is not yet in place and these inputs would not be considered pollutants to the existing ecosystem. However, the alternative scenario was still considered using the U.S. Environmental Protection Agency standards and the level was calculated assuming a lower target concentration of 230 mg/L. This lower concentration would result in a filling time of 201 days at 100 gpm (pumping 24 hours a day). With respect to acute and chronic exposure by aquatic life to chloride above this level, freshwater aquatic plant and wildlife species had existed in the pond prior to Hurricane Sandy at approximately the 4,000 mg/L salinity (chloride concentration) level. Species have various salt tolerance levels and as the ecosystem transitions from the existing higher salinity of Jamaica Bay (23,000-27,000 mg/L) to a lower level (4,000 mg/L) only species tolerant of the lower salinity levels would reestablish through natural recruitment in the area. This would not be considered an acute or chronic exposure to a pollutant.

Natural precipitation is a substantial proportion of the water balance, and the pond persisted without supplemental water supply prior to Hurricane Sandy, although increases in chloride were noted. Given anticipated water level management requirements (i.e., seasonal draining and replenishing to support wildlife), it is unlikely that maintenance of the pond could rely solely on precipitation, unless perhaps engineered diversion of storm drainage into the pond was accomplished to provide more water than assumed by the water balance calculations. The amount of water that would remain in West Pond following seasonal drawdown for wildlife management purposes, and therefore the amount required to replenish the pond at the end of the seasonal drawdown period, has not been determined due to the lack of site-specific bathymetry data and other site-specific information necessary to determine how much water would remain in the pond during seasonal drawdown to expose mudflats. However, in the absence of additional engineered inputs of water to the pond, an alternative water source (e.g., pumping well) would likely be required to maintain the pond in the desired condition and provide the ability for periodic lowering and raising of the water level. It is reasonable to assume that if a water supply well is sufficient to accomplish the initial filling of the pond as calculations predict, it would also be sufficient to maintain the pond in the desired condition over time.

Based on average precipitation and runoff rates (table 2), preliminary estimates indicate that it would take roughly 1 year to restore West Pond to freshwater conditions when relying solely on natural precipitation and runoff as a freshwater source (assuming there is no road runoff with dissolved road salt during winter). The precipitation rate used is a conservative estimate and represents the lower end of the range of rates from Sanford and Selnick (2013). The actual timeframe would be dependent on site specific rainfall/runoff conditions, evapotranspiration rates, seepage rates, the water levels in West Pond following repair of the breach, and potentially other site-specific parameters that are unknown factors at this time. In comparison, it took approximately 2 years for freshwater conditions to return to nearby East Pond due to precipitation/runoff contributions following repair of a similar breach caused by Hurricane Sandy.

In summary, the following estimated filling periods are indicated by the water balance calculations:

- Precipitation/runoff alone – approximately 1 year
- Precipitation and water supply well pumping 100 gpm – approximately 174 to 201 days depending on the target chloride concentration (4,000 mg/L and 230 mg/L, respectively)

The water balance presented above is for a 44-acre pond (alternative B). Given the simplicity of the water balance, the time required to fill a 31.6-acre pond to a depth of 4 feet a target concentration of 4,000 mg/L (alternative C) would be approximately proportional. For example, filling a 32-acre pond to a depth of 4 feet using similar water balance assumptions would require approximately 20-30% less water and would be accomplished approximately 20-30 % faster than for a 44-acre pond (i.e., approximately 122-139 days of pumping at 100 gpm assuming a target chloride concentration of 4,000 mg/L, and approximately 141-161 days of pumping at 100 gpm assuming a target chloride concentration of 230 mg/L). The groundwater volume requirements and time required to replenish to the desired level may not be exactly proportional depending on differing assumptions regarding the size of the area that captures precipitation for input into the pond. The calculations and timeframes presented are estimates and would be dependent upon final engineering design and site-specific conditions.

Well Viability to Meet Freshwater Needs

The Lloyd aquifer is the only aquifer with sufficiently low salinity to meet the objectives for West Pond. The estimated capacity for wells completed in the Lloyd aquifer is reported to be approximately 44 gpm/ ft of drawdown (Misut and Monti 1999). Therefore, a well screen length of 10 to 20 feet should supply a sufficient well yield (~100 gpm) with less than 3 feet of drawdown based on the range of specific capacities presented in the preceding Hydrogeology section. The Lloyd aquifer thickness below Jamaica Bay is approximately 120 feet (see figure 5), with a static water level approximately 600 feet above the top of the overlying confining unit, and above ground surface (i.e., the Lloyd aquifer is artesian). It is also reported that some wells installed in the Lloyd aquifer are (or were) flowing at the ground surface (Misut and Monti 1999). Therefore, a supply well completed in the Lloyd aquifer should meet the need for filling West Pond and should also meet the need for supplemental addition of water over time (e.g., due to seepage out of the pond, evaporation, and the need to periodically raise the level following intentional drawdown to manage the pond for migratory seasonal use by wildlife).

Potential Impacts of Groundwater Pumping to Local and Regional Groundwater Levels and Quality

Potential adverse impacts associated with installation and use of a water supply well at West Pond includes changes in water quality, excessive drawdown of the potentiometric surface, and land subsidence. Changes in water quality and excessive drawdown of the potentiometric surface are the most significant considerations given the coastline location of West Pond and the proximity to saline water. Review of readily available literature describing aquifer properties and historical groundwater withdrawals combined with simple quantitative analysis indicates that the impact to local and regional water levels and water quality in the Lloyd aquifer resulting from water withdrawals to replenish West Pond would be negligible. A summary of information supporting this conclusion is provided below. Use of water in the Jameco-Magothy aquifer was not considered because it is likely too saline to meet the objectives for West Pond.

- Transmissivity in the Lloyd aquifer is significant and can readily accommodate the relatively small water requirement necessary to fill and maintain West Pond without promoting additional saltwater intrusion. Salt water intrusion is caused by lowering of the potentiometric surface in the freshwater aquifer (e.g., via pumping) which, if substantial enough, eventually creates hydraulic gradients to be directed inland, which in turn promotes inland migration (intrusion) of salt water. The drawdown created by a water supply well pumping 100 gpm should be small given the considerable transmissivity and specific capacity of the Lloyd aquifer; therefore, the effect on the regional hydraulic gradient should be negligible.
- The Lloyd aquifer is overlain by a thick aquitard (the Raritan Clay Member) which greatly limits downward migration of more shallow groundwater that may contain contamination from surface sources.
- The Raritan Clay Member causes the Lloyd aquifer to be hydraulically isolated from the more shallow aquifers; therefore, there is little to no potential for pumping in the Lloyd aquifer to promote downward hydraulic gradients that could affect the shallow groundwater system and surface water.
- A preliminary well search did not identify any pumping wells within 3.5 miles of West Pond; therefore, impacts to other water withdrawals would likely be negligible.
- At a pumping rate of 100 gpm, the expected drawdown at the well based on the reported specific capacity of the Lloyd aquifer and a supplemental Theis analysis (attachment 2) would range from 2 to 6 feet. This drawdown is negligible compared to the estimated 120-foot saturated thickness of the aquifer and approximately 700 feet of confined potentiometric head.
- A Theis analysis indicated that pumping from the Lloyd aquifer at 100 gpm would create a large, shallow cone of depression (due to high transmissivity); however, the hydraulic gradient changes as the result of pumping would be negligible more than 200 feet from the well (less than 0.005 ft/ft change). Additional details on the Theis analysis are provided in attachment 2. Furthermore, a capture zone analysis using the method of Javendal & Tsang (1986) indicated that the lateral width of the groundwater capture zone side gradient of the pumping well (i.e., to the northwest and southeast assuming a predominantly southwesterly groundwater flow direction [figure 4]) would be approximately 3,200 feet.
- As described in section 2.2.4, historical pumping from upland recharge areas has been reduced, thereby increasing hydraulic heads in the upland areas and increasing recharge rates to the lower aquifers.

Land subsidence is caused by dewatering of formerly saturated portions of the subsurface, resulting in compaction of geologic materials that were formerly partly supported by pore water. Based on the estimated minimal impact to local and regional water levels in the Lloyd aquifer resulting from water withdrawals to replenish West Pond, the potential for the pumping to cause land subsidence is judged to be negligible.

RECOMMENDATIONS

Additional information and analyses would be required to finalize the evaluation of the use of groundwater, including:

- Determining the depth to the Lloyd aquifer beneath the West Pond area with a greater degree of accuracy;
- Quantifying the dissolved chloride and iron concentration in the Lloyd aquifer based on more extensive research of available literature and records;
- Determining the need for water treatment given the chloride and dissolved iron concentrations in the Lloyd aquifer;
- Determining the optimal location for a pumping well;;
- Obtaining site-specific bathymetry data to determine the volume of water needed for annual pond maintenance given the need for seasonal lowering of the water level for wildlife management purposes; and
- Determining the potential for road runoff and storm sewer water to contain dissolved salts that would negatively impact the water quality of West Pond.
- Further evaluating regulatory restrictions and permit requirements applicable to installation of a water supply well in the Lloyd aquifer. Further evaluation may include coordination with regulatory authorities regarding permitting and installation of a test well to demonstrate that the area is defined as coastal, and therefore exempt from the moratorium on new water supply wells in the Lloyd aquifer.

CONCLUSIONS

The preliminary hydrogeologic analysis presented in this report indicates that the Lloyd aquifer is the most promising source of groundwater to meet the objectives for water supply to West Pond in terms of both water quantity, and to a lesser degree quality (depending on the target concentrations of the pond). Based on figure 2, this confined aquifer is present from approximately 530 feet to 650 feet below the surface of Jamaica Bay, is highly transmissive, and has low salinity but may have relatively high dissolved iron concentrations. Based on this analysis and reported assumptions and limitations, a well installed at West Pond could have chloride levels below the upper target level of 4,000 mg/L.

The U.S. Geological Survey well depth records for nearby wells screened in the Lloyd aquifer indicate depths ranging from 725 feet to more than 1,000 feet. Installation and use of a groundwater well screened in the Lloyd aquifer should not have an adverse impact on the sole source aquifer pursuant to section 1424 of the Safe Drinking Water Act, and therefore should not pose an adverse impact to the recharge zone designated under section 1424(e). However, additional assessment would be required to determine whether this scenario would be feasible from a regulatory perspective given existing administrative controls on extraction from the Lloyd aquifer. The times required to add fresh groundwater to West Pond and dilute chloride concentrations in pond water to target levels of 4,000 mg/L and 230 mg/L are estimated to be approximately 174 days and 201 days, respectively, assuming a 100-gpm pumping rate. The estimated timeframe to reach 4,000 mg/L and 230 mg/L for Alternative C would be approximately 122-139 days and 141-161 days, respectively, assuming a 100-gpm pumping rate.

Transmissivity in the Lloyd aquifer is sufficiently high that this aquifer could accommodate the relatively small water requirement necessary to fill and maintain West Pond. The likelihood that saltwater intrusion would occur as a result of pumping 100 gpm from the Lloyd aquifer is judged to be minimal given the relatively small volume requirements, the aquifer transmissivity, and the fact that the aquifer is overlain by a thick confining unit that limits downward migration of more shallow groundwater into the Lloyd aquifer. In contrast, the overlying aquifers likely have a more significant and widespread saltwater wedge and would not be as useful as a supplemental freshwater source. Similarly, the likelihood that other contamination would enter the Lloyd aquifer from overlying sources is minimal given the presence of the overlying Raritan Clay Member, which greatly limits downward migration of more shallow groundwater.

Currently, there is a moratorium on wells installed in non-coastal areas of the Lloyd Aquifer. However, the West Pond area is likely a coastal area (having elevated concentrations of chlorides in the Magothy Aquifer) and exempt from the moratorium. Demonstrating this may require installation of a test well in the Magothy, which could subsequently be advanced into the Lloyd aquifer if the Magothy aquifer was determined to have elevated chloride levels.

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LIST OF PREPARERS

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John Hicks, P.G. Parsons Technical Director, Hydrogeologist. 31 years of experience. M.S. Geology (Emphasis in hydrogeology).

ATTACHMENT 1: WATER BALANCE DETAILS

HYDROGEOLOGY CALCULATION SHEET

Client:	GSA Contract No GS-00F-0005R		
	Jamaica Bay Wildlife Refuge West Pond Breach, GATE 201449		
Project:		Job Number:	640330.0000.749192.06000
Task:	Task Order No P13PD02625	Calc By:	JWS
Subtask:	Groundwater Report	Checked By:	JH
Date:	7/17/2015		

WATER BALANCE GOVERNING EQUATIONS

$$TgVol = Inflow - Outflow$$

TgVol	Target Volume of Pond

$$TgVol = P + GW_1 - ET - Seep$$

P	Precipitation
GW1	Groundwater Pumping into pond
ET	Evapotranspiration
Seep	Groundwater Seepage out of Pond (estimated)

$$TgVol_{diladj} = TgVol * DilRat$$

TgVol diladj	Dilution Adjusted Target Volume
DilRat	Dilution Ratio based on 30 g/L sodium (current) and 4 g/L sodium (target)

$$TgVol_{diladj} = P + GW_2 - ET - Seep$$

GW2	Groundwater pumping based on dilution adjusted target volume

$$GW_2 = TgVol_{diadj} - P + ET + Seep$$

ATTACHMENT 2: THEIS ANALYSIS DETAILS

PROJECT DESCRIPTION	
Project Name:	GATE West Pond

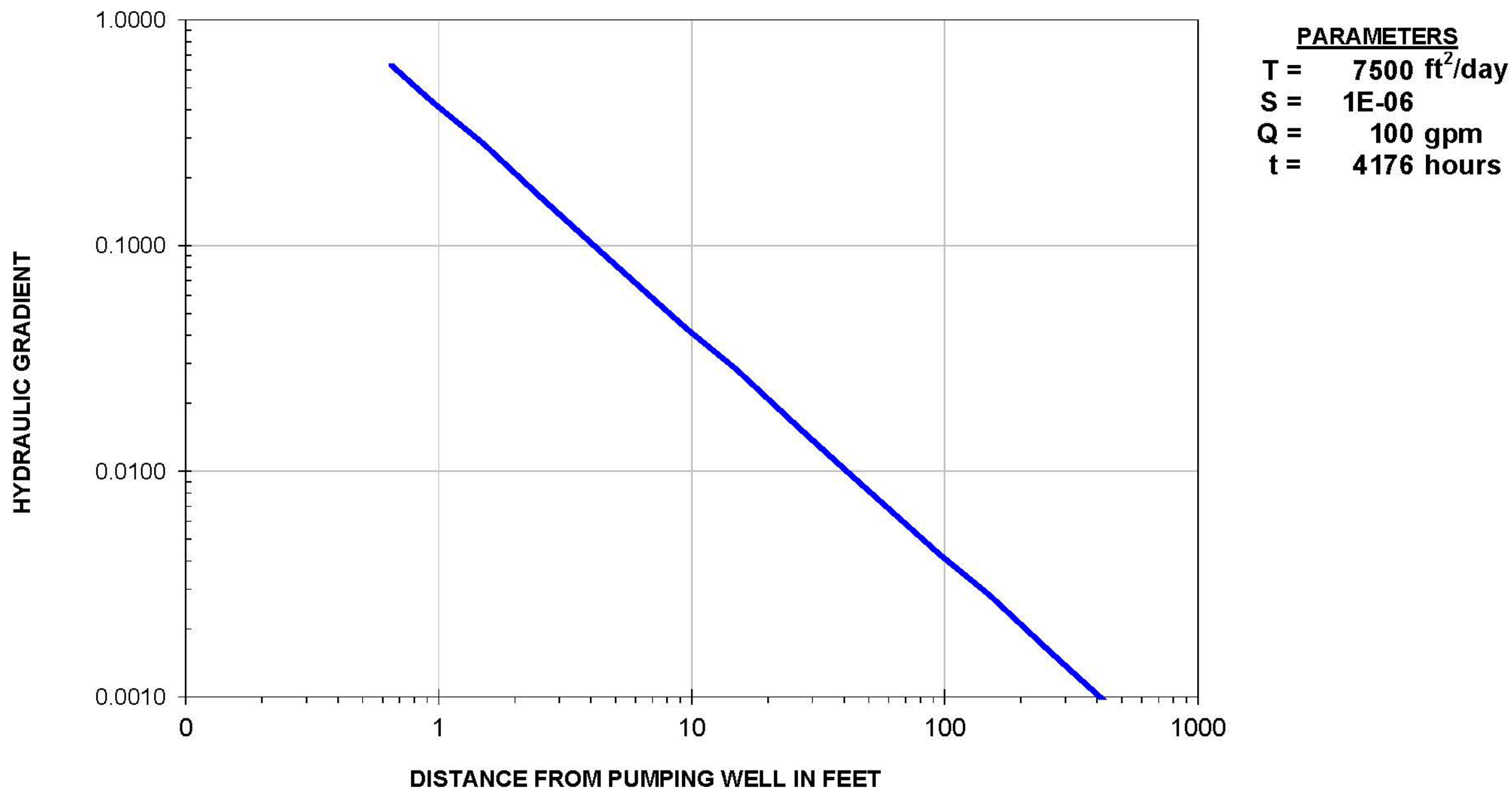
Calculated Flow to a Single Well
Using the Theis Unsteady State Equation (Theis, 1935).

$$Q = \frac{s4\pi T}{W(u)} \qquad s = \frac{Q}{4\pi T}W(u) \qquad u = \frac{r^2 S}{4Tt} \qquad W(u) = \int_u^\infty \frac{e^{-u}}{y}dy$$

AQUIFER PARAMETERS	Entered	Units	Computed
Confined (C) or Unconfined (U):	C		C
(K) Hydraulic conductivity	50	ft/day	
(m) Initial saturated thickness of aquifer	150	(ft)	
(T) Transmissivity:	7500	(ft^2/day	7500
(S) Storage Constant or (Sy) Specific Yield:	0.000001		
(i) Natural Hydraulic Gradient	0.0002		
PUMPING WELL DATA	**Entered**		**Computed**
(Q) Well discharge(1):	100	(gpm)	100.00
		ft^3/day	19225
(S) Drawdown(2):		(feet)	6.06
(r) Radius of pumping well:	0.6	(feet)	
(r_e) Estimated effective radius of pumping well:	1	(feet)	
(t) Pumping time:	174	(days)	
		(hours)	4176
(Q_t) Total Discharge(3)		(gallons)	25056000.00
BOUNDARY CONDITIONS	**Entered**		**Computed**
Boundary type: none (N), recharge (R) or impermeable (I):	n		N
(d) Distance to Horizontal Boundary:	50000	(feet)	0
WELL FUNCTIONS	**Entered**		**Computed**
(u) Well function argument:			6.89655E-14
($W(u)$) Well function :			29.7279541

(1) Enter the well discharge rate and blank drawdown to calculate drawdown.
(2) Enter drawdown and blank discharge rate to calculate discharge rate.
(3) Total gallons pumped during the specified pumping time

Reference:
Theis, C.V. 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage. *Transactions, American Geophysical Union*. vol. 16, pp. 519-524.



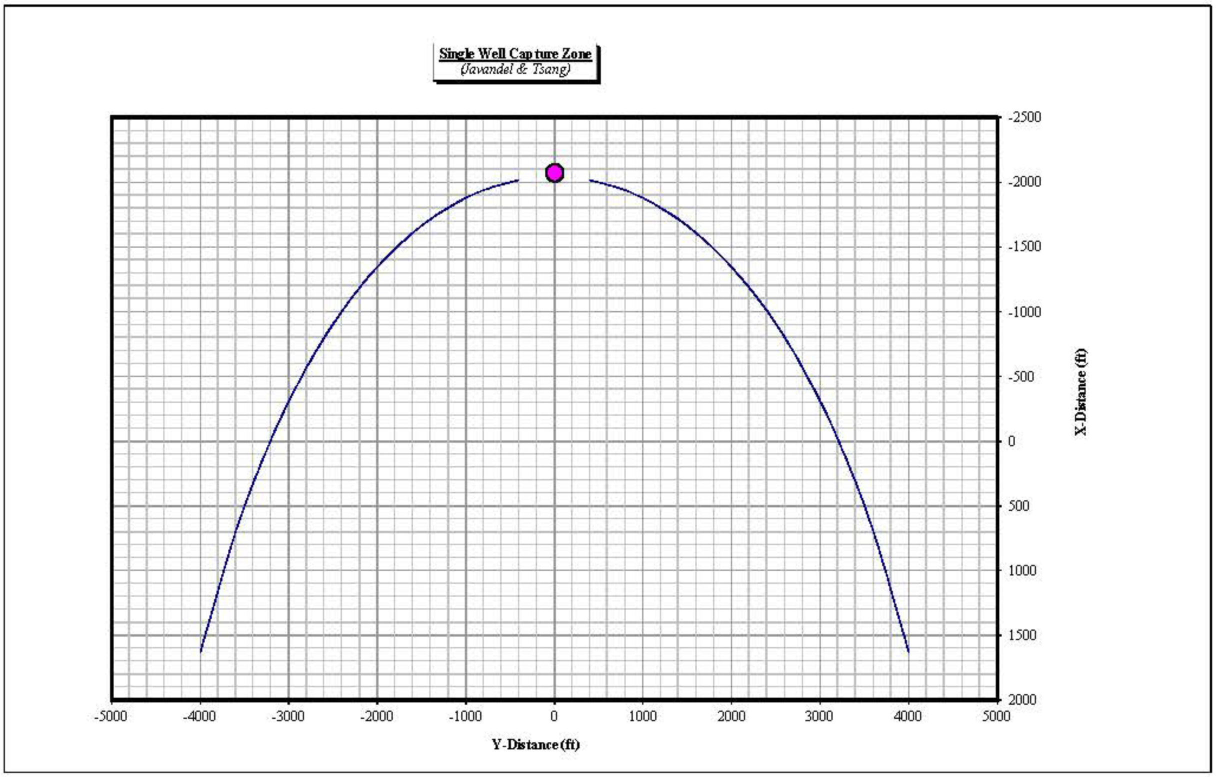
GATE West Pond

PARSONS

ATTACHMENT 2 (page 2)
DISTANCE-GRADIENT CHART
FOR SINGLE EXTRACTION WELL

Javendal & Tsang (1986)
Capture zone from a single GW extraction well

Q =	**100**	gpm	
Kh =	**374**	gpd/sq.ft	***(Kh = horizontal hydraulic conductivity)***
Gradient (I) =	**0.0002**	ft/ft	
Aq.Thkness (B):	**150**	feet	
u=Kh*I=	0.00001	ft/min	
Bu=	0.00104	sq.ft/min	
Q/Bu =	12834	feet	***Max Upgradient width of capture zone (Q/Bu = 3912.87 meters)***
Q/2Bu=	6417	feet	***Capture zone width perpendicular to pumping well***
Q/(2*pi*Bu)=	2044	feet	***Distance to downgradient Stagnation Point***



APPENDIX D: MUNICIPAL WATER SUPPLY – A BRIEF OVERVIEW

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NEW YORK CITY MUNICIPAL WATER SUPPLY: A BRIEF OVERVIEW

The following information provides a brief overview of the New York City municipal water supply and water treatment. Parameter values presented are summarized from the New York City 2014 Drinking Water Supply and Quality Report available on line at: http://www.nyc.gov/html/dep/html/drinking_water/wsstate.shtml.

The New York City Department of Environmental Protection provides high quality, safe drinking water to over 8 million residents of the City of New York. The area around West Pond is included in the distribution area (see figures 1 and 2 for maps of New York City's water supply system). The water supply originates predominantly from surface water. In years past a small portion of southeastern Queens used distributed groundwater for their drinking water. In 2014, all of New York's water supply came entirely from the Catskill-Delaware Watershed.

The Catskill-Delaware supply is treated at the Catskill-Delaware Ultraviolet Water Treatment Facility, located in the Towns of Mount Pleasant and Greenburgh. This facility came online in October 2013 and was constructed to meet the U.S. Environmental Protection Agency's Long Term 2 Enhanced Surface Water Treatment Rule. It is designed to treat 2.24 billion gallons per day. The site could also add a 2 billion gallons per day filtration plant in the same location if deemed necessary in the future (Water-Technology.net).

In May 2015, the Croton Filtration Plant located in the Bronx was commissioned and reestablished another source of drinking water to the City's residents. The Croton Watershed supplies the filtration plant with an average of 100 million gallons per day and the new plant can treat up to 290 million gallons per day. This additional source will allow necessary repairs to be made to the Catskill-Delaware conveyance system (New York Times 2015).

New York City Department of Environmental Protection disinfects its water with ultraviolet light (UV) and chlorine (elemental or sodium hypochlorite) as a secondary disinfectant. UV treatment is a disinfection process that works by passing the water by special lamps that emit UV light, which can inactivate harmful microorganisms. UV treatment does not change the water chemically, as nothing is added except energy. Chlorine is a common disinfectant added to kill germs and stop bacteria from growing on pipes. Residual chlorine levels in the distribution system ranged from 0.00 to 1.51 mg/L (n = 15,023 samples, average = 0.63 mg/L).

New York City Department of Environmental Protection also treats the water with food grade phosphoric acid and sodium hydroxide. Phosphoric acid is added to create a protective film on pipes that reduces the release of metals, such as lead, from household plumbing. Sodium hydroxide is added to raise the pH and reduce corrosivity, which also leads to a reduction in potential exposure to lead. Ortho-phosphate concentrations in the distribution system ranged from 0.74-3.54 mg/L (n = 15,024 samples, average = 2.11 mg/L). The average pH within the distribution system was 7.3 (n = 15,025 samples).

In addition, New York City Department of Environmental Protection treats its drinking water with a controlled, low level of fluoride for consumer dental health protection. The New York City Department of Environmental Protection target dose of fluoride is 0.8 mg/L and the highest level allowed is 2.2 mg/L. The fluoride levels measured within the distribution system ranged from non-detectable to 0.9 mg/L (n = 1,689 samples, average = 0.8 mg/L).

Figure 1: Map of New York City's Water Supply System (NYCDEP 2015)

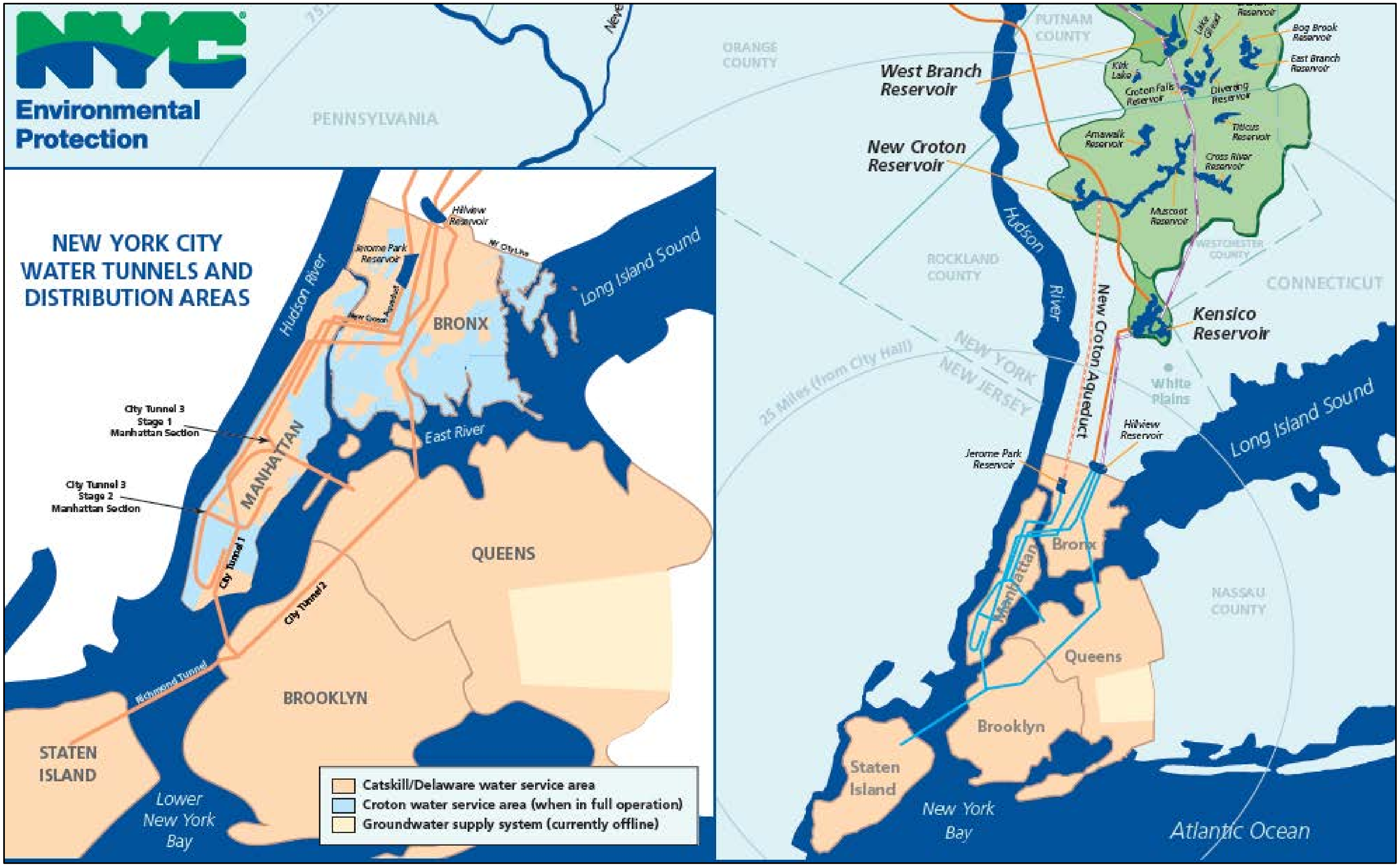

Figure 2: New York City Water Tunnels and Distribution Areas (NYCDEP 2014)

SUMMARY OF POTENTIAL TOXIC EFFECTS OF TREATED DRINKING WATER AND FISH AND WILDLIFE

Chlorine Toxicity

Most aquatic animals are sensitive to chlorine. They have acute toxicities to chlorine as measured by lethal concentrations (LC_{50}) or half maximal effective concentrations (EC_{50}) in micrograms per liter (μg/L).

Examples of chlorine levels and effects on pond aquatic life (USEPA 1976; USEPA 1986) include:

0.006 mg/L will kill fish fry in about two days.

0.003 mg/L will kill insect larvae, such as dragonflies.

0.002 mg/L will fatally damage the sensitive skin on tadpoles, frogs, salamanders and other amphibians

0.01 mg/L is the maximum level that experts say adult fish can tolerate.

0.25 mg/L is the level at which only the hardiest koi or other pond fish can survive.

0.37 mg/L is the level at which all pond fish will die.

Pursuant to Clean Water Act §304(a) for aquatic life, the freshwater criteria maximum concentration for chlorine is 19 μg/L and the freshwater criteria continuous concentration is 11 μg/L (USEPA 2009). These concentrations are national guidelines and are intended to protect the majority of aquatic life.

Fluoride Toxicity

There is reportedly not as much sensitivity to fluoride when compared to chlorine. LC_{50} and EC_{50} fall within the mg/L range for most organisms (WHO 2002). The acute toxicity of fluoride, measured as 48-hour LC_{50} or EC_{50} range from 53 to 304 mg/L for aquatic invertebrates. Literature indicates that rainbow trout (*Oncorhynchus mykiss*) are one of the most studied and sensitive fish species to fluoride concentrations. The 96-hourLC_{50}s for freshwater fish range from 51 mg/L (rainbow trout in relatively soft water – 17 mg/L $CaCO_3$, Fleiss 2011) to 460 mg/L (threespine stickleback, *Gasterosteus aculeatus* in hard water – 300 mg/L $CaCO_3$). Water hardness limits the toxicity of fluoride. Organisms are more susceptible to fluoride concentrations in soft water than the same concentrations in hard water. Estuarine and marine fish species (the ambassid [*Ambassis safgha*], the crescent perch [*Therapon jarbua*], and the striped mullet [*Mugil cephalus*]) have 96-hour LC_{50}s greater than 100 mg/L (Camargo 2003).

Potential Treatment of Treated Drinking Water Necessary to Support Fish and Wildlife

Because treated drinking water can be toxic to aquatic resources as briefly summarized above, there would be a need to pretreat the municipal water source prior to supplementing water in West Pond. There are a range of treatment options available including diluting and mixing the municipal water with existing pond water in a wet well before reintroducing it into the pond. The existing suspended and dissolved organic matter would take up the residual chlorine quickly. Aeration of the municipal water by spraying it instead of using pipe injection would help dissipate some of the chlorine residual as well. Other options include chemical adjustment and activated carbon filtration to remove chlorine and activated alumina filtration to remove fluoride. Additional research would be required to determine the optimum treatment for safe use for the pond resources. This concern would be addressed in future pond management strategies that would be developed by the NPS. In addition to pretreatment, further coordination with local agencies would be required to address agency concerns.

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APPENDIX E: SPECIAL STATUS SPECIES WITHIN THE WEST POND AREA

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Special Status Species within the West Pond Area

	Scientific Name	Common Name	Regulatory Status: Federal Listing	Regulatory Status: State Listing	Likely Occurrence within West Pond Area
Bird Species					
Passerines	*Ammodramus henslowii*	Henslow's sparrow	-	Listed	Rare migrant
Passerines	*Ammodramus maritimus*	Seaside sparrow	-	Listed	Uncommon breeder
Passerines	*Ammodramus savannarum*	Grasshopper sparrow	-	Listed	Rare migrant
Passerines	*Caprimulgus vociferus*	Whip-poor-will	-	Listed	Rare migrant
Passerines	*Chordeiles minor*	Common nighthawk	-	Listed	Rare migrant
Passerines	*Cistothorus platensis*	Sedge wren	-	Listed	Rare migrant
Passerines	*Dendroica cerulea*	Cerulean warbler	-	Listed	Rare migrant
Passerines	*Dolichonyx oryzivorus*	Bobolink	-	Listed	Rare migrant
Passerines	*Eremophila alpestris*	Horned lark	-	Listed	Rare migrant
Passerines	*Icteria virens*	Yellow-breasted chat	-	Listed	Rare but possible breeder
Passerines	*Lanius ludovicianus*	Loggerhead shrike	-	Listed	Rare migrant
Passerines	*Melanerpes erythrocephalus*	Red-headed woodpecker	-	Listed	Rare migrant
Passerines	*Passerculus sandwichensis*	Savannah sparrow	-	Listed	Uncommon but possible breeder
Passerines	*Pooecetes gramineus*	Vesper sparrow	-	Listed	Rare migrant
Passerines	*Vermivora chrysoptera*	Golden-winged warbler	-	Listed	Rare migrant
Raptors, Falcons, and Owls	*Accipiter cooperii*	Cooper's hawk	-	Listed	Common migrant
Raptors, Falcons, and Owls	*Accipiter gentilis*	Northern goshawk	-	Listed	Rare migrant
Raptors, Falcons, and Owls	*Accipiter striatus*	Sharp-shinned hawk	-	Listed	Abundant migrant
Raptors, Falcons, and Owls	*Asio flammeus*	Short-eared owl	-	Listed	Rare migrant
Raptors, Falcons, and Owls	*Asio otus*	Long-eared owl	-	Listed	Rare migrant
Raptors, Falcons, and Owls	*Buteo lineatus*	Red-shouldered hawk	-	Listed	Rare migrant
Raptors, Falcons, and Owls	*Circus cyaneus*	Northern harrier	-	Listed	Rare but possible breeder
Raptors, Falcons, and Owls	*Falco peregrinus*	Peregrine falcon	-	Listed	Rare but possible breeder
Raptors, Falcons, and Owls	*Haliaeetus leucocephalus*	Bald eagle	-	Listed	Rare and unlikely breeder
Raptors, Falcons, and Owls	*Pandion haliaetus*	Osprey	-	Listed	Common breeder
Raptors, Falcons, and Owls	*Strix varia*	Barred owl	-	Listed	No information

Scientific Name		Common Name	Regulatory Status		Likely Occurrence within West Pond Area
			Federal Listing	State Listing	
Shorebirds and Waders	*Calidris canutus*	Red knot	Threatened	Listed	Abundant migrant
	Charadrius melodus	Piping plover	Threatened	Listed	Rare and unlikely breeder
	Chlidonias niger	Black tern	-	Listed	Rare but possible breeder
	Ixobrychus exilis	Least bittern	-	Listed	Rare but possible breeder
	Laterallus jamaicensis	Black rail	-	Listed	Rare but possible breeder
	Rallus elegans	King rail	-	Listed	Rare migrant
	Rynchops niger	Black skimmer	-	Listed	Uncommon but possible breeder
	Sterna antillarum	Least tern	-	Listed	Uncommon but possible breeder
	Sterna dougallii	Roseate tern	Endangered	Listed	Very rare and unlikely breeder
	Sterna hirundo	Common tern	-	Listed	Uncommon but possible breeder
	Bartramia longicauda	Upland sandpiper	-	Listed	Rare and unlikely breeder
	Botaurus lentiginosus	American bittern	-	Listed	Rare but possible breeder
	Gavia immer	Common loon	-	Listed	Uncommon migrant
	Nyctanassa violacea	Yellow-crowned night-heron	-	Listed	Uncommon breeder
	Nycticorax nycticorax	Black-crowned night-heron	-	Listed	Common breeder
	Podilymbus podiceps	Pied-billed grebe	-	Listed	Uncommon breeder
Reptiles & Amphibians					
Kinosteron subrubrum		Mud turtle	-	Listed	Very rare but possible breeder
Clemmys guttata		Spotted turtle	-	Listed	Very rare but possible breeder
Terrapene Carolina		Eastern box turtle	-	Listed	Breeding unlikely after Hurricane Sandy

APPENDIX F: RELEVANT CORRESPONDENCE

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

JUL 3 0 2014

Jennifer T. Nersesian
Gateway National Recreation Area
ATTN: Jamaica Bay Wildlife Refuge, West Pond EA Comments
210 New York Avenue
Staten Island, NY 10305

Dear Ms. Nersesian:

This is in response to the letter received June 16, 2014 requesting scoping comments on the Environmental Assessment (EA) currently being prepared by the National Park Service (NPS) for the Gateway National Recreation Area, Jamaica Bay Wildlife Refuge, West Pond Restoration Project. The purpose of the project is to address the breach in the West Pond that resulted from Super Storm Sandy and is currently resulting in salt water intrusion into the pond. The project will attempt to improve existing conditions of the pond while also enhancing visitor experience and ensuring sustainability in the future.

The EA should clearly document the direct and indirect impacts of the no action alternative and restoration alternatives. This will entail a discussion of the pre-storm condition and history of the West Pond, a discussion of the existing post-storm conditions, and a discussion of what will occur if the pond is not restored. Restoration alternatives should also address methods for improving the resiliency of the pond.

West Pond is widely recognized as a one of the most significant bird sanctuaries in the northeast and it is designated as a Global Important Bird Area. It is known for its year-round bird watching, with over 335 species sightings over the past 25 years. The western most end of the pond is home to Terrapin Trail, an area heavily utilized by female terrapins for nesting. Since the breach that resulted from Super Storm Sandy, West Pond has become increasingly brackish. Salinity in West Pond is currently at levels that do not support many of the freshwater species that historically utilized the area.

However, the storm has not been the only impact on West Pond conditions. Many of the unique qualities of the West Pond, such as the close proximity of fresh and salt water resources and the diversity of wetland types that provided an ideal habitat for hundreds of species, had already deteriorated. Invasive species have significantly affected the dynamics of the ecosystem. Species that once thrived are no longer present and species, including the diamondback terrapins at Terrapin Trail, that once nested and fed at the pond no longer do so. While upgrades to the visitor's center provides an excellent opportunity for visitors to learn about the unique ecosystem, the variety of habitats in and around the ponds have suffered. Impacts from Super Storm Sandy coupled with invasive species and problems with valves and pipes for the ponds have dramatically altered the system. These conditions need to be detailed in the EA.

With regard to the no action alternative of not closing the breach, the EA needs to address the longer term impacts to all of the species that utilized or inhabited the area prior to the breach. The discussion should identify and indicate any impacts to other freshwater habitats in the area that may be influenced by displacement of species from West Pond.

In addressing restoration alternatives, the EA should consider the creation of a more resilient system that can withstand future storm surges. EPA believes that one key element to ensuring a more resilient system is the creation and maintenance of freshwater marsh habitat to help anchor the shoreline, trap sediments, and provide habitat for the variety of species that utilize the pond. Additionally, we believe the EA should evaluate approaches to address the invasive species with alternatives that include their removal and replacement with natives.

Sustainability should be addressed in the EA in regards to any development that occurs in association with the restoration project. Just as the Jamaica Bay Wildlife Refuge Contact Station is a LEED Gold building, EPA encourages the same commitment to sustainability be maintained for development associated with the restoration at West Pond. Further, EPA believes that visitor experience can be enhanced while simultaneously limiting human disturbance by providing designated viewing areas that protect marshes with boardwalks or viewing platforms.

Lastly, to enhance protection of the area, and ensure the success of restoration efforts, the EA should address ways to ensure the lasting health of the system. One approach that we believe will enhance the continued success of any restoration work is to increase the presence of qualified resource managers throughout the area. Staff should be available to both maintain and monitor the health of the ecosystem in greater numbers and to manage and prevent invasives, address possible valve and pipe issues, and ensure the continued recovery and stability of the system.

Thank you for the opportunity to comment. Should you have any questions concerning this letter please feel free to contact Stephanie Lamster of my staff at 212-637-3465.

Sincerely,

Grace Musumeci

Grace Musumeci, Chief
Environmental Review Section

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

Regulatory Branch

JUL 1 4 2014

SUBJECT: Environmental Assessment, Gateway National Recreation Area, Jamaica Bay Wildlife Refuge, West Pond by the National Park Service

United States Department of the Interior
National Park Service
Attn: Jennifer Nersesian, Superintendant
Jamaica Bay Wildlife Refuge
210 New York Avenue
Staten Island, New York 10305

Dear Ms. Nersesian:

On July 7, 2014, the New York District, U.S. Army Corps of Engineers, received a letter dated June 30, 2014 from your office stating that an environmental assessment is being prepared in support of a proposed project to address damage that resulted from a breach at Gateway National Recreational Area, Jamaica Bay as a result of Hurricane Sandy in 2012 and you are seeking soliciting scoping comments.

The proposed work described in the letter would require a Department of the Army (DA) permit from this office. Please see the enclosed Regulatory Program Applicant Information Guide for information related to the DA Permit program and sample permit application drawings.

Please feel free to contact Leslie Bowles-Early, of my staff, at (917)790-8516 with any questions you may have.

Sincerely,

Stephan A. Ryba
Chief, Eastern Section

Enclosures

Received 7/18/14
GATE -**Natural Resource Management**
DOA From J. Smith

Andrew M. Cuomo
Governor

Rose Harvey
Commissioner

New York State Office of Parks, Recreation and Historic Preservation

Division for Historic Preservation
Peebles Island, PO Box 189, Waterford, New York 12188-0189
518-237-8643
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September 18, 2014

Maryanne Gerbackus
Associate Regional Director, Resource Stewardship
National Park Service
Northeast Region
United States Custom House
200 Chestnut Street
Philadelphia, PA 19106-2878

Re: National Park Service
Determination of Eligibility Review for Rulers Bar Hassock, Jamaica Bay, Queens
14PR03653

Dear Ms. Gerbackus:

Thank you for requesting the comments of the State Historic Preservation Office (SHPO). We have reviewed the project in accordance with Section 106 of the National Historic Preservation Act of 1966. These comments are those of the SHPO and relate only to Historic/Cultural resources. They do not include potential environmental impacts to New York State Parkland that may be involved in or near your project. Such impacts must be considered as part of the environmental review of the project pursuant to the National Environmental Policy Act and/or the State Environmental Quality Review Act (New York Environmental Conservation Law Article 8).

Based upon this review, the New York SHPO concurs with the National Park Service that the Rulers Bar Hassock is not eligible for listing in the National Register of Historic Places. While the property possesses historical significance as a bird and wildlife sanctuary the historic design, materials, workmanship, and association have diminished with the deterioration or destruction of topographic, vegetation, and water features from gradual saltwater encroachment and by Hurricane Sandy.

If further correspondence is required regarding this project, please be sure to refer to the OPRHP Project Review (PR) number noted above.

Sincerely,

Ruth L. Pierpont

Ruth L. Pierpont
Deputy Commissioner for Historic Preservation

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NPS 646/125980 / October 2015